MARCH 2018

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LyondellBasell to buy A Schulman

LyondellBasell has agreed to buy compounding and composites giant A Schulman for $2.25bn, in addition to assuming outstanding debt and certain other obligations.

The company said the acquisition builds on its existing platform in this space "to create a premier Advanced Polymer Solutions business with broad geographic reach, leading technologies and a diverse product portfolio".

CEO Bob Patel added it will enable LyondellBasell to reach into markets beyond automotive, where Schulman is strong, such as packaging, consumer products, electronics and appliances, construction and agriculture.

Schulman's president, chairman and CEO Joseph Gingo said the deal "provides our shareholders with a compelling, immediate cash premium". He added that it represented "the culmination of a robust assessment of strategic alternatives undertaken by our board of directors."

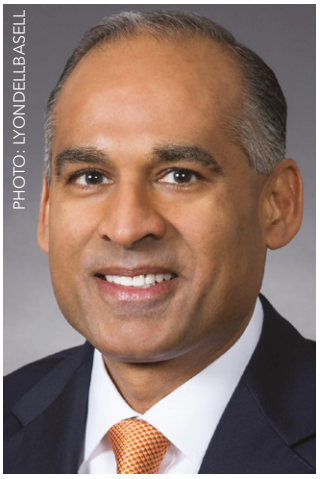

PHOTO: LYONDELLBASELL

LyondellBasell CEO Bob Patel

PHOTO: A SCHULMAN

Schulman Chairman, President and CEO Joseph Gingo

Schulman has been going through a "resetting" of the business following the discovery of alleged reporting irregularities in parts of the Citadel Plastics business it acquired back in 2015 for $800m. These are still the subject of legal action, reflected in the inclusion of a contingent value right (CVR) in the LyondellBasell deal.

LyondellBasell expects to achieve $150m in cost synergies within two years through the deal, which it said should be accretive to earnings within the first full year following closing. This is scheduled for 2H 2018 (subject to regulatory approvals and approval by A. Schulman shareholders).

Combined, Schulman and LyondellBasell's Polypropylene Compounding (PPC) business represents revenues of $4.6bn and adjusted EBITDA of $446m, based on the 12-month periods ending on 31 December and 30 November 2017 respectively. They currently employ about 18,500 people in more than 100 countries.

In a separate move, Schulman said it is partnering with 3M in Europe to develop insulating and light weight compounds based on the latter's Glass Bubbles hollow glass microspheres.

"First innovations which are now in production, such as scuff plates in vehicles, show great potential for further light-weight applications', says Heinrich Lingnau, Vice President and General Manager EMEA at A Schulman. "Due to the combination of 3M's hollow glass beads and our innovative filler systems, a weight reduction of 15% can be achieved without compromising on product properties."

The company said the use of microspheres also enables thermal conductivity reductions of up to 23%. Some of the Glass Bubbles compounds can be used in existing injection moulding tooling.

› **www.lyondellbasell.com**
› **www.aschulman.com**

Velox grows range with Life biocides

PHOTO: VELOX

Life antimicrobials are available in Europe from Velox

Thailand-based antimicrobials manufacturer Life Material Technologies has appointed Velox to distribute its organic and inorganic additives and masterbatches in Germany, Austria, Switzerland, Benelux and the Nordic region.

"With this new partnership, Velox is extending its existing antimicrobial portfolio and is able to address new target markets," said Velox Product Manager Stefan Rokitta.

The Life antimicrobial products are aimed at applications such as home appliances, sanitary ware and textiles. Velox says the additives offer reliable inhibition of bacteria and odour as well as providing colour and thermal stability. They comply with the EU Biocidal Products Regulation (EU BPR 528/ 2012).

› **www.velox.com**

Lanxess investing in dyes and pigment operations

Lanxess is to invest more than €5m to expand capacity for its Macrolex range of soluble organic dyes at its main Leverkusen site in Germany by 25% by the end of the year.

Philipp Junge, head of the Rhein Chemie business unit, said the investment was being made "to meet the growing global demand for high-quality dyes for the plastics industry … especially in Asia". Macrolex dyes are mainly used to colour PS, PC, ABS, PMMA and PET in high-end plastic products such as beverage bottles, electronic devices, car tail-lights and children's toys.

Meanwhile, the company recently introduced a new line of iron oxide red pigments produced at its plant at Ningbo in China covering the mid and yellow-shade end of the red colour range.

The company says the new grades (Bayferrox 520, 5272, 525 and 530 mid-range reds and 510, TP5278 and TP5279 yello-shade reds) are initially targeted at paint and coating applications but are also expected to find application in the plastics sector.

PHOTO: LANXESS

Lanxess is investing in its Macrolex pigment business

"The first step was the market launch…in the paint and coatings industry. This is the target industry for this new generation of iron oxide red pigments," said a Lanxess spokesperson.

"Testing was focused on the new Bayferrox grades in coatings, paints and pastes. But at a later stage our Inorganic pigments business unit will extend the testing to other industries."

A particular benefit of the new grades produced at Ningbo is a reduced water soluble salt content, which makes the products suitable for use where corrosion may be a concern.

› **www.lanxess.com**

Teknor adds recycled PA in Europe

US-based Teknor Apex is now supplying its Chemlon 500 series of recycled polyamide compounds, available for some years in the US, to Europe customers.

The Chemlon 500 range is based on recycled PA 6,6 and includes unfilled, impact-modified and glass-reinforced compounds supported by Teknor Apex's upstream recycling capabilities. They are targeted at automotive, office furniture and other applications where cost savings or mandates for recycled content are important.

According to the company, the Chemlon 500 compounds provide "a high degree of lot-to-lot consistency and yield finished products that exhibit good surface appearance and dimensional stability".

› **www.teknorapex.com**

SABIC ups Noryl/Ultem capacity

SABIC has announced projects in Asia and Europe to increase global capacity for two of its engineering thermoplastic materials, Ultem and Noryl. Both are said to be a response to growing demand and follow ongoing expansions for both materials at company sites at Mount Vernon in Indiana and Selkirk in New York State in the US.

The company said it will add a new production facility for its Ultem polyetherimide at its Singapore compounding site, pending final government clearance. It intends this to be online in 1H 2021. It will expand the company's capacity by 50% from its 2018 baseline, while giving it its first Ultem production in Asia (currently the region is supplied from its plants at Mount Vernon and Cartagena in Spain).

SABIC said it will also recommission its polyphenylene ether (PPE) resin plant at Bergen-op-Zoom in the Netherlands by the end of 2019. PPE is the base resin for its Noryl products. This move, it said, "provides customers with a second source of PPE resins globally" and will add more than 40% to global capacity over a 2017 baseline.

SABIC is investing in Noryl and Ultem

› **www.sabic.com**

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NEWS IN BRIEF...

BASF is to invest around $200m over 10-years in its kaolin production operations across its sites in Middle Georgia in the US. The company said "the attractive long term growth outlook" for the key industries it supplies to justify the investment in the business. The focus of the investment will be on infrastructure and process improvements.
www.basf.com

PTT Global Chemical is considering construction of a styrene monomer plant in Thailand to boost its position in the ABS sector. The company is the sole producer of acrylonitrile in south east Asia and also produces butadiene, as well as ethylene and benzene feedstocks. It said the ability to make styrene monomer would fill a gap in its polystyrene and ABS value chain and support further expansion.
www.pttgcgroup.com

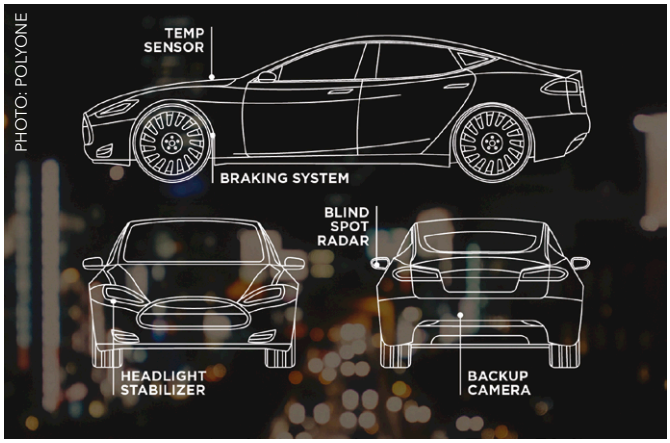
Mitsubishi Chemical has started production of its Tefabloc styrenic thermoplastic elastomer at its Thai subsidiary, Mitsubishi Chemical Performance Polymers (Thailand). Tefabloc is one of Mitsubishi's core TPE brands. The company already manufactures its Thermorun TPE for automotive airbag applications, Treprene crosslinked olefinic TPE and Sunprene flexible PVC compounds in the country.
www.mcpp-global.com

PolyOne targeting EMI/RFI with Integral partnership

PolyOne has signed an exclusive 10-year license agreement with Integral Technologies to commercialise the latter's Electriplast long fibre conductive plastic materials for EMI and RFI shielding applications.

The company said the materials, developed by Integral Technologies subsidiary Electriplast, complement its own specialty engineered materials portfolio and provide a superior lightweight shielding solution for housing applications for items such as automotive advanced driver assist systems (ADAS), as well as connectors and other electronic parts.

"Using our formulation expertise, we plan to develop ElectriPlast materials tailored for housings and other shielding applications, working in tandem with our customers and the application development experts at Integral Technologies," said Michelle R Hearn, Global Marketing Director, Specialty Engineered Materials at PolyOne.



PolyOne has its sights on autonomous vehicle applications

Electriplast materials can be customised with different amounts and types of metal fibres to provide an optimised EMI and RFI shielding performance. According to Polyone, they offer a potential weight saving of up to 60% over metal.

Commenting on the deal, Integral Technologies CEO Doug Bathauer said: "We've been seeking a commercialisation team to accelerate growth in the automotive industry for some time now, and ultimately chose PolyOne for its deep polymer expertise, global reach, and brand excellence."

■ North American readers can learn more about the latest innovations in conductive plastics technology at Conductive Plastics USA 2018 in Pittsburgh, PA, on 20-21 March 2018. More information **HERE**

› **www.polyone.com**
› **www.electriplast.com**

Petrochemicals giants form JV

Oil and gas giant Total, polyolefins player Borealis and PE and styrenics producer Nova Chemicals have signed definitive agreements to form a joint venture in petrochemicals on the US Gulf Coast. Subject to regulatory approval, Total will hold 50%, and Borealis and Nova Chemicals the other 50% via their Novealis Holdings venture.

The agreement encompasses a 1m tonne/year ethane steam cracker currently under construction at the BASF-Total site in Port Arthur, Texas, and due to start up in 2020, plus two PE sites 110km away in Bayport, Total's existing 400,000 tonnes/year site and Borealis's new 625,000 tonnes/year Borstar facility.

The project is aimed at taking advantage of low-cost natural gas in the US. It will also bring Borstar technology to the North American market for the first time and take Nova beyond its traditional footprint into Canada and into the Gulf Coast.

› **www.borealisgroup.com**
› **www.total.com**
› **www.novachem.com**

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PHOTO: TEIJIN

Teijin's site at Ayutthaya in Thailand

Teijin to compound in Thailand

Japan's Teijin plans to build a 10,000 tonnes/yr resin compounding plant and related R&D facility for customer technical support at its site in Ayutthaya, central Thailand. The company said the move will give it "a framework for responding faster to demands in the ASEAN region".

The compounding plant, which will cost about $13 million to build, should begin operations in mid-2019 and will be built on a 6,000m^2 site with capacity to allow future production expansion depending on demand growth. The R&D facility, meanwhile, will be the company's third in Asia, complementing existing sites in Japan and China.

Thailand has been at the heart of Teijin's polyester fibre production for more than 50 years; the company set up a subsidiary in Bangkok in September 2013 to handle sales.

Teijin has also launched its Solfiga brand of high-performance polyphenylene sulphide (PPS) compounds. Full-scale production will begin at its site in Mihara, near Hiroshima in Japan, this summer. In time, these compounds will also be produced at the company's sites in China and Thailand.

The Solfiga products are targeted mainly at automotive and electronic applications. They draw on the proprietary PPS resin technologies of Initz, Teijin's joint venture with SK Chemicals of Korea, and its own material and compound technologies such as aramid and carbon fibres and speciality polycarbonate resin.

The Initz JV was founded in 2013 to make PPS compounds at a 12,000 tonnes/yr plant at Seongnam.

› **www.teijin.com**

Repsol making high impact copolymers

Repsol of Spain has produced high impact PP copolymers for the first time. The resins will be marketed under the Repsol ImpactO brand, both in their basic PP form and as base polymers for high impact compounds used in the automotive sector and for technical parts and compounds.

The ImpactO range is specifically designed to comply with the automotive market's need for low VOC emissions and weight reduction for fuel savings. Repsol said it is already seeking to add low temperature, high impact grades to the range for interior parts, such as door panels and dashboards, plus items like shopping trolleys, suitcases and child restraints systems for cars and bicycles.

› **www.repsol.energy**

PHOTO: COPERION

Coperion's new service centre at Jubail in Saudi Arabia

Coperion ups service in Middle East region

Coperion Middle East has officially inaugurated its service centre at Jubail in Saudi Arabia.

The facility, which has been in operation since September 2017, covers 1,400m^2 and includes an 800m^2 workshop for die plate, extruder barrel and screw elements servicing and rotary and diverter valve maintenance. The centre also holds a spare part inventory for supply throughout the region.

Coperion, which supplies compounding, feeding and bulk materials handling systems, has been present in Saudi Arabia for 30 years. It established Coperion Middle East in 2011.

› **www.coperion.com**

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SW nanotubes deliver for anti-static films

Single wall carbon nanotube (SWCNT) producer OCSiAl has revealed that one of its development customers – a European-based film producer – has successfully produced a transparent and permanently anti-static PE blown film for electronics packaging using an addition of just 0.01wt% of SWCNTs.

PHOTO: OCISAL

SWCNTs reduce static in the new PE film (left)

The company used OCSiAl's Tuball Matrix 810 SWCNT concentrate, achieving a surface resistivity in the range 5×10^{9} to 10^{11} Ω/sq. This meets ANSI/ESD S541-2003 and IEC 61340-5-1-2007 standards on protection against electrostatic effects for packaging, OCSiAl says.

Conventional anti-static additives such as carbon black can lead to compromised mechanical performance and a darkening of the film; light transmittance of the SWCNT anti-static PE film is 90% in comparison with the natural PE while stress at break in the cross-direction is increased by around 60%, according to OCSiAl.

Use of the SWCNT concentrate has also avoided dust problems associated with using carbon black, according to the company.

› **www.ocsial.com**

Incroslip SL gets EU approval

PHOTO: CRODA

HDPE bottle caps are a target market for Incroslip SL

Croda Polymer Additives' Incroslip SL high slip additiv, has been granted approval for use as an additive in the manufacture of polyolefins and articles that come into contact with food according to EU Commission Regulation 10/2011, as amended.

The company claims that Incroslip SL provides superior stability in challenging conditions compared to traditional alternatives such as erucamide and oleamide, which can lose slip performance as they begin to break down. This is especially at high temperatures or after exposure to UV light and can also lead to negative effects such as odour, taste and changes in colour.

› **www.crodapolymeradditives.com**

Lego goes bio-based for PE "Botanicals"

Danish toy-maker Lego is to use bio-based PE from Braskem to produce some parts for its construction sets.

The company said the sugar cane-derived polymer will be used to produce some of its "Botanicals" elements, including leaves, bushes and trees, and offers performance identical to petrochemical PE. It has not disclosed the volumes of bio-based PE it will use but said PE parts makes up 1-2% of the total volume of components it produces; most are manufactured in ABS.

"This is a great first step in our ambitious commitment of making all Lego bricks using sustainable materials," said Tim Brooks, Vice President, Environmental Responsibility at Lego Group.

› **www.lego.com**

NEWS IN BRIEF...

PolyOne is to begin production of thermoplastic elastomers (TPEs) this summer at its facility at Pune in India. The company opened the Pune site in 2014 and already produces colour and additive concentrates and engineered polymers there. It said local TPE production will benefit its growing customer base in India by offering shorter lead times.
www.polyone.com

Ampacet has started up a new additive masterbatch line at its Messancy plant in Belgium, its largest European production location where it produces black, white and additive products. The new line is intended to enable the company to shorten lead times while providing additional capacity to meet future market growth expectations.
www.ampacet.com

Ineos Styrolution has introduced an enhanced version of its high heat Luran HH120 grade with optimised scratch resistance for automotive exterior applications. The alpha methyl styrene acrylonitrile (AMSAN) product is said to display minimal gloss reduction when exposed to typical daily wear and tear, which the company says makes it a "perfect fit" for high gloss black automotive trim parts.
www.ineos-styrolution.com

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Record results at Nabaltec

Germany-haedquartered functional filler maker Nabaltec posted a near 6% increase in sales for last year to €168.6m and recorded a record EBIT result of €18.3m (up by 50% from €12.2m in 2016).

The company said sales in its functional filler division were up by 2.8% to €112.2m and specialty alumina sales up 12.6% to €56.4m.

CEO Johannes Heckmann said the 2017 result was particularly pleasing given the loss of revenues last year from its Nashtec business in the US. Production was halted last year to upgrade the facility, which was acquired by Nabaltec last year; production is expected to resume again in Q2 of this year.

Heckmann reconfirmed the company's $12m plan to build a 30,000 tonnes/yr plant for production of refined alumina hydroxides at an as yet undisclosed US location for start up in mid 2019.

› **www.nabaltec.de**

RTP's new plant in Poland will start up this summer

PHOTO: RTP COMPANY

RTP to produce in Poland

US-headquartered compounder RTP Company is to open a 7,990 m² facility at Wroclaw in Poland, its third manufacturing operation in Europe.

Due to open this summer, the new facility will supply the wider central and eastern European market and will employ around 25 people. The production area will house up to six production lines, with scope to expand operations in the future. The site will also include a laboratory , according to the company.

The plant will complement RTP's existing European facilities in France and Germany. The company also has two production sites in China, one each in Mexico and Singapore, and 12 across the US.

› **www.rtpcompany.com**

Three-way partnership yields sparkling 3Dprint effects

Effect pigment specialist Schenk Metallic Pigments and filament maker Herz, both from Germany, together with Austrian-based masterbatch manufacturer Gabriel-Chemie have developed a 3Dprint filament claimed to offer "an astonishingly authentic" metallic appearance.

The three partners used ultra-fine pigments from Schenk with Gabriel-Chemie's masterbatch formula to create "a silky, homogeneous surface" free from visible glitter particles and with a deep shine. Read more about this and other special effect pigment innovations in our feature on page 57.

› **www.gabriel-chemie.com**

PHOTO: GABRIEL-CHEMIE

Vases 3Dprinted using the new metallic-effect filament

Lomon Billions to invest in TiO_2 capacity

China's Lomon Billions has approved an investment of around $285m to build two new chloride route titanium dioxide (TiO_2) manufacturing lines at its site in Jiaozuo, Henan province.

This move will give the company about 200,000 tonnes/year of extra capacity, as well as the ability to make more high-performance product for applications including plastics. Commercial production is expected to begin during 2019.

Formed by the merger of Henan Billions Chemical and Sichuan Lomon Titanium Industry in 2016, Lomon Billions currently has a combined 700,000 tonnes/year of chloride and sulphate route TiO_2 across three sites in China, where it also owns an ilmenite mine.

The company claims to be the world's fourth largest producer of TiO_2 and the largest in Asia.

