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Luxus ups capacity by 20%

UK-based compounder Luxus has commissioned a new £1.5m line, increasing its capacity for technical and recycled polymer compounds by more than 20% to 45,000 tonnes/yr.

The investment is intended to keep pace with increasing customer demand. "We are committed to producing high performance, yet sustainable compounds able to meet the demanding service and long-life requirements of rapidly growing sectors including, returnable transit packaging and civil engineering," said Managing Director Peter Atterby.

"We required new equipment to enhance our infrastructure by supporting this demand, particularly for the development of polymer formulations for the progressively high-end colour specifications in these markets," he said.

Luxus generated sales of around £29m in 2018 and is forecasting a result of around £33m for 2019.

The new line is built around a Coperion STS 96 Mc^{11} twin screw extruder with a Gala pelletiser. It will provide an additional capacity of around 10,000 tonnes and has been specified to handle recycled material inputs, which require highly effective devolatilisation and filtration capabilities.

The investment follows installation of a 70mm Coperion compounding line at the company's facility near Louth in 2015. That amounted to £1.7m and was part of the EU-funded Hycolene project to develop scratch resistant PP compounds for the automotive industry.

› **www.luxus.co.uk**

PHOTO: LUXUS

Above: £1.5m investment ups capacity by more than 20%

Solvay enhances Technyl One

Solvay Performance Polyamides has introduced an enhanced version of its Technyl One range of halogen-free flame-retardant materials.

The new generation, the company said, "increases the potential for miniaturisation of electrical and connection safety systems while retaining the same level of safety". Specific target applications include smart meters and circuit-breakers.

The materials enable devices to comply with UL94 V0 at 0.4mm wall thickness, ensure optimal performance at 150°C, and are fire-resistant at up to 800°C. They are also said to reduce corrosion.

› **www.solvay.com**

PolyOne acquires Fiber-Line

PolyOne has paid $120m for Fiber-Line, a major producer of customised engineered fibres and composite materials for the fibre optic cable, oil and gas, industrial and consumer markets.

Fiber-Line has five manufacturing sites. The business will become part of PolyOne's Specialty Engineered Materials segment and is expected to add close to $100m in revenues in 2019, while being immediately accretive to earnings.

› **www.polyone.com**

Kraiburg TPE adds line in Asia

Kraiburg TPE commenced production on a new line at its plant in Kuala Lumpur, Malaysia, in January, boosting production capacity there by 35% and increasing its global capacity to 60,000 tonnes/year.

PHOTO: KRAIBURG TPE

The TPEs specialist said it is also expanding its offices and warehouse in Malaysia alongside the new line investment and will be extending its sales network in Hanoi, Vietnam.

Kraiburg has production sites for TPE compounds in all three regions of the world; the others are at Waldkraiburg in Germany and Buford in Georgia in the US.

› **www.kraiburg-tpe.com**

Left: New line in Kuala Lumpur ups local capacity by 35%

BASF makes its first step in chemical recycling

BASF has made its first products based on chemically recycled plastic as part of its ChemCycling project, which aims to feed oil or syngas derived from plastics waste back into the production chain.

The company is developing pilot products, including mozzarella packaging, refrigerator components and insulation panels, with 10 customers. All offer the same properties as products made from virgin polymer, the company said.

BASF's ChemCycling process uses either oil derived from plastic waste from Recenso in Germany or plastic waste derived syngas. The company said the first batch was fed into the steam cracker at Ludwigshafen in Germany in October last year. Mass balance calculations are used to determine the share of recycled raw material in the final certified product.

The next step will be to make the first products from the project commercially available.

PHOTO: BASF

Above: BASF has produced its first products from chemically recycled plastic waste

However, BASF said, various technological and regulatory conditions must be addressed first as chemical recycling and the mass balance approach are not recognised in legislation in different regions.

■ Meanwhile, BASF has signed a framework agreement with authorities in China's Guangdong province setting out more details of its plan to build a new 'smart verbund site' on around 9 km^2 of land at Zhanjiang.

The company said the total investment in the multi-stage project will be up to $10bn and will include a wholly-owned steam cracker with a planned capacity of 1m tonnes/yr of ethylene, plus several plants for consumer-oriented products. It will be it's second verbund faciiity in China, alongside one in Nanjing.