› **www.lomonbillions.global**

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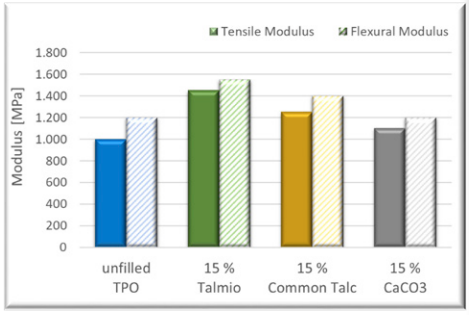
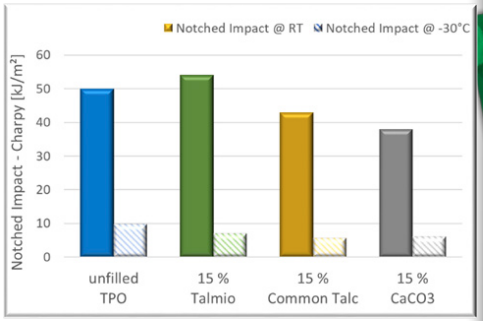
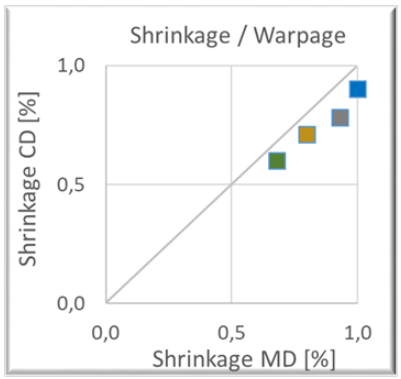


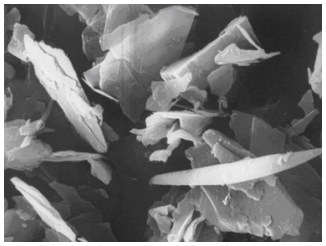
Reinforcement with 2 microns Talc in TPO



Impact strength with 2 microns Talc in TPO



Example: anisotropic shrinkage in TPO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Compounding World Expo to host free training seminars

Visitors to the Compounding World Expo will be able to attend a series of six free training seminars covering a range of topics including process optimisation, REACH compliance and the psychology of colour. The seminars will take place over both days of the exhibition, which is being held at Messe Essen in Germany on 27-28 June 2018.

"The practical seminars will be delivered by acknowledged experts and experienced trainers," said Andy Beevers, Events Director at AMI, the organiser of the exhibition. "We want to provide visitors with valuable educational content, in addition to the opportunity to meet more than 130 suppliers who will be exhibiting at the Compounding World Expo."

The opening training seminar will cover the specification of twin-screw extruders for compounding. It will be given by **Adam Dreiblatt**, Director of Process Technology at **CPM Extrusion Group**, which manufactures compounding lines in the US, Germany and China. Dreiblatt has more than 35 years of twin-screw extrusion experience. Prior to joining CPM in 2007 he ran a consulting and training company focused on compounding technology, and he developed training workshops for the Society of Plastics Engineers.

The second training seminar at Messe Essen will focus on REACH 2018 and address the big question of whether your company is compliant with the latest European chemicals legislation. The talk will be delivered by **Dr Anna Gergely**, Director for EHS Regulatory at the international law firm **Steptoe & Johnson**. Dr Gergely has a PhD in analytical chemistry and worked in a technical position at Monsanto before moving into the legal field, so is well placed to relate regulatory developments to the world of plastics additives and compounds.

The upcoming Compounding World Expo includes free expert training seminars delivered by (clockwise from top left): Adam Dreiblatt, Director of Process Technology at CPM Extrusion Group; Dr Anna Gergely, Director for EHS Regulatory at Steptoe & Johnson; Laurent Ratte, Sales Manager at Sciences Computers Consultant (SCC); Luis Roca Blay, Head of Compounding at Aimplas; and Dennis Keller, European Head of Colour Marketing at Polyone

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The next free training seminar will focus on what's happening inside the twin-screw extruder. **Laurent Ratte**, Sales Manager at **Sciences Computers Consultant** (SCC), will discuss the use of computer modelling to optimise compounding. SCC is a leader in computer simulation software for twin-screw extrusion and Ratte manages the company's workshops to educate the industry about the technology.

The first free training seminar on the second day of the Compounding World Expo will focus on optimising screw configurations in co-rotating twin-screw extruders. The talk will be given by **Luis Roca Blay** who is Head of Compounding at **Aimplas**, the plastics technology centre in Spain. He has been with the R&D centre since 2000 and in his current role leads research projects and delivers courses in compounding and additives.

Dennis Keller, European Head of Colour Marketing at **PolyOne**, will deliver the next seminar, focusing on the psychology of colour and its importance in buying decisions. This will be a valuable session for anyone involved in the development, production or application of colour compounds and masterbatch.

The final seminar in the Compounding World Expo educational series will see the return of **Adam Dreiblatt** to the stage. His second presentation will focus on scale-up strategies for twin-screw compounding extruders.

If you wish to attend any of the training seminars at the Compounding World Expo, register for your free ticket **here**. This will give you free admission to the exhibition and its two conference theatres featuring technical presentations and business debates in addition to educational seminars. It will also ensure free entry to the Plastics Recycling World Exhibition.

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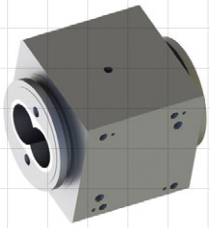

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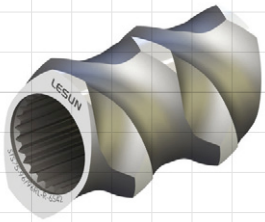

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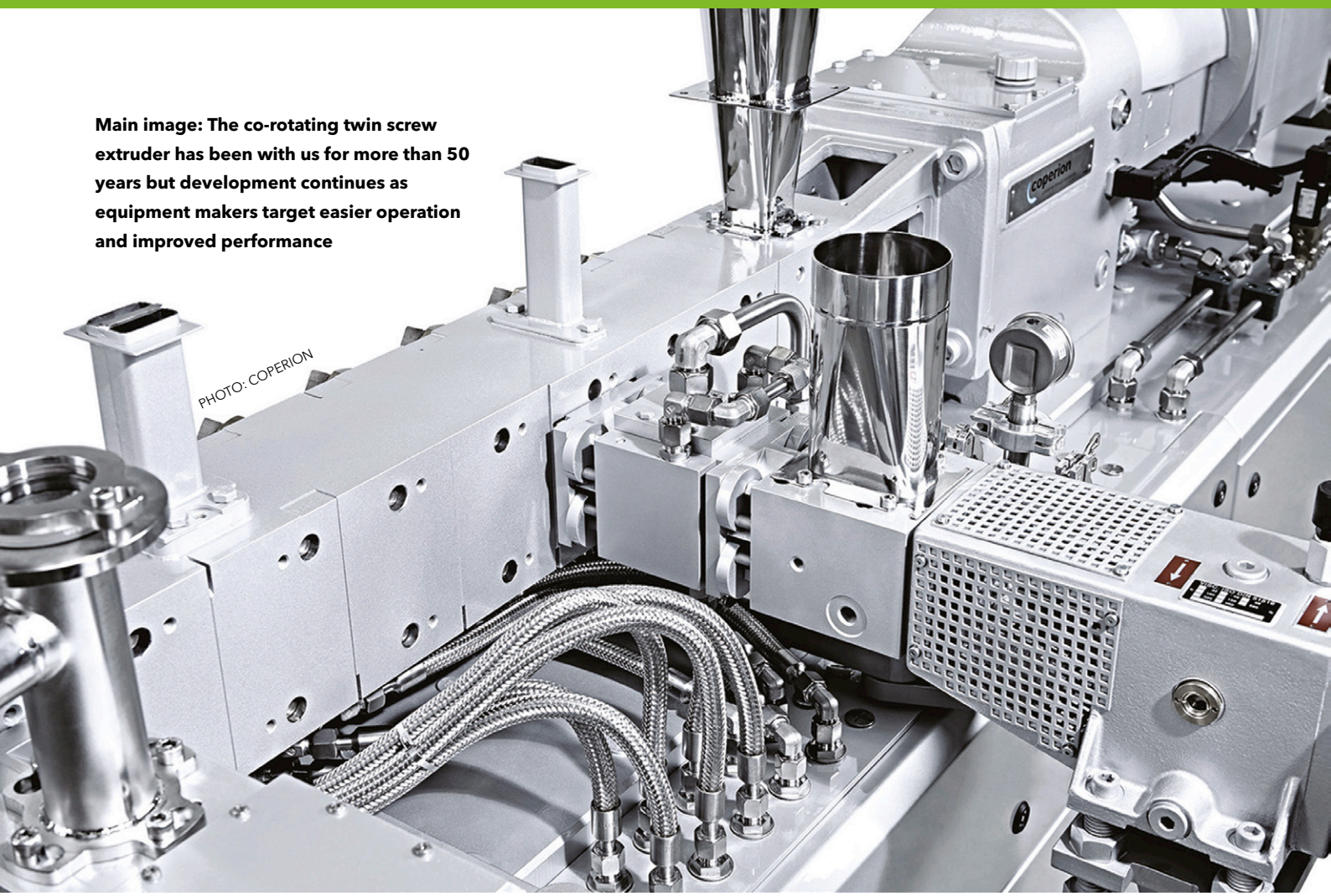

Main image: The co-rotating twin screw extruder has been with us for more than 50 years but development continues as equipment makers target easier operation and improved performance

PHOTO: COPERION

Improving the breed

*Today's co-rotating twin screw extruders are the result of more than half a century of development and progress continues to this day. **Peter Mapleston** reviews the latest introductions*

The co-rotating twin screw extruder has been with us now for around 60 years, as evidenced by anniversary announcements last year from Coperion and Leistritz (the former saying it delivered its first example in 1957 and the latter adding the technology to its standard extruder product line a couple of years later). But the technology has been far from static since then and all suppliers of co-rotating twin-screw compounding extruders continue to make improvements to their equipment.

As might be expected for a mature technology, development is more evolutionary than revolutionary. However, the improvements are real and range from filling gaps in current product lines to expanding into new production territories. Either way, they promise to make operation easier and more cost-effective for users.

CPM Extrusion Group's new CXE 45 sHO will get its first public outing at NPE 2018 in Florida in the US in May. The company says the machine, with 45mm OD screws, "fits perfectly" between existing machines with 26mm and 50mm ODs. Developed by group company Extricom Extrusion (acquired by CPM at the beginning of last year) it is targeted at producers of compounds and masterbatches.

A broad variety of optional "smart" features are now also being offered as an extension to the existing HO variants in the CXE machine series (HO stands for High Output with the machines offering a torque density of 18 Nm/cm³ and screw speed of

PHOTO: CENTURY EXTRUSION GROUP

Right: CPM's CXE 45 HO, which will be launched at the upcoming NPE show in the US, is offered with many optional "smart" features

900 rpm). In future, smart features will be available on all machine types and sizes. For the motor, safety clutch and gearbox, for instance, optional temperature and vibration sensors can be applied to provide a comprehensive condition monitoring solution to enable a preventive maintenance programme to be planned. A gearbox oil sensor constantly evaluates impurities, water content, soot formation, air content, oil ageing, acidification, oil and ambient temperature, relative humidity, transmission, electrical conductivity and the relative permittivity of the oil.

Sensors on each screw shaft assess torque and provide information on performance corresponding to the specific energy input to the product, as well as an indication of wear on shafts and barrel. There are also energy monitoring features for drive, heaters and cooling water to summarise the energy efficiency of the extruder.

Screw development

Thomas Bauer, Managing Director at **Extricom Extrusion** (which along with Century Extrusion in the US and Ruiya Extrusion in China form the three arms of CPM Extrusion Group) also highlights new screw segments and barrier screws for more gentle incorporation of glass fibres and thermally sensitive flame retardants and additives. In addition, he points to the company's "T-Profile Technology" elements, which lift mixing and degassing efficiency.

"Furthermore, the tie-rod design enabled us to implement an extraordinarily efficient cooling water system for a maximum of temperature control. In combination with the high duty and high-power cartridge heater, even high temperature nylons for automotive applications [can be] processed with an unmatched control," Bauer says.

Entek will feature its newest twin-screw extruders and technologies at NPE 2018. There will be two machines on its booth: the new QC³33mm co-rotating twin-screw extruder, which was introduced in 2017 and is being shown publicly for the first time; and the high-output 73mm twin-screw extruder.

Below: Entek's QC³33 is the latest addition to the QC³ range and is intended for small lot compounding duties

PHOTO: ENTEK

The QC³33mm is a new size for Entek. Designed for small lots of compounds, it includes all the company's latest QC³ (Quick-Change, Quick-Clean, and Quality Control) features. Other QC³ models have 27mm, 43mm, and 53mm screws. Larger models (with 73mm, 103mm, and 133mm screws) are currently not available in this format.

The company will also have two interactive work stations to demonstrate what it claims is a unique screw-layout software program. "Visitors will be encouraged to use the program to see how easy and fast it is to input their information and design a screw layout that will work for their compounding needs," the company says.

Modular novelties

Leistritz Extrusion will display a ZSE 50 MAXX that includes a modular design for barrels and screws and an insulated barrel cover. The company says this system is novel in that the extended length facilitates multiple downstream operations, including multi-stage venting, liquid injection and up to two LSB 50 XX side stuffers for filler or fibre introduction into the melt stream. Suitable for a wide range of compound types, it can be equipped with a 600HP AC motor and can produce at up to 1,000 kg/hr with the screws rotating at 1,200 rpm.

LSB XX series side stuffers are supplied with a high OD/ID screw ratio of 2.0 and can convey materials with very low bulk densities. The screws can be segmented, enabling them to be configured for the raw material in use, while barrels can be jacketed for cooling or heating. Internal cooling of the screws is also optional.

Leistritz will also show its ZSE 18 system for production of 3D printing filaments at NPE. Apart from a ZSE 18 co-rotating twin screw extruder fitted with a gear pump and a die to produce 1 to 5 mm 3D filaments, it includes loss-in-weight feeders, a custom air-rack for air

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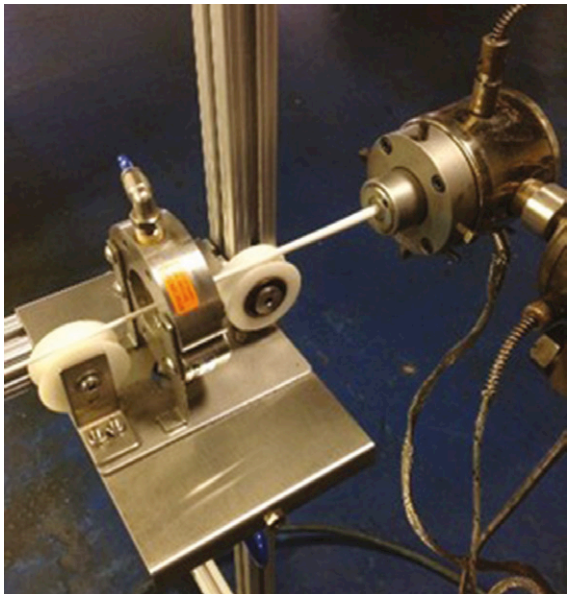

PHOTO: LEISTRITZ

Right: 3Dprint filament production on a Leistritz ZSE 18 extruder fitted with a gear pump

quench cooling and sizing of the filament, belt puller, laser gauge and winder. The company says the system is well-suited to in-line compounding of polymers with additives and active-fillers to quickly develop new filaments and formulations. These can be modified "on the fly," enabling production of a new sample every 10 minutes.

The ZSE 18 system can handle high-temperature engineering polymers, and is designed to process at rates up to 20 kg/hr. The system on show in Orlando will be available for testing in the Leistritz laboratory at Somerville, in New Jersey in the US, after the exhibition.

Targeting torque

Following the introduction of the compact TEX34αIII high-performance compounding extruder at the IPF show in Tokyo last October, **JSW** has now launched the unit on the European market. The TEX34αIII, which replaces the slightly smaller TEX30α small-lot extruder and actually features 36mm diameter screws – JSW says the original design used 34mm screws and, having given the machine a 34 designation, it decided to keep to it.

The very high torque density (18.2 Nm/cm^3) enables effective yet gentle compounding at low screw speeds and temperatures, but without detriment to throughput, according to JSW. Should torque rise too much, a limiting function protects the machine by disengaging the drive motor and gearbox, stopping screw rotation.

Typical throughput for a compound such as talc-filled polypropylene is up to 500 kg/h, while masterbatch producers can expect to reach around 250 kg/h. 150 kg/h is achievable for polymer blends such as PC/ABS, which the company claims is a world-beating level of performance for such a compact compounding extruder. "The TEX34αIII also excels with its conventional yet convenient EZ easy-change tie-bar system, which makes changing barrels easier than in the past," JSW says.

The company offers the TEX34αIII with a choice of a standard model and an ultra-compact version with the control cabinet incorporated within the footprint of the machine frame, saving both space and installation time. "The standard model has a separate control cabinet, because sometimes customers prefer to have the control cabinet in a separate room to protect them from, for example. dust during heavy-duty operation," says Jun Kakizaki, General Manager at JSW Europe. "The ultra-compact model is designed for laboratory applications, where space may be limited".

While the ultra-compact version does not lend itself easily to customisation for individual needs, the standard model can be easily customised, Kakizaki points out, citing provision of a multiple number of vents, adjustment of L/D ratio with screws of different lengths, and the ability to increase screw speed by choosing to use one of three drive motors with different performance levels. Modification to permit explosion-proof operation in hazardous environments is also possible.

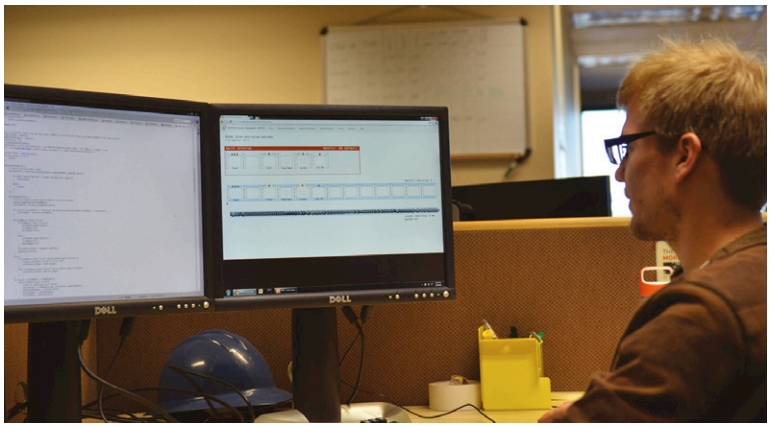

PHOTO: ENTEK

Entek's screw design program is designed to enable simple and quick design of screw and barrel layouts for specific applications. It features drag and drop functionality and includes safeguards to prevent elements being placed where they don't belong

Custom capabilities

JSW says numerous in-house developed special devices can be incorporated to increase the capability of the TEX34αIII. NIC (Nikko Intensive Cylinder) mixing barrels, for example, use longitudinal grooves to enhance mixing performance by allowing more material to pass through the larger gap between the depth of the grooves and the screw. The associated reduced shear rate enables lower temperature mixing and is said to avoid localised heat build-up. Energy consumption can be

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Engineering Value

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Above: This Leistritz ZSE MAXX twin screw extrusion system is equipped with two of the latest LSB 50 XX side stuffers

anywhere from 10 to 20% lower than when using standard non-grooved barrels, the company claims.

The TKD (Twist Kneading Disc) screw element, meanwhile, has twisted rather than conventional straight flights, resulting in less pressure on the flights and good dispersive mixing with low screw wear – an important advantage when compounding abrasive materials. As mixing can take place at around 10% lower temperature than with conventional mixing elements, and with less demand on the drive motor, there is a corresponding 10% lower energy consumption when using TKD elements.

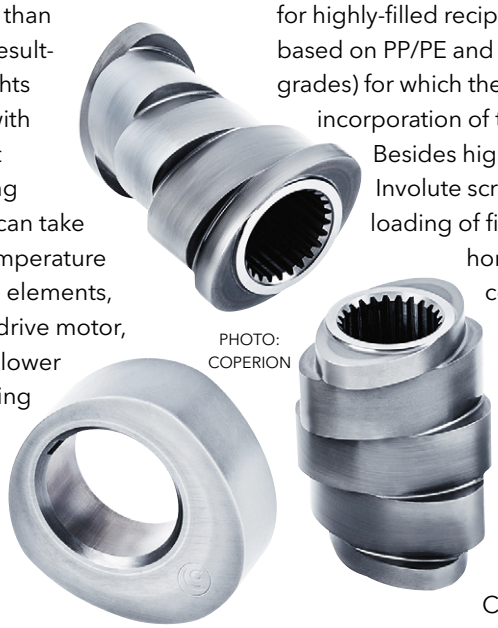


PHOTO: COPERION

Right: Coperion has further optimised its Involute mixing elements, which are said to enable improved throughput with heavily filled formulations

Improvements made to the Exanet control system's 15-inch colour LCD control panel include better visibility of icons on the touch-screen display to enable easier triggering of specific functions. The system can also control auxiliary equipment, although JSW points out that customers can choose to use a PLC system of their own choice if they prefer. Like Entek, JSW also offers software packages for simulation of process conditions, screw design, and screw element management.

JSW's Korean subsidiary **SM Platek** (acquired in 2015) recently launched the TEK25MHS[153], which has a torque density of 15.3 Nm/cm. The supplier says the new unit meets the various demands of customers in small lot production or laboratory use with a combination of high performance and easy operation. The unit provides around 40% more toque than its predecessor, the TEK25MHS. Suitable for commodity and engineering plastics, it uses a 30kW motor to provide a maximum screw speed of 1,225 rpm.

Right: JSW's latest 36mm diameter TEX34αIII extruder in the ultra-compact version with integrated control

A newly designed tie-bar barrel connection system allows users to change configurations by dismantling barrels one by one, instead of dismantling the entire barrel assembly. Side feeders are mounted on a swing arm (which also has a new design), with their position easy to change. The unit can be fitted with JSW's Exanet or a third-party PLC. All necessary electrical components, such as motor drive and TIC controller, are mounted on the machine frame.

Pushing throughput

At **Coperion**, Markus Schmudde, Head of Research & Development, says that to significantly increase throughput rates of its ZSK extruder series, the company has developed its special Involute screw elements with a new and patented cross section design. He says the new screw elements are ideal for highly-filled recipes (70-85% $CaCO_3$, TiO_2, mainly based on PP/PE and 20-50% talc for automotive grades) for which the dispersion rating and the incorporation of the filler represents a limitation. Besides higher throughput rates, the Involute screw elements ensure higher loading of filler, better dispersion and homogenisation, lower energy consumption, "and a significant increase in profitability."

Throughout last year, says Schmudde, Coperion ran extensive tests with the new elements in its laboratory and has further optimised the mixing sections. "With the new Involute screw elements, Coperion has the advantage to run highly-filled compounds on a one-size-smaller machine with comparable or even better product quality," he says. "For customers this means significantly lower CAPEX and OPEX cost decrease due to the lower energy consumption."

Coperion has also introduced new designs of its side degassing unit ZS-EG and side feeder unit ZS-B. The redesign focuses on the optimisation of

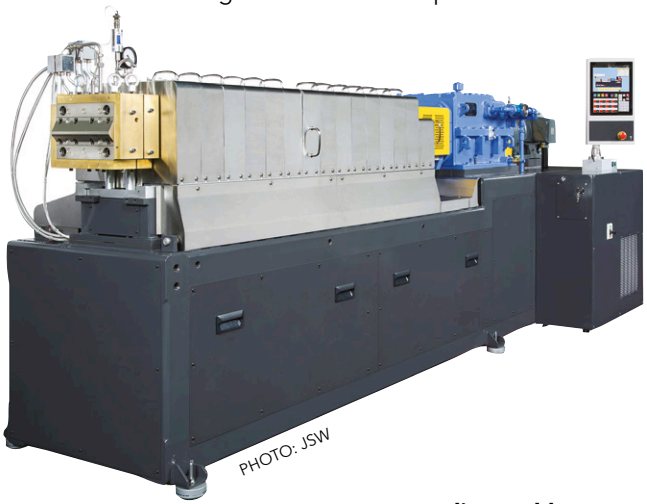


PHOTO: JSW

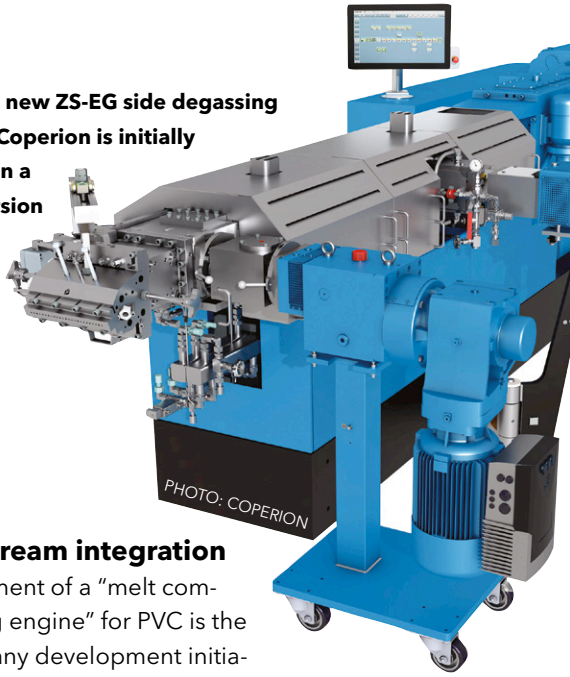
the handling of these units during cleaning and maintenance, including a fast connection mechanism to mount the barrels. The ZS-EG is now fitted with radial shaft sealing rings and, as a result, the lantern area remains visible. They additionally permit nitrogen purging in an explosive environment. "Thanks to the new seals, there is no longer a vacuum present in the gear lanterns, and the service life of the gear-side shaft seal is considerably longer," Schmudde says.

The new features are already available for the 58mm version of Coperion's side degassing and side feeder units. All other sizes – from 40mm to 92mm – will become available this summer.

Flexible operation

KraussMaffei Berstorff points to several new highlights on its ZE BluePower series, including the highly flexible processing section, safe torque transmission, and optimum wear protection. The company says the modular range of barrel sections with 4D and 6D lengths – equipped with C-clamp system for rapid and safe replacement – together with the wide variety of screw elements, ensure "uncompromising flexibility" when configuring customised solutions for specific applications. "The combination of increased free volume in the processing section and higher torque gives optimum conditions for cost-effective compounding," the company says. Improved side feeders and a variety of feed-port stuffers help ensure high output rates.

Tooth profiles of screw shafts and screw elements have also been optimised, as has the screw preloading system and the geometry of the connecting sleeves, to make sure high torque levels are safely transmitted. The company says a number of other technical improvements implemented in the ZE BluePower series "provide increased availability and unparalleled ease of maintenance in 24/7 production mode." For example, new wear liners complement its range of induction hardened or powder-coated barrel sections to achieve effective wear protection for all applications.



Right: The new ZS-EG side degassing unit from Coperion is initially available in a 58mm version

Downstream integration

Development of a "melt compounding engine" for PVC is the first of many development initiatives started over the last year at **Steer** with the aim of commercialising a twin-screw extruder with improved capabilities, according to Managing Director & Chief Knowledge Officer Dr Babu Padmanabhan. He says this melt compounding engine provides very precise control over specific mechanical energy input. "PVC processing is extremely sensitive to the point at which complete fusion occurs," he notes.

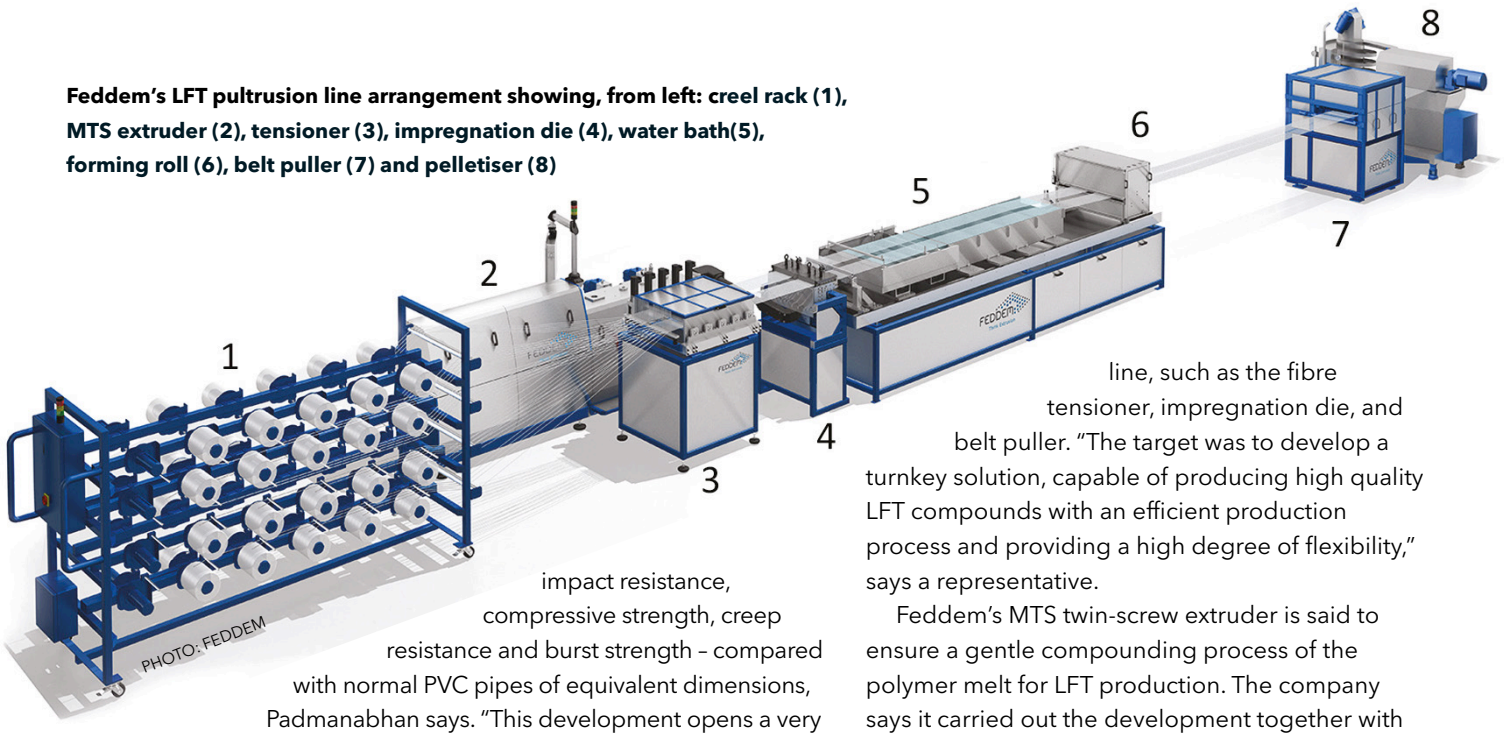
Rigid PVC pipe and profile production normally employs counter-rotating screws to minimise shear and avoid degradation. "Counter-rotating screws offers minimal shear but more importantly a strong elongation flow at the nip zone to achieve fusion," Padmanabhan says. "The problem is that the specific throughput is low, resulting in a large residence time distribution. With our Fractional Geometry Technology, we were able to achieve the elongational flow requirements with much higher specific throughput rates, reducing the residence time as well as providing better control over stability."

Knowing that Sheer's co-rotating extrusion technology can achieve better dispersion and distribution of glass fibre with PVC while minimising shear and attrition, Padmanabhan says the company began a series of experiments with patented wave elements and other fractional geometry technology-based advanced screw designs. "Fractional geometry technology of Steer will also pave the way for production of normal PVC pipes, with associated benefits of high output, less stabiliser level and reduction in replacement costs of screws," he claims.

Reinforced PVC pipes obtained using the melt engine exhibited superior mechanical properties – tensile and flexural strength,

Right: KraussMaffei Berstorff's ZE BluePower machines are designed for flexible production and maximum uptime

PHOTO: KRAUSSMAFFEI BERSTORFF



Feddem's LFT pultrusion line arrangement showing, from left: creel rack (1), MTS extruder (2), tensioner (3), impregnation die (4), water bath(5), forming roll (6), belt puller (7) and pelletiser (8)

impact resistance, compressive strength, creep resistance and burst strength – compared with normal PVC pipes of equivalent dimensions, Padmanabhan says. "This development opens a very significant market, hitherto inaccessible to plastics pipes in applications other than fluid transmission," he adds. Steer intends to license the process.

Also looking downstream is **Polimer Teknik**, which says it has been focusing on in-line compounding and production of composite panels with its Poex series of twin screw extruders. These panels are formed by bonding two metal skins to either side of a flame retardant thermoplastic core.

Long fibre focus

Several equipment makers are increasing their attention on systems for production of long fibre-reinforced thermoplastics, LFTs. **Feddem**, for example, has expanded its ICX (Innovative Compounding and eXtrusion) Technology to include pultrusion process technology for production of such compounds. It says the development of its own pultrusion technology was mainly focused on the optimisation of various components along the line, such as the fibre tensioner, impregnation die, and belt puller. "The target was to develop a turnkey solution, capable of producing high quality LFT compounds with an efficient production process and providing a high degree of flexibility," says a representative.

Feddem's MTS twin-screw extruder is said to ensure a gentle compounding process of the polymer melt for LFT production. The company says it carried out the development together with the sister company Akro-Plastic, which is already using the technology to produce its own LFT compounds. The two companies will present the technology at NPE 2018.

Feddem is not alone in working in this area. Several other companies are already active in marketing systems for LFTs (CW May 2016) and they will soon be joined by **Sino-Alloy Machinery**. The Taiwanese company says it is now very close to concluding its own development. "We've been spending most of our resources [in recent months] on getting a new LFT factory built and past its inspections," says Donald Stephens, International Representative for the company. "We will then work on installing our first 32-strand LFT line."

Stephens says the factory will be the new home for Sino-Alloy's compounding R&D. "Not only are we [an equipment] manufacturing company, but we also have Polyalloy, which is our specialty compounding firm. This allows us to share resources. We'll also use the new factory to showcase our LFT machines," he says.

PHOTO: STEER

Steer's fractional geometry screw design is said to allow better distribution of glass in reinforced PVC pipe compounds, resulting in improved performance. It showed some pipe examples at the PlastIndia trade show

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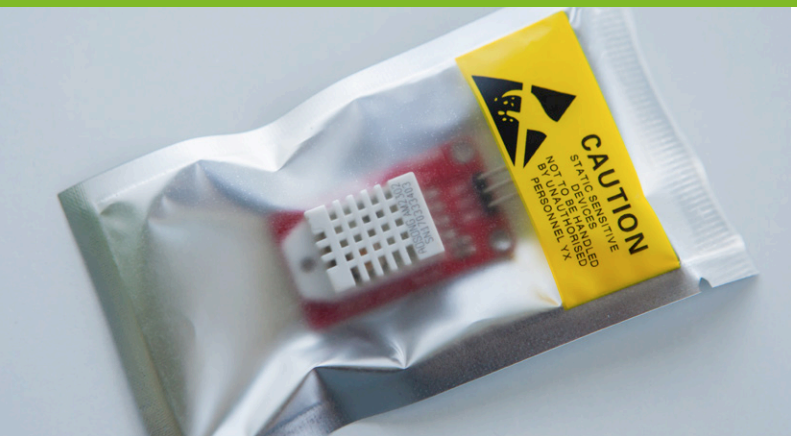

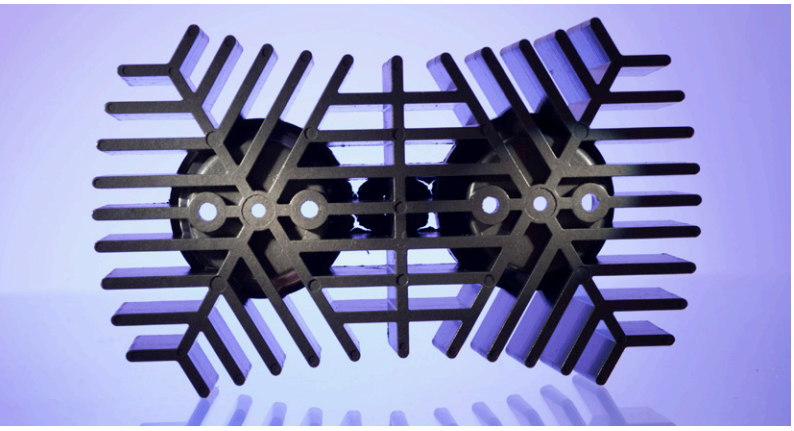

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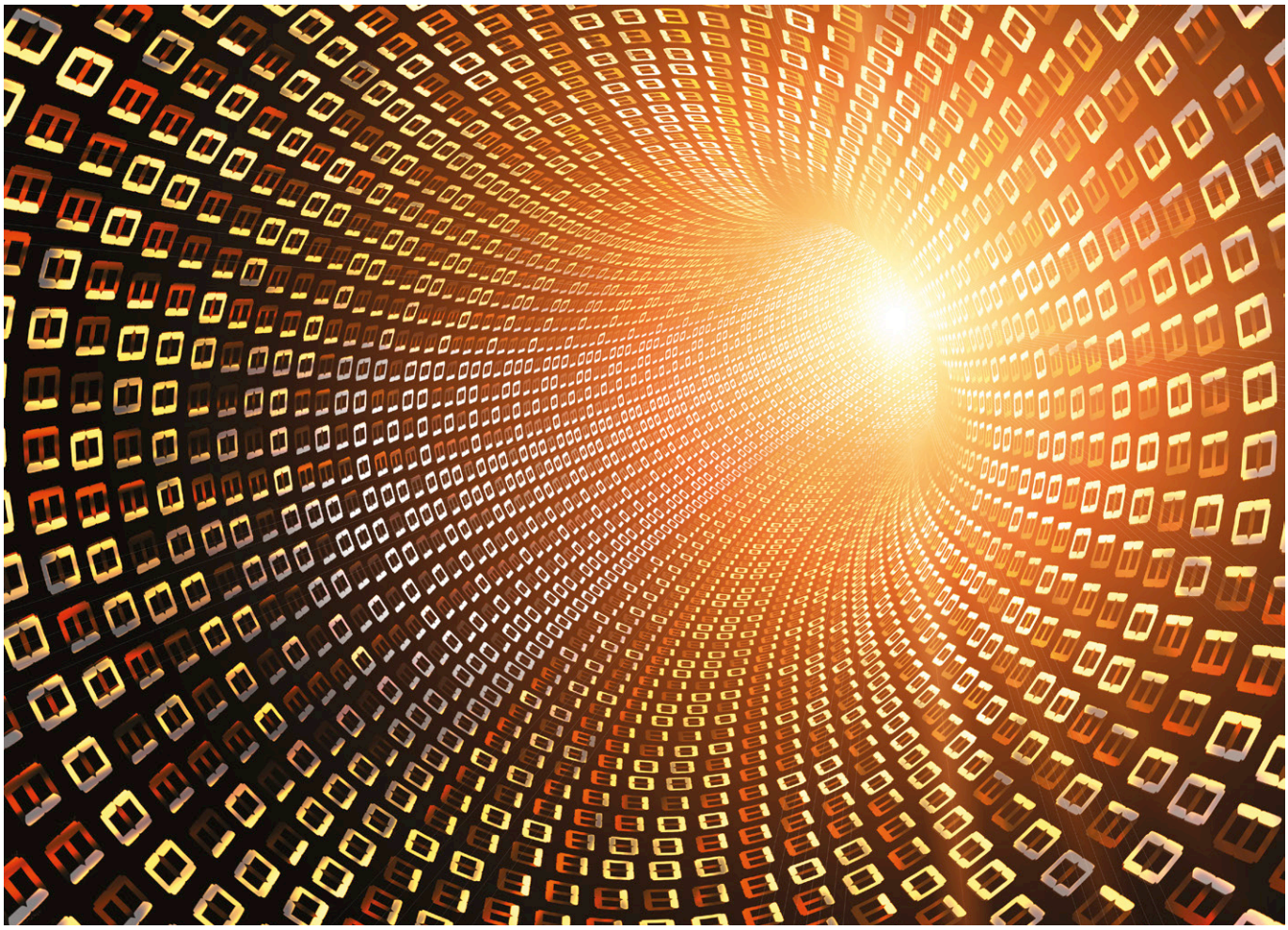

PHOTO: SHUTTERSTOCK

Building the perfect model

*Computer-based modelling tools can help compounders to understand processing characteristics and optimise screw designs. **Jennifer Markarian** reviews developments*

Today's modelling software presents compounders with a powerful set of tools that can not only help predict how materials will perform under a variety of processing conditions or with different screw designs, but can also optimise compounding performance and troubleshoot problems such as structural vibration. Many simulations can be run quickly on a computer to identify the best settings before confirming through experiments on an extruder, providing the potential to save time and cost when scaling up from pilot to commercial scale or determining extrusion conditions for a new compound.