› **www.basf.com**

SABIC signs Plastic Energy deal

SABIC has signed a memorandum of understanding with Plastic Energy, a UK-based chemical plastics recycling firm, to supply feedstock to its European petrochemical operations.

The two companies intend to build a commercial scale production plant in the Netherlands, due to open in 2021, that will make Plastic Energy's Tacoil from low quality, mixed plastic waste that would otherwise go to incineration or landfill.

According to Frank Kuijpers, General Manager for Corporate Sustainability at SABIC, the facility "is a significant milestone for Sabic towards the company's commitment to establishing a circular economy and, more broadly, its sustainability goals".

Plastic Energy already has two commercial plants in operation at Seville and Almeria in Spain using its patented thermochemical technology to convert a wide range of end-of-life, dirty and contaminated plastics into usable feedstock.

› **www.sabic.com**

NEWS IN BRIEF...

Evonik has agreed a new distribution agreement with US-based **Compounding Solutions** for its Care brands of medical grade polymers in North America. The deal covers Evonik's Vestamid Care ML PA12, ME PEBA, Trogamid Care clear PA, and Vestakeep Care PEEK medical grades
www.evonik.com
www.compoundingsolutions.net

Following its initial announcement in April 2017, **Ineos Styrolution** has confirmed its investment decision to build a new 100,000 tonnes/yr acrylonitrile styrene acrylate (ASA) plant at its site in Bayport, Texas. Due to start up in 2021, the new plant will support additional ABS polymer capacity at the firm's site in Altamira, Mexico.
www.ineos-styrolution.com

The European compounders and masterbatch producer association **EuMBC** announced its new board at its General Assembly meeting in Prague in the Czech republic last year. Ampacet's Mark Cornu is appointed to the role of President, Sirmax's Massimo Veronelli as Treasurer, and Lati's Cristiano Citterio and Clariant's Gunther Luebke become Vice Presidents. Other board members include Cabot's Válerie Moise, and A Schulman's Joan Vuylsteke.
www.compounders.eu

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Indorama to acquire Invista unit

Thailand's Indorama Ventures (IVL), which has facilities in 30 countries worldwide, has agreed to buy Invista Resins & Fibres in a deal that will significantly expand its position in barrier resin technologies.

Invista owns a PET manufacturing facility at Gersthofen, Germany, with a capacity of 282,000 tonnes/yr, where it produces Polyshield PET and Oxyclear Barrier PET for oxygen barrier packaging. The deal includes global IP rights.

› **www.indorama.net**

Compound Company takes stake in Transmare

The Compound Company, which is based at Enschede in the Netherlands, has acquired a controlling stake in fellow Dutch specialist toll compounder Transmare Compounding.

"This is yet another building block in our growth strategy," said Simon Put, Managing Director of The Compound Company, which is best known for the EcoForte range of customised thermoplastic compounds and Yparex extrudable adhesive resins.

It is the latest in a series of recent investments; the company has expanded operations into South-East Asia and built an additional compounding plant in Enschede.

"It strengthens our position as a speciality compounder in Europe, adding new products, extra capabilities and valuable people with scarce compounding skills to the group. The combination will provide critical mass to our EcoForte portfolio and extra capacity for our custom compounding partners," Put said.

Transmare produces a wide variety of compounds and masterbatches on a toll basis at its Roermond site.

Compound Company said it will continue to operate as a stand-alone company with technical and financial support from its new owner. Henk-Jan Aarsen will retain a minority stake in Transmare. Stijn van den Brekel has been named as the new General Manager while Peter Wolf, former CEO and shareholder, has taken over the group's trading activities, Transmare Distribution.

› **www.thecompoundcompany.com**
› **www.transmarecompounding.com**

SABIC marks 70 years of LNP compounds

December marked the 70th anniversary of SABIC's LNP performance compounds business, which the company celebrated with a technical summit in Taipei in Taiwan that attracted more than 130 customers.

Originally established at Malvern in Pennsylvania in the US in 1948 producing PTFE powdered compounds, the LNP business has gone on to develop one of the broadest ranges of engineering compounds, including lubricated, fibre reinforced, thermally and electrically conductive grades and LFTs.