Simulation can cut the number of live experiments needed in half when setting up a new product, says Laurent Ratte, Sales Manager at France-based **Sciences Computers Consultants** (SCC), the creator of Ludovic 1D and 2D simulation software for twin-screw extrusion. Developing a model with the software can provide a picture of the sensitivity of the process outputs to process inputs, including variations in temperature or feeders, or even potential changes such as wear in kneading blocks (Figure 1). This knowledge can help in setting optimal processing conditions, he says.

Ratte says that in compounding processes, complex screw elements are being increasingly used to achieve either dispersive or distributive mixing. SCC is currently integrating models of new, complex screw elements—such as twisted kneading

Main image: The latest digital simulation tools can help compounders model processing behaviour and optimise screw designs

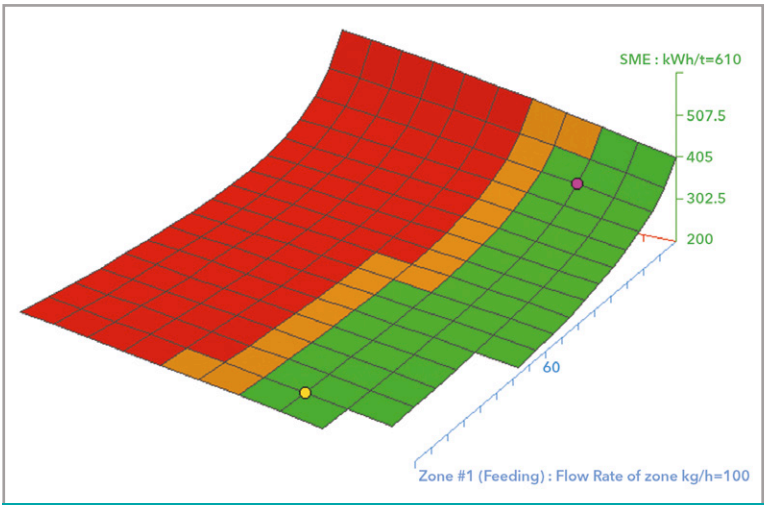

Figure 1: Ludovic software can be used to perform a design of experiments for optimising throughput on a twin-screw extruder. The green area indicates the region where the targeted specific mechanical energy (SME) is maintained (green axis) with changing throughput (blue axis) and rotation speed (red axis). Throughput can be increased from the base case (yellow dot) to a higher throughput (pink dot).
Source: Sciences Computers Consultants

blocks and turbine mixing elements—into its Ludovic software.

Simulation can also be helpful when using twin-screw extruders for reactive extrusion processing. Reactive extrusion depends on both temperature and time in the extruder for the reaction to take place.

A relatively new development that aims to improve the process and possibly make heating more "eco-friendly" is the use of additional energy sources, such as microwaves or ultrasound. A microwave heating source placed on the extruder can concentrate heat in a localised area to help initiate reactive extrusion, says Ratte.

Microwave modelling

A paper published last year detailed SCC's work with researchers from Cranfield University in the UK and Fraunhofer-ICT in Germany to model the reaction kinetics of microwave-energy assisted synthesis of polylactic acid (PLA) via continuous reactive extrusion. The EU-funded **InnoREX** research consortium developed the model of assisted microwave energy sourcing and SCC integrated it into the Ludovic software. Ratte says the standard reactive extrusion model is already part of the Ludovic license; the Micro-Wave model will be available commercially later this year.

Saving time on 3D

3D simulations use finite element method (FEM) or computational fluid dynamics (CFD) to accurately model what is happening inside the machine, but these are time consuming to compute. One-dimensional (1D) simulations are less detailed approximations but require less computing time. Using 3D simulation results as input data for 1D models can provide a good compromise between accuracy and computing time.

Paderborn University's KTP (Kunststoffechnik Paderborn) Plastics Technology Institute in Germany uses Extrud3d, a CFD 3D solver, for detailed inputs to its 1D SIGMA modeling software. Extrud3d was developed by the Technical University Dortmund and subsequently commercialised by **IANUS Simulation**, a 2006 spin-off of the University Dortmund. This year, KTP will automate the data exchange between Extrud3d and SIGMA, creating the user-friendly SIGMA3D.

"The CFD model accurately describes up to three fully filled screw elements in one calculation. It can be used for isothermal and non-isothermal calculations of shear-thinning polymer compounds," says Frederik Sporkmann, SIGMA project manager at KTP.

"For example, if you have two kneading blocks with a conveying element between, you might want to know how high the shear rate is in the kneading blocks. The 1D model doesn't calculate such local details accurately, but the 3D model can [Figure 2]. The 3D data can be used to identify flow characteristics such as dead zones or wall slipping and further improve the 1D analysis of the whole process [Figure 3]. We can simulate materials with low to high viscosity, within a practical range of the process parameters that are commonly used in the

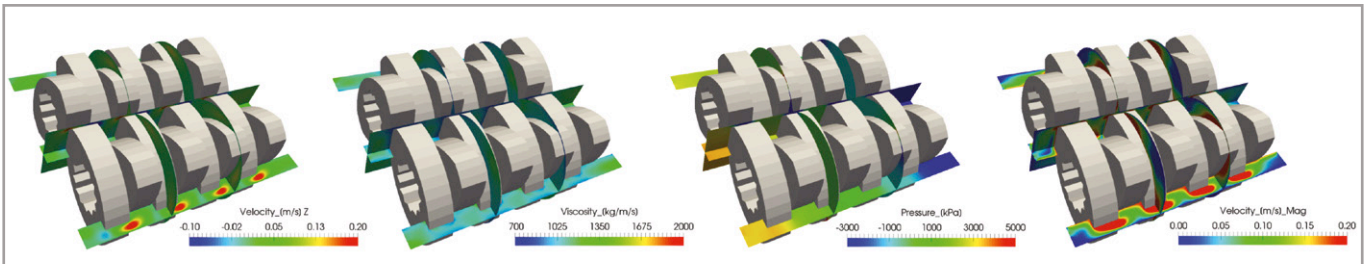

Figure 2: Extrud3d CFD modelling software can provide a detailed analysis of data (such as viscosity, pressure and velocity) in a localised area
Source: Kunststoffechnik Paderborn/IANUS Simulation

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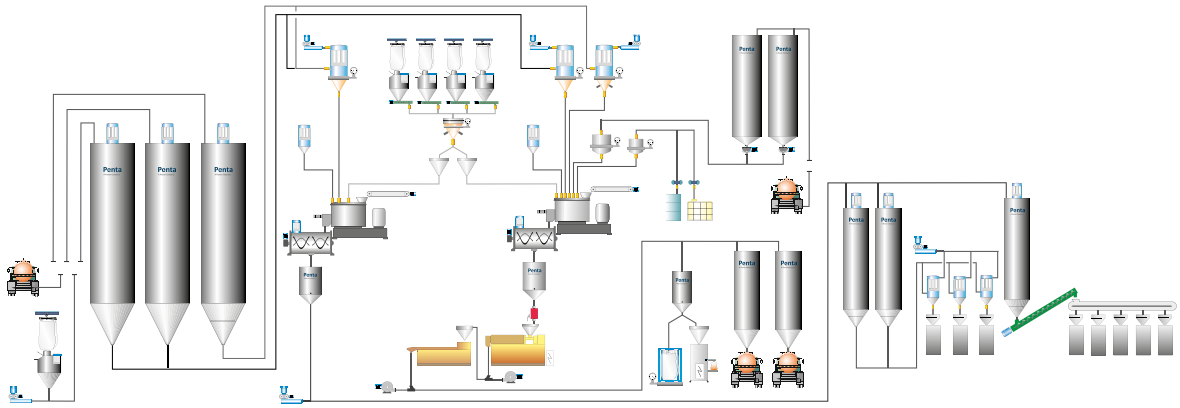

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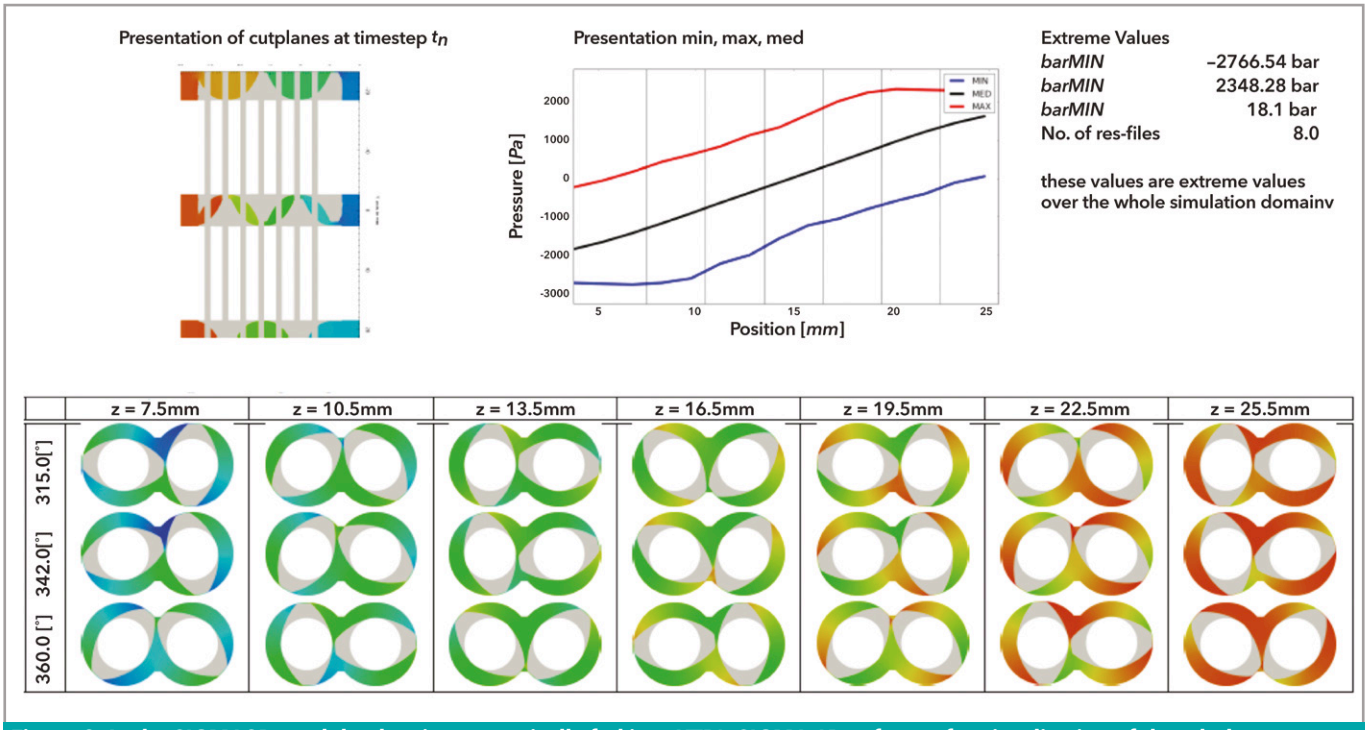

Figure 3: In the SIGMA3D module, data is automatically fed into KTP's SIGMA 1D software for visualisation of the whole system
Source: Kunststoffechnik Paderborn/ IANUS Simulation

industrial area and with good accuracy," Sporkmann says.

KTP's SIGMA software is continually improved under a series of 2-year projects with industry partners. A new project cycle, SIGMA 12, is beginning this month and the next goals for project development will be discussed with the project committee. An important upcoming topic for the project committee to consider is the integration of recycled carbon fibres within the software's fibre breakage module.

The SIGMA software is available for license only by project partners within the project committee, which gives companies input into what features they would like to see developed.

Melting simulation

Another project performed by KTP last year improved SIGMA's melting module, which is designed to provide a generic model that can be used for most common industry materials. Particle size and shape (for example cylindrical or round) affects melting so the improvements added a new calculation method to predict the reduction of the particle size, dependent on the statistical probability in which zone the particle is located within the process, which improved accuracy of results.

KTP also added a degassing module to SIGMA that models the free surface and its renewal time within the barrel with respect to the filling degree in order to calculate a degassing parameter, which gives a good representation of the system's degassing ability.

Sporkmann says that the program does not calculate degassing using a diffusion coefficient, which is a material-dependent value and rather complex to measure for each compound, but rather relates degassing to the screw configuration and machine parameters. "We calculate the machines' basic ability to degas a polymer within a certain configuration, to compare different machines. The idea is to be able to use an individual degassing parameter to compare systems with different degassing abilities, such as a different number of vacuum pumps," he explains.

Finding the data

Companies that have already employed modelling know its value for improving compounding efficiency. However, the biggest hurdle to overcome for 1D computer modeling to become widespread throughout the compounding industry is not simulation capability or user friendliness but having accessible data to define the raw material characteristics in the program.

Adam Dreiblatt, Director of Process Technology for extruder manufacturer **CPM Century Extrusion**, says: "There is a big disconnect between the required raw material data and the information available to the compounder. They make hundreds of different compounds, each with different polymers, additives and fillers. They ask, 'How and

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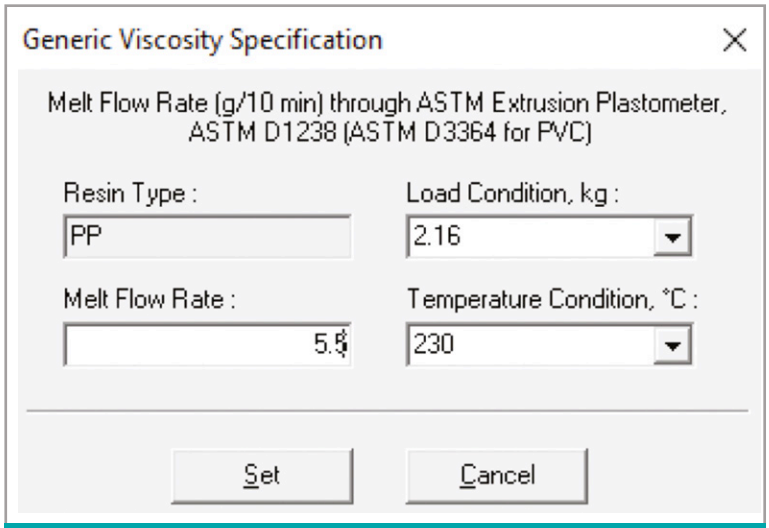


Figure 4: The "Generic Property" specification tool in PolyTech's WinTXS software allows users to specify polymer and melt flow value to quickly create a material file for comparing/optimising screw designs or scale-up between machines
Image: PolyTech

where can we get all of the data to run simulations? We are using more and more recycled resins, where do I find the rheological data?'. This part of setting up simulations is unfamiliar to most process staff, who may know something about the resin melt index, but not much more."

Although data can be obtained from resin suppliers or from material testing, it is not realistic for a typical compounder to collect all of the data required for all of the blends that are produced on each of their machines, says Dreiblatt.

Faced with such a data challenge, some compounders will assume that simulation is too much work. **PolyTech** hopes to address this through the creation of cloud-based materials databases that will make it easier for compounders to use simulation programs. Online materials databases already exist for properties, but these databases do not have all of the required property data necessary for simulation, says Dreiblatt. This new capability is currently under development at PolyTech and is expected to be available in 2019.

Generic materials

In the meantime, users of PolyTech's WinTXS program can create new material files quickly using the "Generic Viscosity" tool (Figure 4). This feature allows users to specify any polymer type (for example LDPE, PP, PA) and a melt flow value to create a new material file. In such instances generic reference values are used for properties such as melt density or thermal behaviour and a suitable rheological model implemented to create the material file using only melt flow.

"While the resulting material file is not 100% accurate, multiple material files can be created quickly and easily to run simulations. For scale-up and screw design optimisation, use of a material file that approximates the actual machine torque and melt temperature provides acceptable results since the same material is used to model two configurations or two different machines," says Dreiblatt.

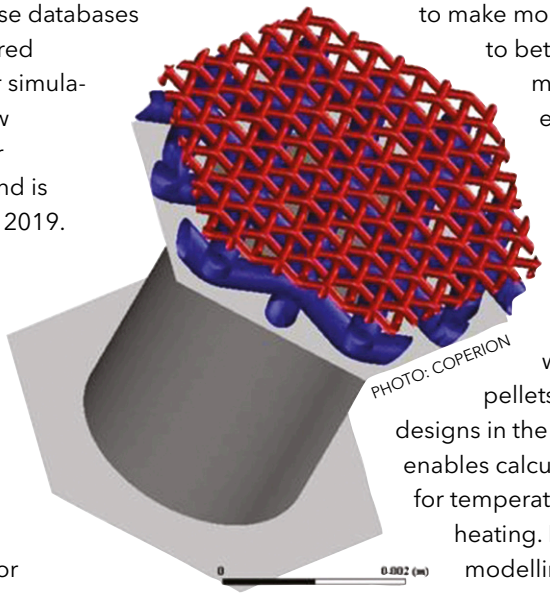
Polytech's WinXTS software is distributed in the US by **Manufacturing Productivity Solutions** and is available in Europe from Germany-based **Extricom**, which was acquired by CPM Century Extrusion early last year.

Filtering results

Another use of simulation software – beyond the melting, mixing, and conveying zones – is to model the melt filter and die at the end of the extruder. **Coperion** is working on improving its models for flow through melt screens and on validating its existing models.

"The pressure drop in the discharge equipment can be critical to the whole process," says Markus Schmudde, Head of Research and Development at the company in Germany. "Melt filters are still a bit tricky to simulate due to multiple flow channels within the screen changer and the mesh itself. Especially in the screen area, elongational flow has to be considered. Simulating that elongational flow is challenging, and good material data is needed to set up the right model."

Coperion's research enables its engineers to make more accurate calculations and to better understand how models may deviate from real equipment, so that deviation can be taken into consideration when optimising melt screens. The company uses FEM to design heating of die heads to guarantee an even flow, which helps produce uniform pellets. Modelling helps optimise designs in the development phase and enables calculation of the best position for temperature sensors that control die heating. During the design stage, modelling can also calculate the



Right: 3D model of a screen fitted above the support plate for CFD calculation

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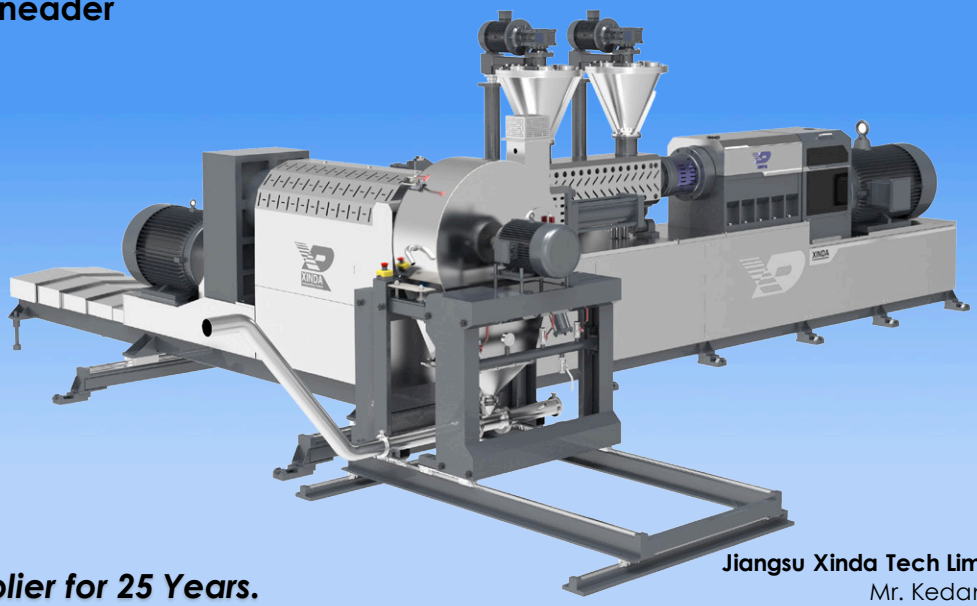

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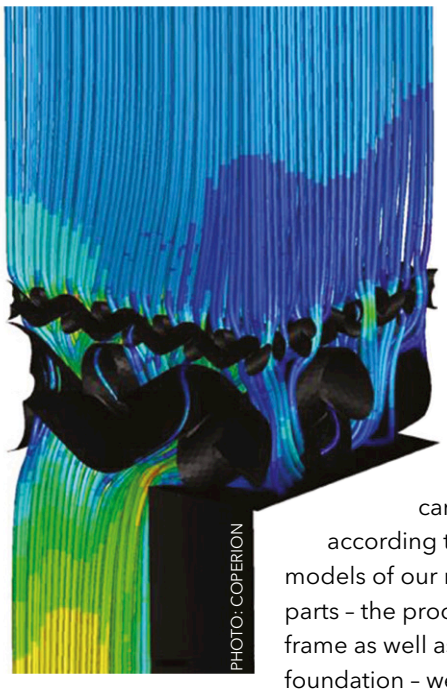
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Above: Simulation of flow velocity for polymer melt passing through a screen mesh

best heating power for different heater cartridges used in the die head, according to Schmudde.