Part of SABIC since 2007, LNP has had several owners over the years including GE, ICI and Kawasaki Steel but the traditional LNP is still intact, according to Joshua Chiaw, Director Business Management LNP SABIC. "We are very much customer focused and, looking at the trend in the projects we are working on, we would say even customer obsessed," he said.

SABIC marked the 70th anniversary of LNP last month

"The LNP portfolio reflects a strong history of working closely with customers to develop materials that meet their needs – and also showing customers that novel high performance materials can sometimes meet a need they didn't even know they had," he said.

Chiaw said almost 70% of LNP's business is custom compounds developed to solve specific customer issues. Three global technical centres and more than 10 manufacturing locations ensure customers are supported wherever they are located.

He said LNP benefits from SABIC's strength in polymers but is not restricted to using its materials, although it is currently developing a range of PC copolymer grades to leverage SABIC's strength in that area. These, however, will be marketed under LNP's established brands.

"LNP has been around for 70 years and we continue to do what we do with our compounding solutions approach. The SABIC brands… compete in very different markets to where we are. We are customer centric and focus on unique customer requirements," he said.

› **www.sabic.com**

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Force majeure on HMD at Ascend

Ascend Performance Materials has declared force majeure on PA66 feedstock hexamethylene diamine (HMD), suggesting the already tight market may see more severe shortages over the coming months.

The company said manufacturing delays beyond its control arose as it completed projects in December to expand both adiponitrile (ADN) and HMD. While the AND expansions are now operational, Ascend said that those for HMD have not yet met its targeted production rates.

The company said that force majeure continues for all Ascend polymers, compounds and fibres, and that availability is reduced for all polymer products and HMD. It said it "will allocate existing products as prescribed in its contracts and is currently working with affected customers to minimise the impact to their respective businesses".

Compounding World reported in November that only 55% of Europe's PA 66 capacity is available. ADN shortages appeared to be the main issue then, with supplies squeezed by a combination of rising demand and unplanned outages (there are only five ADN plants worldwide).

› **www.ascendmaterials.com**

Borealis to add PP capacity

Borealis has made a final investment decision on its proposed 80,000 tonnes/yr expansion of its polypropylene plant at Kallo, Belgium, and has approved the commencement of front-end engineering and design work to expand another PP plant at Beringen, which is also in Belgium.

PHOTO: BOREALIS

The Borealis facility at Kallo in Belgium

"In Europe, PP supply is not keeping up with increasing demand. With the market tightening and continuous application expansion for PP materials, additional investment is needed to support the growth of our customers," said CEO Alfred Stern. The extra capacity will go mainly into the flexible and rigid packaging and automotive markets.

The expansion at Kallo is expected onstream in mid-2020. Borealis said that a final decision will be made about the Beringen expansion, which would include an upgrade to the company's proprietary Borstar polymerisation platform, in mid-2019. If the decision is made to go ahead, a further 250,000-300,000 tonnes/yr would be added by mid-2022.

› **www.borealisgroup.com**

Teknor Apex launches styrenic TPEs

Teknor Apex has launched a new series of styrenic thermoplastic elastomers (TPEs) that are said to provide the surface appearance and haptics of silicone.

Aimed at applications in food grade packaging and cosmetics, the Monprene RG-15100 series TPEs are claimed to exhibit a lower compression set than standard TPS compounds, withstand temperatures in excess of 100°C and provide good chemical resistance. The company said the products meet US and EU regulations for single and repeated-use exposure to dry, acidic, aqueous and alcoholic food types.

The new translucent grades are available in Shore A hardnesses from 30 to 80 and are suitable for injection moulding and extrusion applications. They can also be used in two-component parts in combination with polyolefins, the company said.

› **www.teknorapex.com**

Songwon to partner with Disheng

Korea's Songwon Industrial has entered a partnership with Disheng Technology of Jiangsu province in China covering production of some of its ultra-violet absorber (UVA) light stabilisers.

The Chinese company is currently building a new factory in Fujian province that will make it one of the world's largest producers of light stabilisers. Under the new arrangement, Disheng will make Songwon's Songsorb and Songsorb C UVAs for sale worldwide.

The two companies, which have worked together for several years, said in a statement that the move will strengthen Songwon's supply reliability thanks to reserved production capacities. They also said they will "closely cooperate on a technology level for the development of future light stabilisers".

› **www.songwon.com**

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Industry leaders to share insight at Compounding World Expo's free-to-attend US conferences

Influential leaders from across the plastics compounding industry will take part in four industry debates at the Compounding World Expo, to be held at the Huntington Convention Center in Cleveland, Ohio, US, on 8-9 May 2019.

The four debates will cover the future for technical compounds, masterbatch, cable compounds and PVC. They will feature senior managers from an array of leading producers in these fields and will be free to attend to show visitors who register in advance **here**.

Compounding World magazine Editor-in-Chief Chris Smith will chair the discussion on the future for technical compounding, which will include: Frank Roederer, Senior VP, Engineering Composites at **A Schulman**; Jean Sirois, MD of Strategic Planning and Acquisitions and GM Canada at **RTP Company**; and Tom Drye, VP Emerging Markets and Innovation at **Techmer PM**.

Andrew Reynolds, Director of AMI owner Advance Bidco, will chair a high-level discussion on the future for thermoplastics concentrates. This will feature business leaders from major masterbatch producers including: Matthew Hellstern, CEO of **Americhem**; Dr Deepak Parikh, Region President and CEO at **Clariant Corporation USA & Canada**; and Amit Puri, owner and Director Marketing at **Alok Masterbatches**.

The future for PVC compounds will be discussed by influential representatives from leading suppliers of vinyl formulations including: Darrell Hughes, CEO of **Aurora Plastics**; Renee Havrilla, Vice President Compounds at **Westlake Compounds**; and Gautam Nivarthy, Vice President and General manager Compounds Business at **Mexichem Specialty Compounds**. The discussion will be chaired by Sylvia Tabero, Senior Project Consultant at AMI Consulting.

Participants in the free-to-attend industry debates include (from left) A Schulman Senior VP Engineering Composites Frank Roederer, Americhem CEO Matthew Hellstern, Westlake Compounds VP Compounds Renee Havrilla, Vice President Compounds, and Southwire Chief Engineer Formulations Dave Camillo

Key trends in cable compounds will be the subject of a separate discussion involving experts in this dynamic market including: Tariq Quadir, Chief Technologist and Senior Scientist at **Champlain Cable**; Dave Camillo, Chief Engineer Formulations at **Southwire**; and Eric Bates, Principal Engineer at **General Cable**.

Organised by AMI, the Compounding World Expo takes place alongside the Plastics Recycling World Expo and Plastics Extrusion World Expo. By registering in advance, visitors will receive free admission to all three exhibitions, featuring more than 200 leading suppliers, plus free entry to five conference theatres hosting technical presentations, educational seminars and business debates. Attendees and exhibitors also have the option to buy tickets ($20 each) for a networking party at Cleveland's iconic Rock and Roll Hall of Fame on the evening of 8 May.

Rita Andrews, head of exhibitions at AMI said: "Our debut compounding and recycling exhibitions in Essen, Germany, attracted 4,024 visitors. We are confident that our first Cleveland shows will build on this success and be the biggest plastics industry gathering in the USA in 2019".

The three expos, which will occupy the two largest halls at the state-of-the-art Huntington Convention Center, will feature a wide array of leading manufacturers of extrusion, compounding and recycling equipment, plus suppliers of a huge variety of polymers, additives and related services. The exhibitor line-up already includes companies such as Clariant, Milliken, Coperion, Cabot, Leistritz, Heritage Plastics, CPM Century, Struktol, Entek, Dover Chemicals, Farrel Pomini, Ferro, Omya, Nordson, NFM, Chemours, Maag, Wacker, Lanier Color, Modern Dispersions, B&P Littleford, IMI Fabi, Zoltek, Buss, and more than 160 additional leading suppliers.

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› **ami.ltd/Register-AMI-Expos**

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Total Corbion starts up PLA plant

Total-Corbion announced the start-up of its 55,000 tonnes/yr PLA bioplastic plant at Rayong in Thailand in December. The move makes the company the world's second largest player in PLA after US-based Natureworks.

The facility will produce a full range of PLA resins, which will be sold under the Luminy name, including standard and high heat resistant grades. It is integrated with a 100,000 tonnes/yr plant producing lactides from locally-grown sugar cane and is located on the same site as Total-Corbion's 1,000 tonnes/yr pilot plant, which will provide a product development capability.