FEM simulations can also be used to troubleshoot extruder vibration problems or to predict and prevent them. As twin-screw extruders have been pushed to higher output rates with high drive power, the rotating parts (such as motor, gearbox, screws) can result in structural vibration, according to Coperion. "With FEM models of our machines including all drive parts – the process section and the base frame as well as the connection to the foundation – we are able to simulate vibrations at different operating windows of the extruder," says Schmudde.

Eliminating potential vibration sometimes requires only a small change to the machine design, he explains. "In other cases, the machine design is correct but the foundation was not done according to the vendor's recommendation. But even then, some small adaptions can be made to the machine to improve the vibration level, and the result is very important for the lifetime of the machine."

Modelling dispersion

Scientists from Chemours Company in the US used a modelling program in a study of the effects of twin-screw extrusion process parameters on titanium dioxide pigment dispersion in a highly loaded masterbatch. Other modelling experiments had not experimentally connected dispersion quality with extrusion parameters for a given screw design, according to the paper given at the Society of Plastics Engineers Color and Additives Division regional technical conference (CAD RETEC) in 2016 by Davis, Niedenzu, Reid, and Sedar.

Using computer simulation, the researchers looked at various screw designs and how they impacted fill factor, residence time distribution and viscosity, and then how these factors affected temperature and the ratio (Q/N) of feed rate (Q) to screw speed in RPM (N), which are two key parameters for dispersion quality for any screw design. The simulation allowed them to collect many experimental points and get a clear picture of what was happening in the screw. Actual experiments in an extruder, with dispersion quality measured by screen pack dispersion values, seemed to corroborate the modelling results, the scientists reported.

Quantisweb, from **Quantisweb Technologies**, is an adaptive, expert-driven stochastic approximation optimisation (SAO) software system that automates the process of creating a model and generating a production recipe.

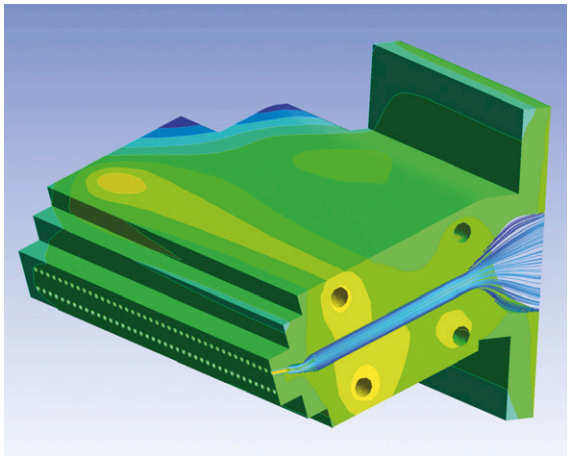
"A veteran employee can go into a lab and get good answers based on their vast experience. A new hire, however, has to either develop that experience over time or be taught by the veterans. The software bridges that skills gap by taking the art and turning it into knowledge that can be reused and refined," says Gilles Gagnon, President and CEO of Quantisweb.

This skills gap is a is a universal problem in maturing industries such as plastics, says Bill Blasius, who is the "Voice of the Customer" advisor to Quantisweb. He says the software's predictive analytics can use legacy data to create new knowledge and build models so veterans can "train forward."

Seeking patterns

SAO uses a mathematical approach to find patterns. "You start with the specifications for a product, a range for those specifications, and their relative importance, along with a list of ingredients and process variables. Quantisweb then generates a minimal dynamic design of experiments (mdDOE)," says Gagnon. If a process has 18 variables, for example, a mdDOE would require 19 experiments while a traditional DOE would require hundreds (Figure 5).

"You go to the lab and run these experiments, then put that data into the software. The SAO part of the software finds the patterns and creates a behavioral model. Another part of the software finds the optimal formulation and process variables using this model and the original specifications. You then go back to the lab with these optimal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Right: FEM analysis can help optimise the thermal profile in the die head, enabling more uniform pellets

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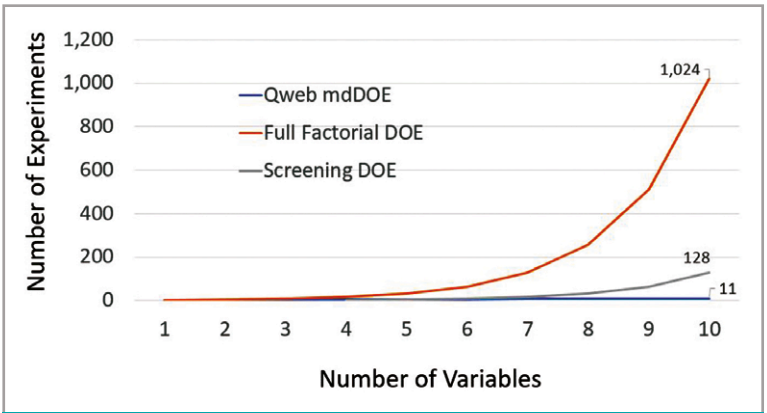

Stochastic approximation optimisation tools in Quantisweb allows DoE programmes to be minimalised, saving time and work
Image: Quantisweb technologies

conditions and validate. If it isn't what you want, you can use this new data to iterate and get a better model," he explains.

Gagnon says the software can also use data from past experiments or manufacturing data to create or optimise a model. In a sense, Quantisweb is doing what Industry 4.0 is aiming for, says Gagnon –employing a cloud-based system that uses data to improve industrial processes.

Quantisweb currently uses its software as a tool for its consulting services and the company has been doing a lot of work in plastics compounding, says Gagnon. It defines a model for each project using the customer's own data. "The software applies to the entire project management lifecycle of plastics compounding. In discovery of a brand new product, we can identify optimal ingredients. In formulation, we can add processing variables to the ingredient variables to see what can actually be manufactured. The software helps with production scaleup, and it can be used to optimize an existing process," he says.

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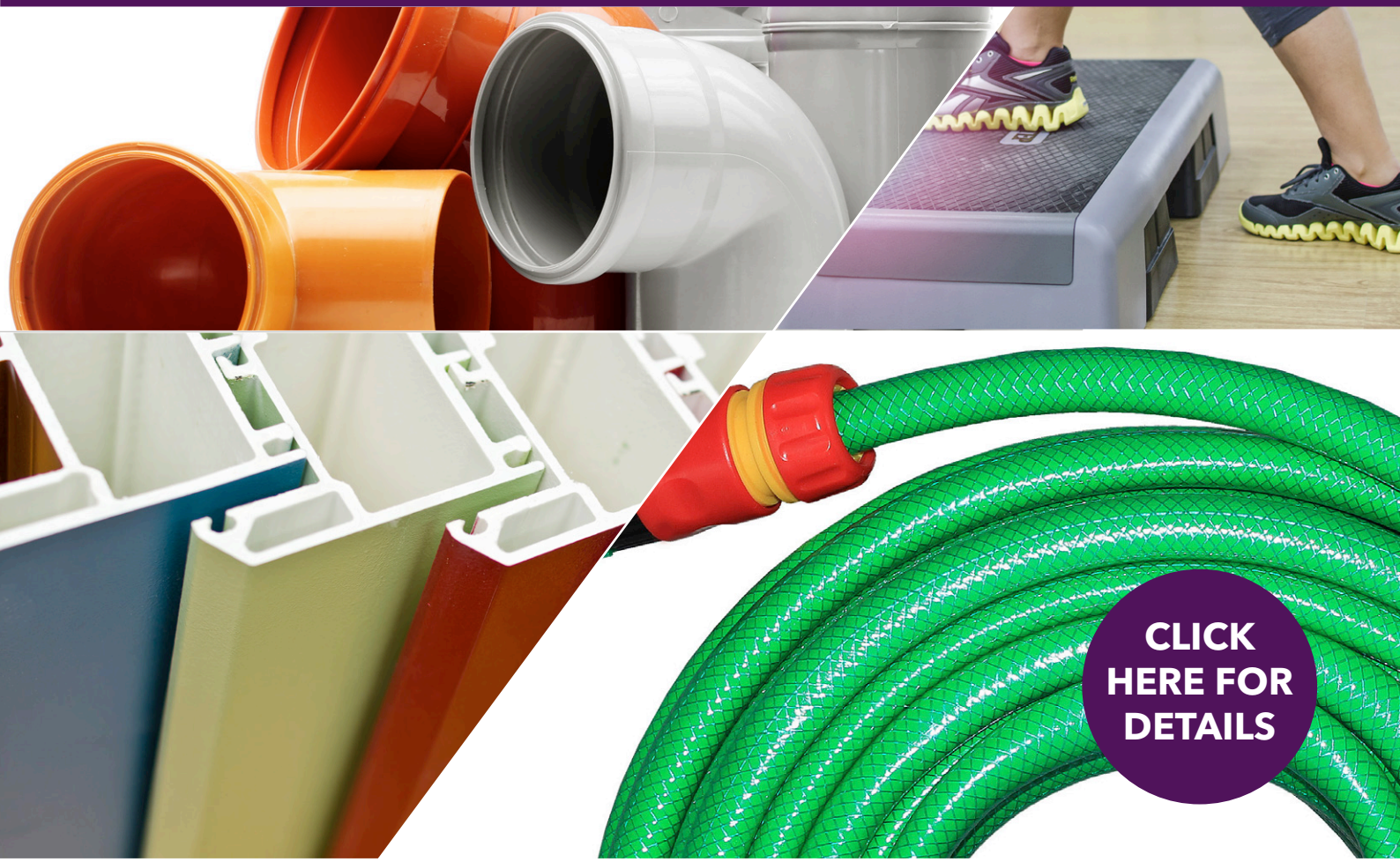

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Natural fibre suppliers see opportunity in compounds

The latest developments in natural fibres and sizing systems are opening up opportunities for weight saving compounds while meeting manufacturers' renewable sourcing goals. Peter Mapleston finds out more

Natural fibres have been used in thermoplastics at some level for decades. Wood is the most commonly used, typically in wood-plastic composites (WPCs) employed in applications such as decking and other construction products in place of "real" wood. However, the technologies in and around natural fibres are moving fast and all sorts of natural fibre-based additives are now being developed and modified for use in thermoplastics - and for all sorts of reasons. Sometimes they are intended for use in place of glass fibres or mineral fillers, sometimes entirely on their own merit. Either way, the effect is to expand the whole market.

As, particularly in Europe, industry moves towards a circular economy, a great deal of attention is being placed on wood fibre – but not wood fibre as we know it today. "Compounding is a key process in the production of biocomposites from agro-industrial residues," says Gary Chinga Carrasco, Lead Scientist, Biocomposites at **RISE PFI**, the Norwegian research institute devoted to processes and products based on lignocellulose.

RISE is currently heavily involved in the European/Latin American ValBio-3D project. "Valorisation of agro-industrial residues is an important research area in the ValBio-3D project, which has the aim of developing efficient technologies for production of sustainable bio-compounds," says Chinga Carrasco.

ValBio-3D was established through close

Main image: Car maker Ford has been evaluating use of bamboo fibres in vehicle interior plastics at its Nanjing technical centre in China

PHOTO: GARY CHINGA CARRASCO, RISE PFI

Above: Granules and test bars made of bioplastic and lignocellulosic fibres at Norway's RISE PFI research institute

cooperation between research institutions and industry in Europe and Latin America and includes partners from Argentina (IMAM Institute of Materials in Misiones), Chile (UFRO University of La Frontera), Finland (VTT Technical Research Centre), Germany (Fraunhofer WKI Institute for Wood Research), and Peru (PUCP Catholic University), as well as RISE PFI.

The project is following two main routes: production of nanocellulose for biomedical applications and production of 100% biocomposite materials based primarily on bio-based thermoplastics and cellulose fibres. The biocomposite materials will be produced by compounding processes and by in-situ-polyesterification, where the polymer itself is polymerised directly onto the fibre surface. "A major novelty of this approach is that the chemical bonding between the reinforcing fibres and the bioplastic does not require any additional coupling agent and will strengthen the material," says Claudi Schirp, Project Manager, Biopolymer Synthesis, at **Fraunhofer WKI**.

Modification of fibres prior to compounding with bioplastics also improves the bonding between the two phases. "We have recently demonstrated that an environmentally-friendly enzymatic-assisted modification of lignocellulosic fibres with hydrophobic compounds improves the compatibility of the fibres with the hydrophobic biopolymers, thus reducing also the water uptake," Chinga Carrasco says. "This is addressing a major challenge of cellulosic fibres: the fibres are hygroscopic and absorb water. This characteristic can be a challenge for compounding processes, as well as for the final product where the dimensional stability is a major requirement as is the case in automotive parts."

Chinga Carrasco says that, in addition to bio-compounds for injection moulding, ValBio-3D will produce novel thermoplastic filaments for 3D printing. "3D printed objects are commonly weaker than the corresponding injection moulded products."

"The biopolymers reinforced with fibres will contribute to 3D print complex structures with appropriate mechanical properties. Biocomposites offer also the potential of cost-reduction, as the lignocellulosic fibres are cheaper than the biopolymer, but this also depends on [using] the appropriate compounding equipment," he explains. "We expect that this biocomposite material can be used to mimic woody products, but also in new complex geometries, individually designed by the consumer."

At Canada-based **Performance BioFilaments**, Business Development Director Geoffrey Fisher says the company sees natural fibres as "a promising avenue for compounders to grow their businesses and increase revenues via new and improved offerings that make a difference for the environment, significantly enhance material properties, and address key mark et trends and customer requests."

Nanostructured options

"With the launch of Performance BioFilaments' nanostructured cellulose fibrils (NFCs), compounders can take advantage of a highly renewable, biodegradable, and recyclable biomaterial that enhances mechanical, physical, thermal, and dimensional properties of engineering thermoplastics," Fisher says.

NFCs have already been demonstrated to enhance the material properties of PP and PA and, says Fisher, "will soon be shown to improve ABS as well as other engineering thermoplastics, for automotive, marine, rail, sports equipment, personal electronics, home appliances, and specialty applications."

A new entry into the market is **Attis Innovations**, which has a portfolio of bio-based polymers and resin extenders, as well as fillers. The company has just announced a strategic partnership with **Genarex**, which it says will allow it "to service customers with a versatile array of materials which bring value and cost savings to a host of applica-

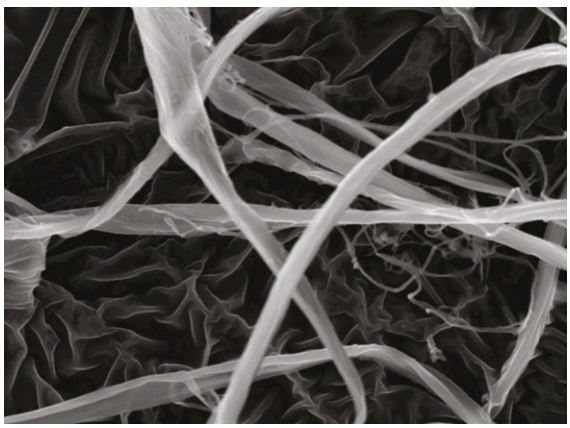

PHOTO: PERFORMANCE BIOFILAMENTS/FP INNOVATIONS

Right: Nanostructured cellulose fibrils are claimed to enhance the mechanical, physical, thermal, and dimensional properties of PP and PA compounds

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tions." Genarex developed Bylox bio-fillers based on components from industrial corn waste streams.

"Attis Innovations' primary product for the plastics space is a unique, melt-flowable lignin which is a bio-additive that brings unparalleled cost savings and performance to common resin systems," says Bob Montgomery, VP of Sales and Product Development at Genarex. "Attis employs a proprietary extraction process that enables the cost-effective separation of lignin from virtually any form of biomass. Once extracted, the lignin can be compounded with traditional resin systems or new bioplastic materials to cost dilute the finished formulation, increase sustainability and maintain performance."

Lignin compatibility

According to Montgomery, Attis's lignin has already shown very good compatibility with polyolefins such as HDPE and PP. Products moulded in compounds containing 15-25% lignin exhibited 100% retention in tensile modulus and impact strength as well as 90% of the tensile strength compared to the neat polymer, he says. The compounds also yield parts with high gloss and uniform surface, and can fill long flow-length parts and complex geometries.

The Bylox bio-fillers complement the Attis lignin bio-additive. "The Bylox suite of products differ greatly from existing bio-filler options in that the material is primarily protein-based and thus offer superior ductility and particle size," says Montgomery. "Bylox LT has shown great success with many film applications, including agricultural mulch film and yard and pet waste bags. Bylox HT is a more thermally stable product that is capable of processing in conjunction with higher temperature products without creating anisotropic shrinkage issues or significant loss of mechanical properties. Bylox Clean is an outstanding product with lower base colour and odour, and in addition to working in films has shown the ability to substitute some plasticiser used in the production of flexible PVC for a significant cost reduction."

Sappi, a leading global provider of sustainable wood fibre products and solutions with headquarters in South Africa, recently initiated a project called Sappi Symbio to investigate the use of cellulose as a reinforcement in plastics. "During the last year, market interest in Sappi Symbio cellulose fibre-reinforced polypropylene increased a lot. We are running numerous commercial trials for a diversity of injection moulding applications. The focus is mainly on furniture, appliances, consumer electronics and automotive but we are running trials in other segments as well," says Jacob Hartstra, New Business Development Manager at Sappi Europe.

Sappi Symbio has several selling points that make it an interesting material for such applications, Hartstra says. "For automotive the low density and high rigidity are obvious ones, but these are not the only and often not the most important drivers," he says. "It is especially the more natural matt look, the soft and warm touch, and the fact it sounds less like a plastic that elicit a very positive response from the market."

The compounds also have scratch resistance

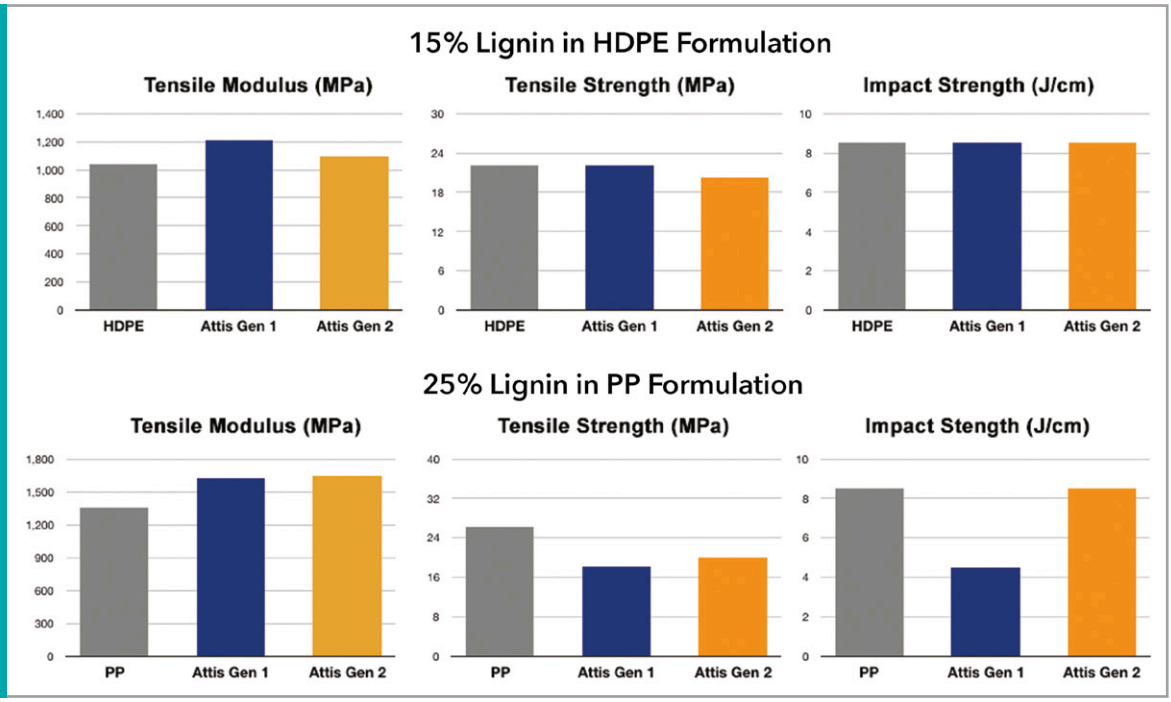

Figure 1: Charts showing the effect of Attis lignin reinforcement on properties of HDPE and PP. The Generation 2 lignin uses a newly developed compatibiliser system

Source: Attis Innovations

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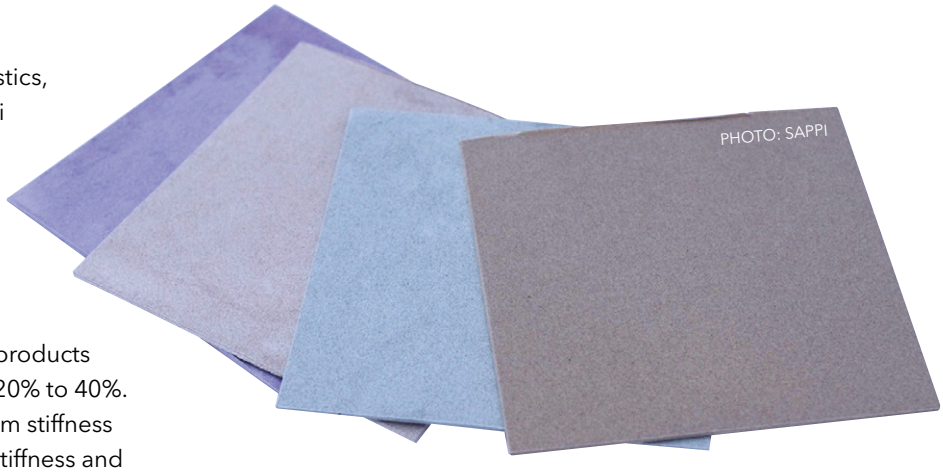

Above: Sappi's Symbio Vivid cellulose reinforcement combines good mechanical properties with a novel and customisable appearance

superior to that of typical talc-filled plastics, Hartstra claims, while adding that Sappi Symbio does not suffer from the typical natural fibre composites smell. "And the fibres are very well dispersed and not visible, giving a lot of design freedom when colouring an application," he says.

The company now has a portfolio of products with reinforcement levels ranging from 20% to 40%. "There are grades that focus on maximum stiffness and there are grades that have a good stiffness and impact balance," Hartstra says. "As we are producing the cellulose fibres ourselves and as we developed a technology that results in the perfect distribution of cellulose fibres in a plastic matrix, we recently also started to supply a concentrate with 50% of cellulose fibres in polypropylene. Commercial trials are running where compounders for example dilute our concentrate material and mix it with glass fibre, additives and their polypropylene of choice."

Last year, the company established its first production capacity via an external partner. It claims to now have an annual capacity of "several thousand tonnes." One of its most recent developments is Sappi Symbio Vivid. This has the same mechanical properties as the original, but adds a novel and customisable appearance to the formulation. "It gives brand owners the opportunity to design attractive and unique looking applications with a colourful yet natural look. Although still in development the material is received very well by the market," Hartstra says.

According to German bio-based technology research outfit **Nova-Institute**, more than 30 companies produced over 80,000 tonnes of plastics filled or reinforced with wood and natural fibres in

PHOTO: PETER MAPLESTON

Right: Samples cut from rotomouldings showing the unusual finish of Beologic compounds containing denim fibres (left) and cork

Europe last year. "There are many reasons to fill or reinforce plastics with wood or natural fibres of all kinds," says Michael Carus, Nova-Institute Managing. "Especially in household goods, consumer goods and toys, attributes like optics, haptics and a green image are important considerations. Weight savings, shorter cycle times, scratch resistance and a lower CO_2 footprint play a crucial role in technical applications and in the automotive industry. And in combination with biodegradable plastics, products are also manufactured for agriculture and horticulture as well as for special applications such as filter balls and coffee capsules."

Nova-Institute puts Portuguese company **Amorim** top of the list of producers with its cork granulates, which are used in applications as diverse as shoe soles and aerospace structures (these products are close to 100% cork, however, with plastics being used as binders). Many producers currently have production levels measured in a few hundred tonnes/yr, although Carus says some thm have substantial growth plans. On the other hand, some players have withdrawn from the market, while others have cut back on previously announced plans for future investment.

...Compound diversity

Second on the Nova-Institute list is Belgian company **Beologic**. Its Project & Sales Manager Alex Beyls speaks about a new type of compound containing natural fibres, for which he has coined the term "Emotional Fibre Composites." Currently processable by rotomoulding or injection moulding, these composites use natural fibres from waste streams involving products such as denim, leather goods and cork. First shown at the Fakuma fair at Friedrichshafen, Germany, last year, the compounds create unexpected sensations in those who handle the finished products, according to Beyls. "We are moving away here from the use of fibres to modify mechanical properties and exploiting their aesthetic properties," he says.

The compounds contain relatively small amounts of fibre (10-15%), so any alteration in mechanical properties is marginal. Part shrinkage is also largely unaffected, so it should be possible to work with existing injection moulding tooling originally designed for use with unfilled material. Beologic is also considering production of more heavily loaded masterbatches.

Touch and feel

The touch and feel effect is not achieved direct from the mould – the moulded parts have to be abraded slightly to expose the fibres behind the resin-rich surface. This adds to the total production cost, but Beyls believes users in its intended markets will be willing to pay more for what he recognises will be premium niche products. "These will not be commodities," he says, adding that the first commercial products could be up-market rotomoulded flower pots with a denim-like surface.

Beyls says Beologic is only at the beginning of the development of the new compounds, and he expects other types of fibre to be used in future in addition to those already being trialled. He says flax may also be used, since the fibres not only provide interesting surface qualities but also have a particularly pleasing scent that adds to the experience. Production of the compounds is not easy, however, with fibres from different sources – even the same type of fibre – often behaving in different ways. "Fibre purity is critical, and control of the fibre milling process is very important," he says.

Beologic intends to offer the new compounds based on various types of thermoplastic. The fibres are thermally sensitive, though, so suitable matrix candidates must have processing temperatures below 210°C.

Aqvacomp, which produces cellulose fibre reinforced thermoplastic composites, sits a little further down the Nova-Institute list. It could be moving up soon, though, as it has opened what it says is the world's first integrated biocomposite plant at Rauma, in Finland. Aqvacomp has licensed a patented wet web technology from Elastopoli that enables the use of wet pulp as a raw material directly from a pulp plant operated by Metsä Fibre,

PHOTO: LG

Right: LG's SJ9 Soundbar incorporates a paper-pulp based acoustic biocomposite from Aqvacomp

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PHOTO: APM

Right: Close-up of a part injection moulded in NAFILean by Faurecia JV operation APM

a leading producer of bioproducts and bioenergy. "In the first phase Aqvacomp will increase the Rauma plant capacity to 5,000 tonnes/yr [over] a few years, matching the increasing demand of the market," says Managing Director Jari Haapanen.

The raw material (cellulose fibres) is pumped directly through a pipeline to its biocomposite process. "Aqvacomp is working closely together with [the] automotive and home electronics sector in product development where the focus is on application-driven tailored solutions to Aqvacomp customers," Haapanen says. "The latest collaboration has been the development of an acoustic composite for LG's SJ9 Soundbar."

Not just for newbies

Compounding with bio-fillers is not just for companies specialising in the bio-based sector. Several mainstream compounders also have offerings. **PolyOne**, for example, says that since introduction in 2016, its reSound NF materials "have inspired the testing of new designs at manufacturers of automotive components, furniture, consumer and sporting goods, packaging, and others."

According to Jean-Paul Scheepens, Global Director of Product Management, Specialty Engineered Materials, the interest across so many diverse industries stems from the material's novel mix of performance and aesthetics. "We introduced reSound NF solutions as a drop-in replacement for glass fibre reinforced polypropylene, at a lower density and with comparable or improved properties," he says. "That balance grabbed the attention of manufacturers in weight-sensitive industries such as transportation. But the attractive graining and aesthetics of parts moulded with reSound NF, coupled with our ability to supply reSound NF in a range of appealing earth tones, helped interest spread well beyond the transportation industry."

Scheepens says many natural fibre reinforced compounds have had issues that hampered their use in commercial applications: water absorption (and a corresponding drop in mechanical performance), odour and mould growth being among them. "PolyOne has been able to overcome these challenges for reSound NF," he claims. "Moisture absorption testing of reSound NF grades with 40% fibre content revealed that tensile bars moulded of the material absorb less than 0.5% moisture when saturated in water for 300 hours of testing. Perhaps more importantly, this low level of absorption has a negligible effect on mechanical properties such as tensile elongation, density, shrinkage, and notched impact strength."

Fogging and odour are not issues with reSound NF either, the supplier points out. Tests results for reSound NF at 40% levels of fibre loading are below those for fogging of 30% glass fibre reinforced PP, the company claims, and results with reSound NF at 30% fibre loading are comparable to 30% GFR-PP for both fogging and odour. The material also performs well in two-component mouldings, showing high adhesion to compatible thermoplastic elastomers.

Automotive on a cusp

Whatever the interest in such materials beyond transport, it is certain that if automotive OEMs can be convinced to use them the volumes could be

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Above: NAFIlean, from Faurecia and Interval JV APM, is used in the instrument panel of Alfa Romeo's flagship saloon, the Giulia

considerable. Many OEMs have investigated natural fibre reinforced thermoplastic compounds, and continue to do so. Ford, for example, has recently been playing up the possibilities for bamboo in various interior components.

Last year, the car maker said some surfaces inside its vehicles could soon be made from a combination of bamboo and plastic "to create super hard material." Janet Yin, a materials engineering supervisor at Ford's Nanjing Research & Engineering Centre, points out that bamboo is "strong, flexible, totally renewable, and plentiful in China and many other parts of Asia."

One major Tier One, **Faurecia**, has put considerable development effort into the area of natural fibre reinforced compounds. In 2014, it created the Automotive Performance Materials (APM) bio-materials development and production company in a joint venture with Interval, a major French agricultural cooperative. Pierre Demortain, Faurecia Interior Systems Joint Venture General Manager at APM, says things now accelerating in this area.

"The need for performing lightweight solutions is more than ever required to lower vehicle emissions or increase electric vehicle autonomy and this is exactly where APM, with its unique business model gathering the complete hemp natural fibres value chain, is proposing solutions with recent new successes," he says. "Indeed, the NAFILean material launched in 2013 is now fully deployed at industrial and commercial level to propose a mature 20% hemp fibre filled polypropylene grade for automotive interiors and "plug & play" implementation in instrument dashboards, door panels or centre console non-visible structural parts, mastering the demanding heat ageing, stiffness/impact balance and odours specs, together with the processing on standard injection machines."

Demortain says six major OEM producers of high-volume and premium cars are now trusting complete interior system concepts in natural fibre-based materials and that these are pre-validated in thin-wall design and CAE correlated to deliver considerable weight savings. "This results in a now-confirmed 15 to 25% weight reduction versus traditional PP or styrenics market references, most of the time brought at equal cost or even with savings," he says. Currently, 12 vehicles contain parts made with NAFILean compounds.

APM has also developed NAFILite, a micro-cellular foamed version of NAFILean, capable of delivering weight savings of up to 35%. The unit currently has production based in France from where it exports to customers in Europe and Asia.

Natural sizing

Christina May is Market Development Manager at **Michelman**, which specialises in the development of polymers, additives and modifiers for fibre sizing, which increases fibre-matrix bond strength. "The use of natural fibres in the production of thermoplastic compounds is an area of great interest here at Michelman," she says.

Michelman chemists have focused their efforts on the sizing of kenaf, hemp, flax, and bamboo. The company is currently testing and evaluating sizing solutions. "We are developing sizing solutions that will optimise their performance in both polypropylene and nylon reinforced composites," says May. "While sizing comprises a relatively small percentage of the total composite recipe, its impact on composite performance is substantial."

The company is also exploring 3D printing and testing is ongoing into surface treatments for bio-based fibres to make them compatible with the bio-based polymers. Michelman is also working on creating biopolymer dispersions, with the ultimate goal of creating a 100% bio derived composite. "Over the next 12-18 months, we expect to validate a number of key concepts, and will pursue commercialisation thereafter," says May.

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From automotive to electronics and packaging, applications for special effect pigments are on the increase. However, Mark Holmes finds that performance is as important as appearance

The use of special effects in plastics is growing and pigment manufacturers are responding with new designs and improvements in performance to meet rising demand. New applications for special effects are emerging in automotive, construction, consumer electronics and packaging, with the desire to establish strong brand identity and to create more "individualised" plastic products both presenting solid growth opportunities. However, as well as looking good, today's effect pigments must also perform well in processing and within the compound.

Merck supplies special effect pigments to a diverse range of industries, which all have their own individual trends, according to Dr Marc Hunger, Global Marketing Director Industrial Pigments, Performance Materials. However, while colour and effect trends drive new product and range developments, the need to add functionality to colour is also increasing. "Electro-mobility and requests for individualisation are driving changes in the market," he says. "Car manufacturers are trying to save weight, while individualisation may change developmental directions. Indeed, car interior colours and effects might get more important than the exterior, and we are seeing increasing requests for flexible solutions to change colour and design to offer individualisation. For example, for highly flexible changes in design and colour, we have developed our IM3D technology [in-mould 3D)] where it is possible to create a 3D visual in plastic parts. In addition, in order to save weight, there is an increasing demand for mass colouration of plastics rather than using coatings."

Introduced back in 2016, the patented IM3D technology works using an overmoulding process that transfers a pattern in the mould surface to a preform/film containing pearl effect pigments. Overmoulding with a transparent resin creates a flat-faced part with an accentuated depth and rich appearance.

More metallics

Hunger cites another example from the automotive industry. "In order to meet customer requests for more metallic-like effects, we have just introduced Xirallic effect pigments for plastic applications," he says. "The move towards mass coloured plastic parts for automotive, as well as interior and exterior architectural applications, requires additional chemical and UV stability. Merck has developed a functional ceramic-like stabilisation of the pigments to withstand the temperature of the extrusion [and injection moulding] process. This WAY (weathering and anti-yellowing) technology is an enabler for

Main image: PolyOne's OnColor Brilliant Metallic masterbatches use coating-grade pigments to mimic painted metallic finishes

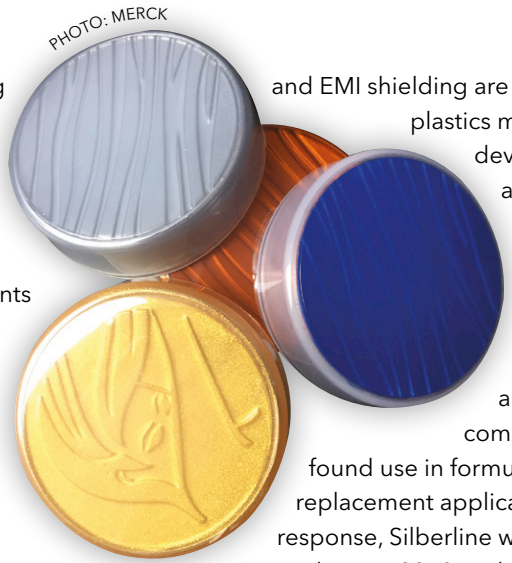

PHOTO: MERCK

Right: Merck's IM3D processing technology allows 3D effects to be created in pearl effect surfaces during injection moulding

these applications by reducing the photo-activity of our effect pigments to almost zero, which is crucial for keeping the polymer matrix stable for long term outdoor exposure. Xirallic effect pigments can also provide a unique appearance for high value products in consumer electronics and cosmetics packaging."

Merck says it has established an automotive platform within the company to be able to bundle its core competences and offer its services and solutions at different points of the value chain. Hunger adds that future trends include the growing influence of digitalisation and manufacturers of colour and effect pigments will need to monitor and react to how this will affect the needs of its customers. The way pigments are processed in the future will also continue to change and manufacturers will need to follow these trends – additive manufacturing, bioplastics, composite and lightweight materials are current examples.

Reflecting change

The need for fine, bright effects within the automotive and appliance markets for numerous mould-in-colour and paint replacement efforts has also been recognized at **Silberline**. "There is a continuous call for highly reflective materials and we are providing effect pigments to meet these requirements," says Jon Kirsch, North American Plastics Executive Sales Manager. "However, we continue to face technical challenges with flow and weld line appearance and each finished part requires a unique solution. While silver appearance has been an ongoing focus, we see an increased need for functional value. Opacity, reflectivity, laser marking and EMI shielding are additional needs for the plastics market. We are continuing to develop and promote value-addition of aluminium pigments for all markets."

Below: Silberline is introducing its Sparkle Silver Elite Liquid Metal and Sparkle Silver Ultra Liquid Metal line for plastics this year

PHOTO: SILBERLINE

In late 2017, Silberline introduced several developmental products to achieve a brilliant, smooth appearance in plastics. The company says that each product found use in formulations that target paint replacement applications. Based on the market response, Silberline will fully commercialise these products in 2018 under the Sparkle Silver Elite Liquid Metal and Sparkle Silver Ultra Liquid Metal line for plastics. "Our Sparkle Silver Elite and Ultra Liquid Metal offerings provide a unique appearance due to high-aspect ratio of the finished flake," Kirsch says. "This feature, coupled with a high-polish surface, results in a smooth, brilliant finish in the final part."

Eckart has recently introduced a range of novel synthetic pearlescent pigments – Edelstein (which refers to the German term for jewel). This new pigment class is based on premium layered silicates. The company says Edelstein pearlescents can be used in conjunction with many existing Eckart products – including its Luxan, Platalux or Symic effect pigments – as well as with absorption pigments to create eye-catching visual effects. It says Edelstein adds intensive colour to the velvety-shimmering and sparkling look.

According to Eckart, Edelstein Ruby Red provides exceptional optical appearance due to its intensive, high-chromatic red combined with powerful sparkle and gloss. The pigment is said to be suitable for plastic colouring applications ranging from consumer electronics, sports and leisure to household and home appliances. It is claimed to open up new possibilities for individual product design and innovative packaging solutions - particularly in high-gloss applications.

Eckart says that this new product category offers good shear stability during processing and is easy to incorporate in all common applications. Edelstein Ruby Red is suitable for use in polyolefins and PVC, as well as engineering resins such as polycarbonate, styrenics, acrylics and polyamides.

Due for launch next month, Netherlands-based **Geotech** is adding six new special effect pigments to its Geopearl Crystal and Geodiamond product ranges. The new Geopearl Crystal Soft products feature a particle size distribution of 1–15 microns and are coated with iron oxide and titanium

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Right: Edelstein Ruby Red from Eckart employs a high-chromatic red pigment with powerful sparkle and gloss

PHOTO: ECKART

dioxide. The company says the new products provide high coverage in chromatic earth tone effects in shades of beige, bronze, copper, golden copper and russet.