PHOTO: TOTAL CORBION

Total Corbion's PLA plant in Thailand is now in operation

"The start-up of this state-of-the-art plant establishes Total Corbion as a world-scale PLA bioplastics producer ideally located to serve growing markets from Asia Pacific to Europe and the Americas. The subsequent increase in global PLA capacity will enable manufacturers and brand owners to move into the circular economy and produce bio-based products with lower carbon footprints," said Total Corbion CEO Stephane Dion.

› **www.total-corbion.com**

In a separate move, process equipment producers Futero, Sulzer and TechnipFMC have announced the formation of a new partnership to offer turnkey plant for production of PLA bioplastics.

The PLAnet partnership is intended to support construction of plant with a throughput of up to 100,000 tonnes/yr. It brings together Galactic group company Futerro's proprietary technology for production of lactic acid and raw lactides, Sulzer's lactide purification and polymerisation know-how, and TechnipFMC's plant design and engineering skills.

› **www.lactic.com**

Mitsubishi buys into ELG

Japan's Mitsubishi is to acquire a 25% stake in UK-based ELG Carbon Fibre (ECF), which reprocesses surplus post-industrial and end-of-life carbon fibre reinforced plastics.

It is buying the stake from a subsidiary of ELG Haniel in Germany. Financial terms were not disclosed. Mitsubishi will market ECF products through its existing sale channels for plastic resins.

Mitsubishi said that although Japan produced 70% of the world's carbon fibre, recycling has not developed so rapidly.

› **www.elgcf.com**

Bruno Peter adds more capacity

Swiss colour and additive masterbatch producer Bruno Peter is expanding its production facility at Büren an der Aare with the addition of a new STS 35 Mc^{11} twin-screw extruder from Coperion.

The new machine, which is currently being installed, will provide an extra 650 tonnes/yr of capacity and will be able to produce at up to 300 kg/hour. It was selected in part for its suitability for fast product changeovers and ease of cleaning.

"We have opted for a solution to expand our production capacity that can be seamlessly integrated into our order structure," said Managing Director Thomas Peter.

"When manufacturing masterbatches, we need to react to recipe changes increasingly quickly and quick product changes are crucial for being able to produce economically," he said.

› **www.brunopeterag.ch**

Perstorp to exit caprolactone

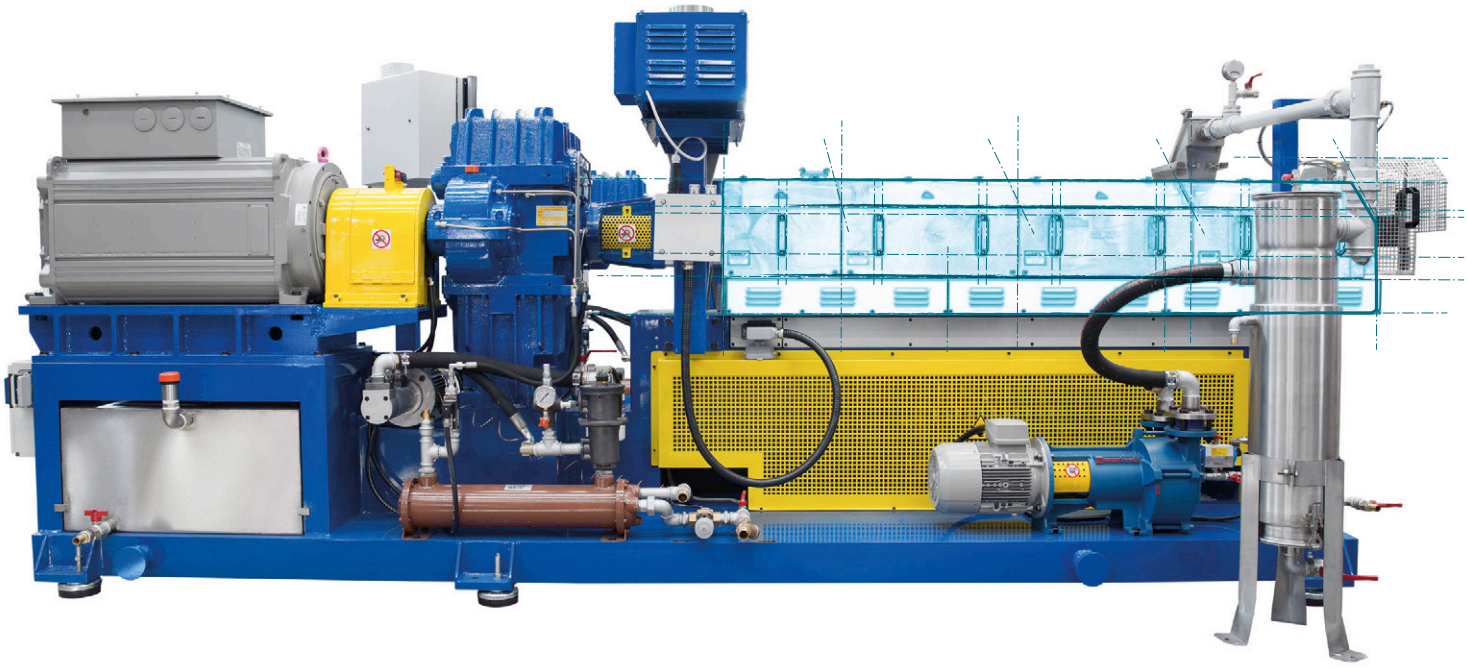
Perstorp is to sell its Capa caprolactone business, including its production site at Warrington, in the UK, to Ingevity for about €590m.