Geotech will also launch a high-chromatic intense red pigment in the 10–60 microns particle size range, which it says is unlike previous alternatives. The company says its combination of a synthetic mica-based pigment coated with high concentrations of iron oxide provides good reflectivity and extreme colour intensity. Its iron oxide coating makes it is an interesting alternative to carmine-coated pigments, the company claims.

Geotech also says that its borosilicate-based Geodiamond range will be extended with an XL grade offering a particle size distribution of 100-500 microns. The new addition will provide high reflective glittering effects in interference colours. The company says with demand for sparkling and glittering effects increasing, the Geodiamond XL range will be presented as an alternative to polyester-based glitter flake.

The company says the new product introductions will be accompanied with the launch of an inspiration box for plastic applications. This contains a selection of plastic samples containing the new special effect pigments. The samples contain 1% special effect pigment, some in combination with 1% coloured masterbatch, moulded in clear polypropylene. The masterbatch colours used include black and translucent red.

Right: Geotech is adding six new special effect pigments to its product range this year

Natural effects

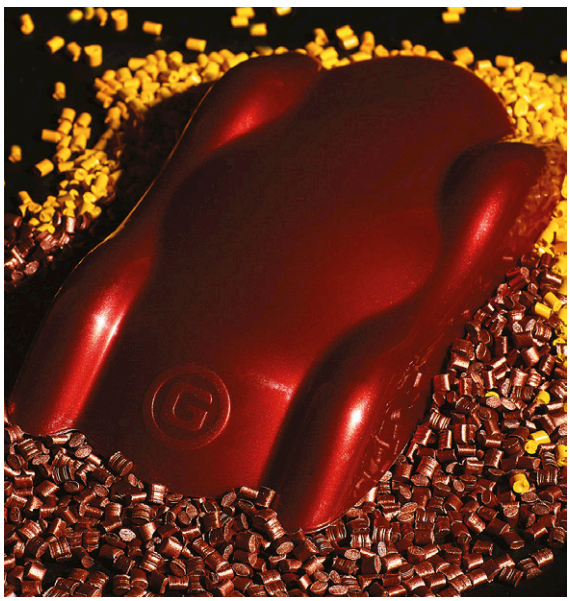
Gabriel-Chemie sees a clear trend in special effects for use in individualised packaging. "As well as laser marking, a high degree of individualisation can be achieved by marble effects in plastics," says Mark Hannah, Marketing Director at the masterbatch producer. "Our Competence Center started three years ago with trials of two or more colour combinations. With significant customer interest, we decided to develop more marble effects and named the range Perfect Imperfection. This was inspired by shapes and structures formed over time in nature. We have developed previously unachieved effects in plastics, such as marble veins, wood grains, oxidation processes and stone surfaces. Perfect Imperfection represents provoked individuality, controlled randomness and an imaginative range of colours."

The company adds that modern injection moulding machines generally require good homogenisation between polymer and pigment to achieve as smooth as possible optical appearance. However, this homogenisation must be avoided in order to achieve a marble effect, which requires precise processing parameters. Gabriel-Chemie says it has developed a range of marble effect masterbatches that can make each moulded item individual and unique.

Complex combinations

"Every polymer type needs special development to find the correct combination of raw materials to achieve the marble effect," says Nicole Ziegler, Media Relations and Marketing Manager at Gabriel Chemie. "The effect masterbatch may consist of up to ten colours and combinations can be custom-made. However, particular attention has to be focused on the processing parameters, which our Competence Center can advise on."

The development of the marble effect started with trials in polypropylene, followed by polyethylene. "Marble effects can now be successfully achieved in injection moulding with both., she says. "We are currently running trials for extrusion applications, such as pipes, film and sheet, and



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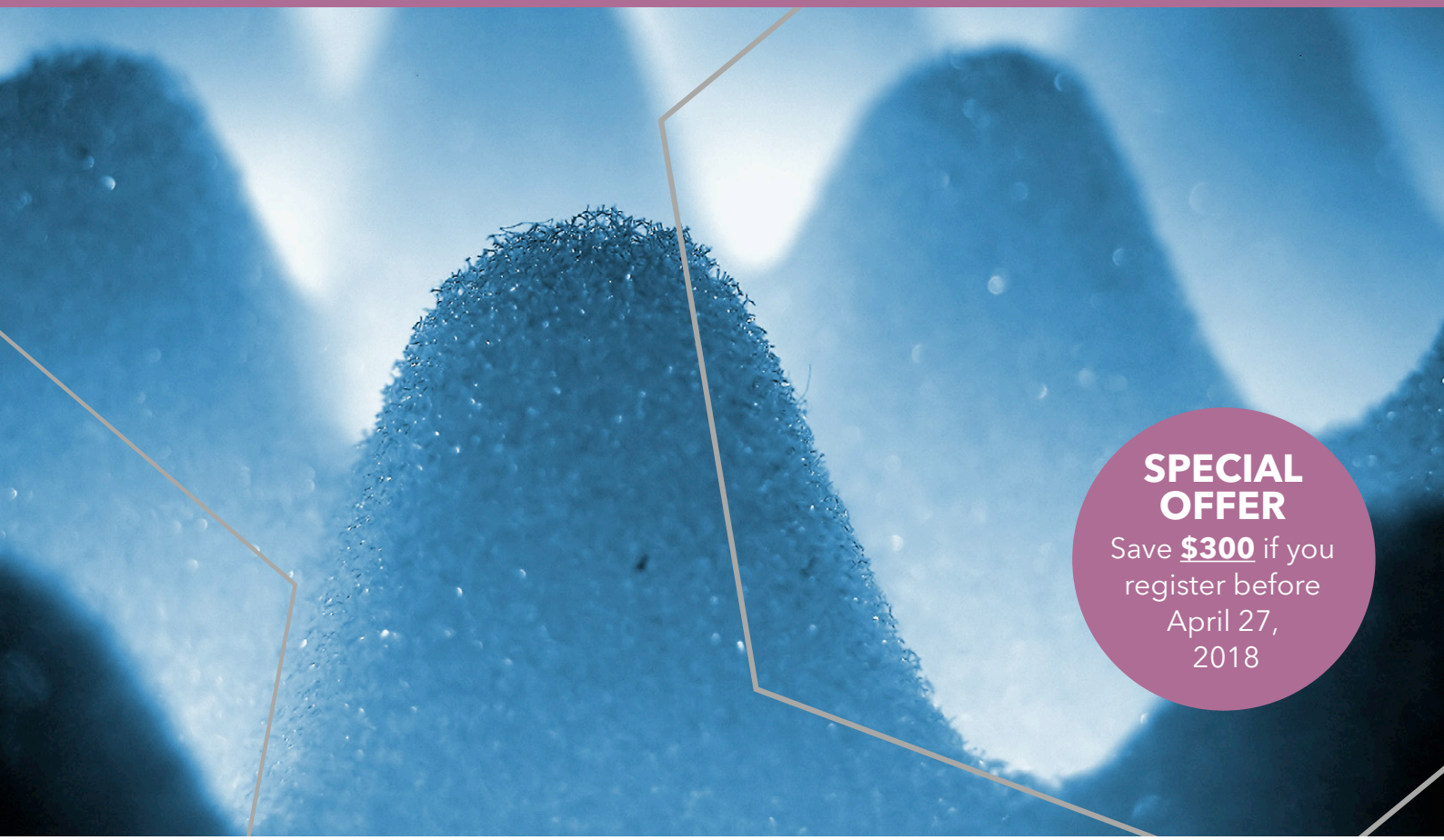

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PHOTO: GABRIEL-CHEMIE

Right: This spinner toy was 3D printed by Herz using a metallic effect PETG filament developed with Gabriel-Chemie and Schlenk

blown bottles. We have also recently developed an ABS with marble effect for a limited range of lip stick containers for a French cosmetics manufacturer."

Gabriel-Chemie can also create other special effects in plastics, for example metallic gloss. Ultra-fine pigments can be used to form silky, homogeneous high gloss surfaces on plastic objects through mass colouration, potentially avoiding costly additional process stages such as metallisation. The company says its Competence Center is also available to help in development of other effects, such as thermosensitive, UV-sensitive, sparkling and cool plastics, as well as haptic effects.

An example of a recent collaboration is development of 3D printing filaments with **Schlenk Metallic Pigments** and filament producer Herz. The masterbatch formulas developed by Gabriel Chemie use ultra-fine pigments from Schlenk to create a silky, homogeneous surface on the filament that is free from visible glitter particles. The companies say the end product has a deep shine with an authentic metallic look. Best results are achieved with a PETG matrix polymer, which is noted for its particularly high degree of transparency and low viscosity. As a 3D printing filament, it is said to combine the positive properties of ABS and PLA.

The PETG metallic filament range currently consists of five colours: Ocean Blue Metallic Gloss, Calm Red Metallic Gloss, Gunmetal Black Metallic Gloss, Brown Metallic Gloss and Fir Tree Metallic Gloss. Further colours are being developed and custom-made colours are available on request. All are claimed to provide brilliance and depth. They also offer good temperature stability, so can be processed at up to 240°C.

Below: Gabriel-Chemie sees its Perfect Imperfection marble effects finding application in mass individualisation production


PHOTO: GABRIEL-CHEMIE

Paint replacement

PolyOne recently introduced its OnColor Brilliant Metallic colourants, a new line of special effect masterbatches that are intended to meet the need for a premium surface finish in paint replacement applications. "Our customers across multiple industries have been looking for a paint-free solution with no trade-offs, which drove us to develop this new masterbatch," says Rob Bindner, Americas Vice President and General Manager, Color and Additives for PolyOne. "It is a cost-effective option for paint replacement on polymer parts and creates an exceptional metallic colour that continues through the part's thickness. When moulded into plastic parts, manufacturers can eliminate painting and its associated processing steps for lower cost and longer-lasting, highly reflective surfaces."

The company adds these newest members of PolyOne's portfolio of OnColor FX special effects rely on coating-grade pigments. The shape and size of these pigment particles enable the metallic shades to replicate the appearance of paint and may even help customers to replace metal or plated parts with plastics. Standard shades include Brilliant Rose Gold, Brilliant Ice Blue, Brilliant Silver and Brilliant Gun Metal, but virtually any hue can be customised for specific applications, PolyOne says.

The new OnColor Brilliant Metallic colourants are said to provide the desired metallic effect in almost any thermoplastic. The new colourants are claimed to provide a significantly brighter sheen on parts than was possible with the metallic-look colourants that have been developed over the past decade, PolyOne says.

The company sees numerous potential applications, such as automotive components, luxury caps/closures, appliances, consumer goods, and premium cosmetics packaging where injection moulded plastic parts are painted in a secondary step. It says benefits include a reduction in manufacturing cost of up to 30% of total part cost, along with reduced logistics due to the elimination of ordering and storing paint consumables. In addition, because the moulded-in colour infuses the entire part all the way through, scratches are not as visible compared with a painted surface, according to PolyOne.

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Polymer firms take their seat next to designers

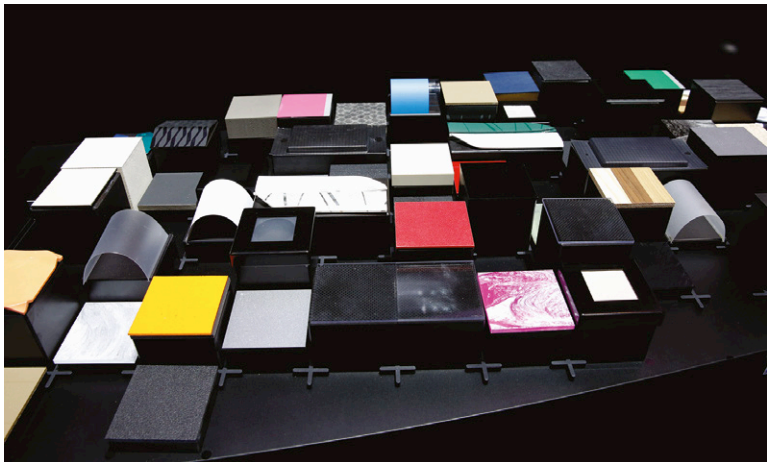
*Polymer producers and compounders are finding ways to collaborate with hard-to-reach designers who are influential in furniture and consumer products. **David Eldridge** surveys their work*

Polymer materials companies have been working more closely with product designers in recent years as they have come to appreciate the role designers play in the development of new plastic products. Old assumptions that industrial designers are only involved in the aesthetics of a new product have been replaced by recognition that they can be influential in many stages of a plastic product's genesis: concept, user research, design iteration, material selection, design-for-manufacturing, toolmaking, production and sometimes the product's launch. Various polymer producers, compounders and colour masterbatch suppliers are now more active in their engagement with designers and using their collaboration as a showcase for their materials.

Product designers can be hard to reach. The majority of independent firms are staffed with no more than ten people, and even the largest firms employ only 75-150 people. It is no easier to initiate contact with design teams in multinational groups, as their work is kept tightly under wraps by brand owners for reasons of confidentiality. Nonetheless, plastics exhibitions such as the K and Fakuma fairs can lure designers from their studios as they search out the latest developments in materials and injection moulding for a specific design project or to provide inspiration to fuel new design ideas. **Covestro** used its stand at Fakuma 2017 as a platform for communicating with potential project partners, including designers. The group had a Sample Bar on its stand at which visitors could see and touch hundreds of samples displaying the variety of colours, effects and surfaces of its wide range of polycarbonates, polyurethanes and other materials.

Explaining the importance of two-way dialogue with designers, Covestro said: "Designers play an important role on the road to a marketable product. They capture ideas and make the components both

Main image: The frame structure and seat shell of the Belleville chair from Vitra are gas injection moulded using BASF Ultramid B3EG6 SI polyamide



Above: Covestro featured a Sample Bar on its stand at Fakuma 2017

functional and aesthetically pleasing. In many sectors, it is the designers who ultimately decide on the material. Covestro is therefore expanding its dialogue with designers and providing them with information about its products, while at the same time learning more about their needs in return. As a supplement to the Sample Bar, the company has developed a Sample app to support designers in making their visions a reality. The award-winning Covestro Sample Lab app can be downloaded on Google Play and from the App Store."

PolyOne has a dedicated industrial design service called IQ Design Labs. As a compounding group, it says it fills a gap between the design support offered by major polymer producers – which is focused solely on that supplier's materials – and the needs of independent design firms, which may have limited understanding of polymer science. "PolyOne is unbiased when it comes to base polymers," says Chris Bray, Global Director for IQ Design Labs at PolyOne. "We formulate materials to meet the specific needs of an application, drawing from a full spectrum of base resins, colorants, additives, fillers, and reinforcements. Our team within IQ Design Labs mirrors this approach, collaborating with manufacturers and providing in-depth design support across a full range of polymer choices."

The benefits of collaboration are fully realised if the polymer experts are involved in all stages of a product's development, and so the IQ team helps designers and engineers 'connect the dots' between selecting the right material and colour, designing each component, and choosing a production process. According to Bray, as a rule of thumb, 85% of a new project's costs can be traced back to the initial stages of product development, so getting those stages right can be the difference between success and failure for OEMs. He says: "Keep in mind that ideation and design concepts are only optimised if you understand what comes later—the material selection and manufacturing process. This is why our service offers a distinctive benefit, because we're able to combine expertise in design, processing, and polymer science."

The IQ Design Labs team works on projects in nearly every industry in which thermoplastics are used, including transportation, sporting goods, electrical/electronics, packaging, and consumer goods. In one recently completed project, it

Pro-K Awards 2018

In January, the Pro-K Awards 2018 were presented to winning companies in recognition of new products where plastics materials are integral to their designs. The Gold Prize went to the PA-based Combisystem Fruit Collector (below) from Gardena, Germany, part of Husqvarna Group

The judges praised the closure and two-in-one design of Mepal's Lunchpot for food on-the-go, made using PP and PETG

Tupperware designed this PP infusion insert so that tea can be prepared in its ThermoTup 1.0 litre hot water jug without the need for refilling

supported the redesign of an off-road vehicle door assembly, seating module, and headrest. The team used 3D modelling and CAD/CAM technology to help the OEM replace metal with polymers for increased functionality and expanded design freedom. In addition, the IQ designers evaluated twin-sheet thermoforming, injection moulding and extrusion blow moulding processes, then offered guidance on the most efficient method for producing each component. The end result, said PolyOne, was a redesign that "scored high on aesthetic appeal, and reduced both vehicle weight and assembly time, racking up significant annual production savings in the process".

BASF has been pro-active in collaborating with designers through its dedicated Designfabrik consultancy. The group employs designers in Designfabrik who enable interdisciplinary communication between design clients and BASF materials experts. Last year, the group strengthened its offering for joint innovations by combining its competencies in design, trend research and simulation. Depending on the type of project, it said it can offer global customers the Designfabrik consultancy, its Ultrasim simulation tool and its trend research know-how in an integrated approach and is bundling these functions at key locations in Germany, Japan, China and USA.

"This integrated, global concept and the bundling of competencies under one roof will improve support for the innovation process at our customers, from the first steps in product development to the development of virtual prototypes," said Raimar Jahn, President of BASF's Performance Materials division.

PolyOne's IQ Design Labs team works on projects in various industries, including transportation, sporting goods, electrical/electronics, packaging, and consumer goods

Visitors to the BASF stand at Fakuma 2017 could choose from three designer chairs which the engineering plastics group contributed to. The Belleville from Vitra, the Metrik from Wilkhahn and the A-Chair from Brunner are all made from BASF's Ultramid SI polyamide which it developed to have the high-quality surface demanded by world renowned designers. During the development of the chairs, the group's Ultrasim simulation tool was used to exploit the potential of the design and material in full.

The Belleville chair, designed by French duo Ronan and Erwan Bouroullec, has two main components: the frame structure and the seat shell. Both are made with Ultramid B3EG6 SI using gas

The Blizzard CX1 is Miele's first bagless vacuum cleaner, and has a fine dust filter for hygienic cleaning. Polymers used in the design are ABS, APEC, PMMA, PC and PP

The Ponza vacuum flask for hot or cold drinks has a Comfort Press pump feature. Justblue Design worked with Emsa's designers on the PP and ABS jug

The L-Boxx from BS Systems is a robust power tool box made from ABS. The boxes are stackable and clickable for efficient transport in a network

Pro-K Awards 2018

Above: BASF is integrating its support for innovation projects with customers. Left to right: Dr. Uwe Seemann, Trend Scout, Eva Höfli, Designer and Helge Weiler-Schlecker, Simulation Expert

injection moulding technology (GIT), which results in a lightweight but strong structure. Using its Ultrasim software BASF said it was able to account for the actual shape of the gas bubbles for the first time in a structural simulation. "In a realistic process on the computer, first the component is volumetrically filled with melt; in a second step, the gas is injected, forming a gas bubble as in the actual injection moulding process. The internal geometry generated through the process simulation with GIT is then used for the strength calculation in the structure simulation."

BASF is not the only polymer producer to become involved in the design of chairs that showcase plastic materials in a combined functional and aesthetic manner. In June 2017, a collaboration between **DuPont Performance Materials** (now part of DowDuPont) and designer Frederic Rätsch, called 'Flexible Seating in public spaces', was displayed at the Royal College of Art graduation show in London. The engineering plastics group provided its materials and manufacturing expertise in the creation of Rätsch's Double Cantilever Chair, which uses Crastin PBT in the frame and Hytrel thermoplastic elastomer (TPC-ET) in the seat.

The chair is intended for use both indoors and outdoors at cafés, libraries, universities and so on. The flexible seating concept is applied in different ways: the flexible Hytrel material allows variable sitting postures; the chair is also flexible in relation to its environment, for example it can be put on a table so the floor can be cleaned. Rätsch also wanted to design a cantilever chair, which is a challenging chair type when using thermoplastics.

"The Crastin PBT with its strength and stiff properties is an adequate material to support the seat shell, while still allowing some flex," said DuPont. "The design process was driven by a constant exchange between the computer and full-scale model making. CAD models are used as a tool to record the process and allow FEA [finite element analysis], stackability tests and arrangements in the chair's context."

In the prototyping phase, wire and cardboard models were made to help define the design idea, and then models in polystyrene foam or plywood enabled the basic seating comfort to be assessed. DuPont said that in the final phase of the chair's development, the Institute of Plastic Processing (IKV) of the RWTH Aachen University, Germany, made a full-scale prototype with its large 3D printing technology, using Hytrel for the seat shell to showcase the intended flexibility.

Eastman has provided the material and technical support for another plastic chair called Luxtiera from Japanese group Kawajun, which produces furniture and accessories for hotels and other public settings. The clarity of Eastman's Tritan copolyester is highlighted in the seat of Luxtiera which is intended for public spaces and commercial usage including premium hotels, restaurants, hospitals and offices.

A diamond pattern is moulded throughout the chair's seat and back, which presented a challenge in material selection. Nanae Imbe, Chief Designer in Kawajun's Planning & Development Group, said: "We knew this design was too demanding for polypropylene, the plastic used in traditional chair applications. We looked at other options, but PMMA didn't give us the toughness nor the chemical resistance we wanted—and polycarbonate lacked the chemical resistance we needed for durability." Eastman said the properties of Tritan make the chair easier to process and give it greater impact strength and resistance to body oils and environmental cleansers. Tritan also makes the chair more comfortable and softer feeling for the end user, it said. Chairs are a new area for Tritan copolyester, which Eastman has targeted largely at food and drink applications. A recent

Right: DuPont Performance Materials worked with designer Frederic Rätsch on his Double Cantilever Chair

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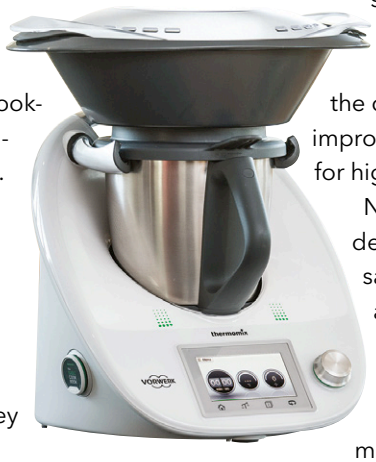
Above: The Luxtiera chair from Kawajun uses Eastman's Tritan copolyester in its design

example is Panasonic's MK-F800, 500, and 300 food processors. These have jugs made from Tritan, with the largest having a capacity of 2.5 L. Eastman said Tritan's high heat resistance, chemical resistance against oils and cleaners, and toughness give it the durability needed for repeated use in this application.

Kitchen appliances are a rich area for great plastics design. PMMA producer **Evonik** revealed it has collaborated with Vorwerk, the German producer of Thermomix premium brand appliances. Its Plexiglas PMMA compounds are used to mould the high gloss body of the Thermomix TM5, the latest in Vorwerk's multi-functional food appliances. Thorsten Gläser, head of Materials Engineering at Vorwerk, said: "Many of our customers have been loyal Thermomix fans for years, because they know they can rely on our quality." The TM5 appliance has been designed so as to perform various functions – including weighing, chopping and cooking – without the need for changeovers, while remaining easy to clean. "For this we rely on the highest engineering skills and first-class materials," said Gläser.



Right: For the curved white housing of the Thermomix TM5 food appliance, Vorwerk decided on a high-gloss surface finish with Evonik Plexiglas moulding compounds

Evonik said Plexiglas injection moulding compounds are widely used in the automotive, construction and lighting industries, but they can be used for other demanding designs too. "As overmoulded or co-extruded finishes, they lend their excellent properties also to the underlying material. And it isn't just the functionality that impresses: In the Thermomix housing, for example, the excellent transparency of Plexiglas results in a seamless and particularly high-gloss surface with a brilliant depth effect," said Evonik.

The toughness of PMMA means it can stand up to long-term use. "Plexiglas has the highest surface hardness of all thermoplastics, and so makes surfaces more robust," said Andreas König of Technical Service at Ter Hell, a long-standing compounding partner of Evonik. Any knocks during use leave the material unaffected, as does hot food dripping on to the housing or the detergent used in cleaning the appliance after cooking.

ABS is another tough material that is regularly selected for household appliances that are put through years of use and abuse, such as vacuum cleaners. Styrenics producer **Ineos Styrolution** is providing ABS materials to Samsung for a new range of refrigerators and vacuum cleaners recently launched in Asia. It said: "Samsung approached Ineos Styrolution for an eco-friendly grade that offers excellent paintability, ease of processing and superior metallic appearance from high luminance spray. The existing ABS grades available in the market require an additional primer treatment prior to the colour and clear coating process to improve the chemical resistance required for high luminance spray."

Novodur Xspray is an ABS alloy developed by Ineos Styrolution which it says offers good chemical resistance and excellent paint adhesion required in high luminance spray painting to achieve the desired superior metallic appearance. The material's good chemical resistance eliminates the need for the primer treatment process, resulting in eco-friendliness and better cost savings for the customer, according to the company. As well as refrigerators and vacuum cleaners, Novodur Xspray can be used for other

Classic design, modern material

Like all great designs, Mondaine's Official Swiss Railways Watch is simple yet unmistakable. Its easy-to-read face and black and red hands are representative of clean Swiss design, making it a famous watch all over the world.

A 'timeless' timekeeper, but the recently launched SBB Essence version of the watch has something new: the casing is made from BASF's Ultramid S Balance, a high performance polyamide derived from castor oil, which is reinforced with glass fibres.

The watch is "a clear signal for sustainability and increasing the use of eco-friendly materials", said Mondaine. Essence is supplied in a soft, gray pouch made from recycled PET bottles that can be easily reused as a protective casing for mobile phones, sunglasses, and more.

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Ineos Styrolution says its Novodur Xspray ABS alloy offers good chemical resistance and excellent paint adhesion for a metallic appearance on consumer goods (relevant parts indicated by arrows)

household applications requiring a metallic appearance, such as coffee machines, air conditioner housings and top covers of washing machines.

"Complementing our extended range of material solutions, we are excited to collaborate closely with Samsung to provide the best material and best technical service and support throughout the entire project," said ChiGyu Kang, Global Key Account Manager at Ineos Styrolution.

Thermoplastic elastomers are materials that lend themselves to consumer product design. The soft-touch properties of TPEs are ideal for product features that are in contact with the user's fingers or hand. Their flexibility makes them suited to items which are worn or manipulated in some way by the user. From the production viewpoint, TPEs are integrated easily through, for example, multi-shot injection moulding, making them a cost-effective option in material selection.

Two **Hexpol TPE** materials are used in the new Symbioz snowshoes from TSL Outdoor. One helps provide a cushioning function and user comfort in TSL's Hyperflex design and its patented Sound and Shock Absorbing System, while the second compound was developed for a bi-material, comfort strap.

Yoan Bibollet, R&D Engineer at TSL Outdoor, said: "For our new ankle clamping design, we were looking for materials that offer comfort for the user while maintaining good mechanical strength. With the wide range of properties available from [Hexpol's] Dryflex TPEs, we were confident that we would find the right materials for our specifications. The quality of Dryflex TPEs ensures the chemical adhesion between the soft zones (for the comfort) and hard zones (for the mechanical forces). This has allowed us to develop several new applications for our outdoor products, especially in Nordic walking sticks."

Right: Symbioz snowshoes from TSL Outdoor feature Hexpol Dryflex TPE materials

The new bi-material TPE strap has also allowed TSL Outdoor to relocate production of this part to its injection moulding site in Haute-Savoie, France. The predecessor part was made in Asia. "The relocation gives us greater flexibility and offers more customisation possibilities for special series (for example the ease of colour change), whereas our previous textile version imposed high minimum quantities for special colours," said Bibollet.

The creativity of designers when using plastics is shown in BabyPyke sunglasses from Belgian company Pyke. Inspired by the design of swimming goggles, the sunglasses' design makes good use of TPE materials to help protect babies' and children's eyes against harmful UV radiation (the company's name derives from "Protect Your Kid's Eyes").

Kraiburg TPE said the frame and headband of the BabyPyke sunglasses are injection moulded using its Thermolast M material. This has "excellent" flow properties so it can fill the long cavities of the injection mould in short cycle times. It can easily be coloured, allowing Pyke to offer the sunglasses in eight different colours. Kraiburg developed Thermolast M as a hypoallergenic material primarily for products in the medical and pharmaceutical sector. But it also complies with the

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Above: BabyPyke sunglasses use Kraiburg TPE's Thermolast M material

Right: ZTE selected DSM's Arnitel TPE for the strap of its Quartz smart watch

requirements of the EU Directive 10/2011 and the Code of Federal Regulations, Title 21 (CFR21) of the US Food and Drug Administration for applications with food contact. Production of the TPE elements and final assembly in accordance with EU standards take place at Pyke's facility in Belgium.

The "wearable tech" category is a new one in consumer electronics which has grown quickly with the success of fitness and activity trackers. TPEs are the material of choice for the wrist band of many trackers. This material selection is now also appearing in another wearable tech product, the smart watch.

DSM said the selection of its Arnitel TPE has helped drive the market success of the Quartz smart watch from ZTE. The watch was launched in China in April 2017, and then rolled out in worldwide markets. Arnitel was selected for the soft strap of the watch, providing comfort, flexibility, safety and design flexibility, and it also feels cool and smooth on the skin, said the materials group.

"We are very proud to be selected by ZTE, because ZTE is a respectable market leader and they have a very high standard of selecting materials," said Martin Chen, Marketing Manager Electronics (Wearables) at DSM. "DSM began research and development in the smart wearable market in 2014, and we are happy to see that our intensive R&D efforts have paid off with the creation of state-of-art Arnitel TPE for the wearable industry."

Arnitel TPE meets ISO 10993 standards, and is rated USP Class VI, the highest classification for the biocompatibility of devices. Arnitel's thermal plastics are resistant to perspiration, oils and other liquids that come into contact with wearable devices. The material is also highly resistant to UV rays, and so helps prevent plastic aging.

DSM said its teams supported ZTE in every phase of product development, from product design, prototyping and small batch sampling to mass-production. ZTE's production line has been optimised to achieve cost-effective, top quality production.

Luo Wei, VP of ZTE Terminal Division, Head of Operator Product Department, said DSM is supporting ZTE's approach to the wearables market. "Arnitel TPE is helping us make the cutting-edge ZTE Quartz a resounding success in the market," he said.

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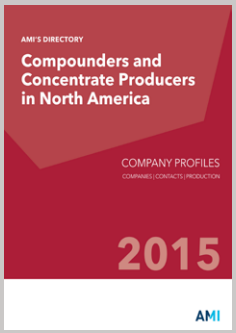

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CONDUCTIVE PLASTICS USA 2018

Taking place in Pittsburgh, PA, USA, on 20-21 March 2018, the second North American Conductive Plastics conference focuses on additives and technologies for tailoring the electrical and/or thermal properties of polymer compounds.

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THIN WALL PACKAGING USA 2018

The 7th AMI international conference on thin wall packaging will take place on March 20-21, 2018 in Chicago, IL, USA. The event offers a unique networking opportunity for buyers and suppliers to debate the latest developments in light weight plastics packaging.

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GRASS YARN & TUFTERS FORUM

Established as the meeting point for the international synthetic turf manufacturing industry, AMI's 13th Grass Yarn & Tufters Forum takes place in Barcelona, Spain, on 9-11 April 2018. Topics on the agenda include growth prospects and technical innovations.

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FIRE RETARDANTS IN PLASTICS 2018

Running in Pittsburgh, PA, USA, on 10-11 April 2018, Fire Retardants in Plastics is the established meeting point for all involved in fire protection of plastics, covering the latest regulatory perspectives and technology and application developments.

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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

PVC FORMULATION 2018 EUROPE

The 10th anniversary edition of AMI's European PVC Formulation conference takes place in Cologne in Germany on 10-12 April 2018. This industry-leading event covers business developments and technical innovations in all PVC markets.

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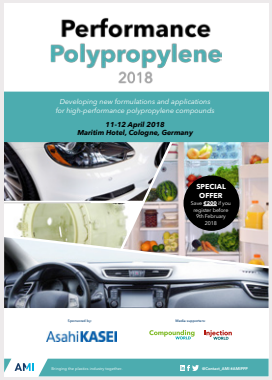
PERFORMANCE POLYPROPYLENE 2018



This brand new event from AMI takes place on 11-12 April 2018 in Cologne in Germany and will take a detailed look at the latest innovations in polypropylene resins and compounds for automotive, E&E, appliance and consumer applications.

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PLASTIC PIPES IN INFRASTRUCTURE 2018

The sixth Plastics Pipes in Infrastructure conference runs from 17-18 April 2018 in London, UK. Expert speakers will discuss innovative applications ranging from drinking water and sewerage through to gas distribution and electrical cable protection.

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POLYMERS IN BUILDING INSULATION

This new event from AMI takes place in Cologne in Germany on 18-19 April 2018 and takes a look at challenges and opportunities for thermal and acoustic insulation. Topics on the agenda include compliance testing and processing innovations.

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PLASTIC CLOSURE INNOVATIONS

AMI's Plastic Closure Innovations is the leading European conference for the plastics caps and closures industry. Taking place in Berlin in Germany on 22-24 May 2018, this sixth annual event brings together expert speakers from brand owners, producers and suppliers.

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OIL & GAS POLYMER ENGINEERING TEXAS

Taking place in Houston in the USA, AMI's Oil & Gas Polymer Engineering Texas conference brings together a line-up of expert speakers to discuss developments in non-metallic materials used in the demanding oil and gas exploration and distribution sectors.

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Akro-Plastic

Head office location:	Niederzissen, Germany
Date founded:	1988
Managing directors:	Andreas Stuber/Dirk Steinbrück
Ownership:	Feddersen Group (K.D. Feddersen Holding GmbH)
No. of employees:	380
Sales 2017:	€150m (AMI estimate)
Production 2017	100,000 tonnes (AMI estimate)
Plant locations:	Germany, China and Brazil
Profile:	Founded in 1988, Akro-Plastic has seen rapid growth over its 30-year history. It had outgrown its original production site by 2002, prompting a move into a new production facility. This was further expanded in 2011 and 2012. It established a production subsidiary in China in 2005 and Brazil in 2015. Akro-Plastic has two subsidiaries: AF-Color specialises in colour and additive masterbatch and Bio-Fed in bio-based and biodegradable compounds.
Product line:	Akro-Plastic offers a wide range of high performance compounds based largely on polyamides, including PA6, PA66, PA610, as well as PA/PP, PPA, PBT, PK and PEEK. It has focused development in recent years on PA-based LFTs, flame retarded and high temperature grades.
Product strengths:	As a member of the Feddersen Group, Akro-Plastic benefits from its parent's extensive distribution network and access to the extrusion compounding know-how of sister company Feddem, allowing it to offer consistent high performance products on a global basis.

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:

April

Thermally-conductive compounds
Materials testing
Processing aids and lubricants
Chinaplas preview

May

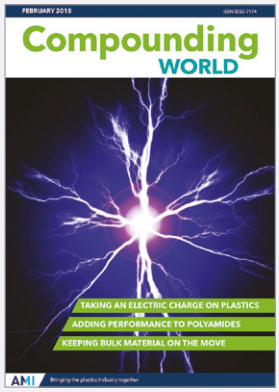
Wire and cable compounds
Compatibilisers and coupling agents
Industry 4.0/plant management
NPE 2018 and Plast 2018 previews

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

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

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 February 2018
The February edition of Compounding World looks at companies working on electrically conductive compounds. Other features cover developments in PA, bulk materials handling, and laser decoration.

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Compounding World January 2018
The January 2018 edition of Compounding World takes a look at the latest innovations in pelletising technology. This issue also explores developments in odour and emissions control, additives for films and polymer foaming.

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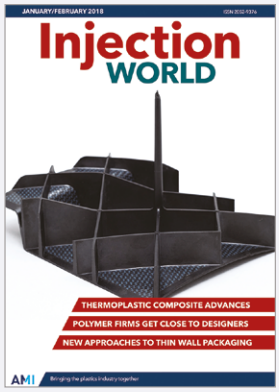

Injection World January/February 2018
The January-February issue of Injection World examines the advances being made with overmoulding thermoplastic composites. It also looks at how polymer firms are collaborating with product designers, and the latest in thin wall packaging.

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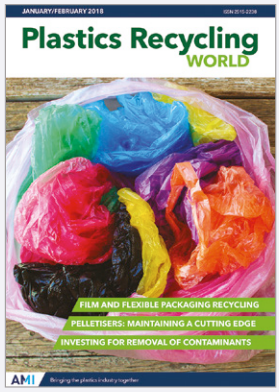

Plastics Recycling World January/February 2018
The January/February edition of AMI's new digital magazine – Plastics Recycling World – takes a detailed look at the latest innovations in recycling of packaging films. It also explores developments in pelletising and material separation technologies.

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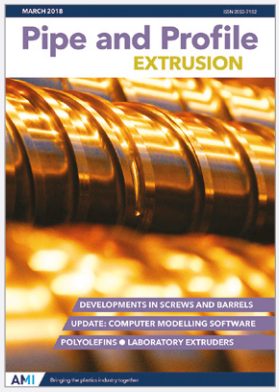

Pipe and Profile March 2018
The March edition of Pipe and Profile Extrusion magazine looks at innovations in screw design. It also reviews developments in polyolefins for pipe applications and examines the latest in process simulation and laboratory extruders.

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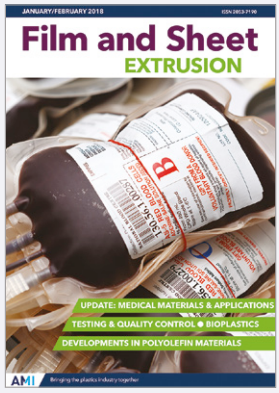

Film and Sheet January/February 2018
The January/February edition of Film and Sheet Extrusion looks at some of the latest medical materials and applications. It also highlights developments in polyolefin resins and materials testing, as well as reviewing progress in bio-based polymer sourcing.

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

GLOBAL EXHIBITION GUIDE

2018	**20-22 March**	Plastics & Rubber Vietnam, Ho Chi Minh	http://plasticsvietnam.com
	22-24 March	MECCSPE, Parma, Italy	www.mecspe.com
	27-29 March	Plastprintpak Nigeria, Lagos, Nigeria	www.ppp-nigeria.com
	24-27 April	Chinaplas, Shanghai, China	www.chinaplasonline.com
	7-11 May	NPE, Orlando, USA	www.npe.org
	9-11 May	Plastic Japan, Osaka, Japan	www.plas.jp
	15-18 May	Elmia Polymer, Jönköping, Sweden	www.elmia.se
	22-25 May	Plastpol, Kielce, Poland	www.targikielce.pl
	29 May-1 June	Plast, Milan, Italy	www.plastonline.org
	29-31 May	UTech Europe, Maastricht, Netherlands	www.utecheurope.eu
	11-14 June	Argenplas, Buenos Aires, Argentina	www.argenplas.com.ar
	19-20 June	Plastics Design & Moulding, Telford, UK	www.pdmevent.com
	20-23 June	Interplas Thailand, Bangkok	www.interplasthailand.com
	27-28 June	Compounding World Expo, Essen, Germany	www.compoundingworldexpo.com
	27-28 June	Plastics Recycling World Expo, Essen, Germany	www.plasticsrecyclingworldexpo.com
	2-4 August	Plasti & Pack, Lahore, Pakistan	www.plastipacpakistan.com
	15-19 August	Taipei Plas, Tapei, Taiwan	www.taipeiplas.com.tw
	16-20 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
2019	**8-9 May**	Compounding World Expo, Cleveland, USA	www.compoundingworldexpo.com/na
	16-23 October	K 2019, Dusseldorf, Germany	www.k-online.com

AMI CONFERENCES

14-15 March 2018	Plastics Regulations, Cologne, Germany
20-21 March 2018	Conductive Plastics, Pittsburgh, PA, USA
10-11 April 2018	Fire Retardants in Plastics USA 2018, Pittsburgh, PA, USA
10-12 April 2018	PVC Formulation 2018, Cologne, Germany
11-12 April 2018	Performance Polypropylene, Cologne, Germany
17-18 April 2018	Plastic Pipes in Infrastructure, London, UK

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

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