The business, which has annual revenues of some €150m, has been part of Perstorp for ten years, over which time operating margins have increased by almost 50%.

Perstorp, which itself changed ownership in September 2018 to a new fund managed by PAI Partners with Landmark Partners as lead investor, said the sale "will unlock significant value and is in line with Perstorp's track record of successful divestments".

The company said it will focus on its polyol, oxo and feed businesses for the future, seeking opportunities for, among other things, its phthalate-free plasticiser Pevalen.

› **www.perstorp.com**



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Lanxess plans to invest €200m to grow global FR capacities

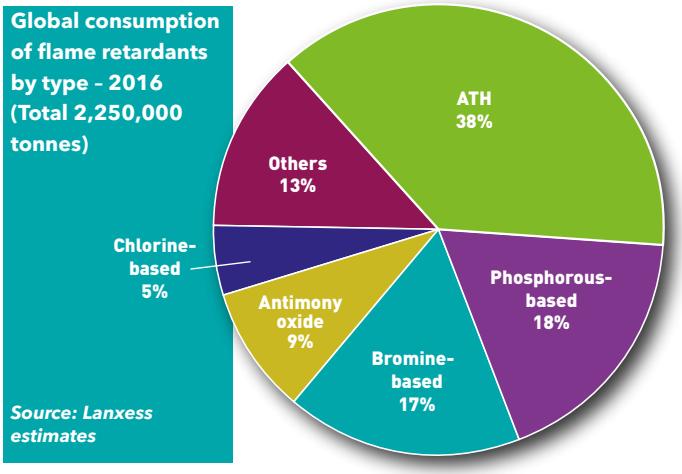
By Astrid Aupetit

Lanxess is to invest €200m over the next three years to expand its global production capacity for flame retardants. The move comes 18 months after its purchase of Chemtura – which broadened its existing phosphorous FR portfolio to include brominated products – and the acquisition last year of Solvay's phosphorous activities in the US.

"With the acquisition of the US company Chemtura in spring 2017 we became one of the world's leading suppliers of flame retardant additives. With the investment package we will further strengthen our strong position in this growing market," said Karsten Job, Head of the Polymer Additives Business within the company's Specialty Additives division.

Lanxess estimates global consumption of flame retardants amounted to 2.25m tonnes in 2016 and cites growth rates of 3-4% annually. Phosphorous-based flame retardants account for 18% of the total and bromine-based 17%.

The company operates a backward integrated production network for bromine and phosphorous based flame retardants with production capacity at Charleston (the former Solvay site), El Dorado and Greensboro in the US, Leverkusen and Krefeld-Uerdingen in Germany, Épierre in France, and Manchester in the UK. It also has two technical centres at Naugatuck in the US and Leverkusen.



The investment announcement coincided with a flame retardants event at the Leverkusen manufacturing site, where the company presented some of the latest developments in phosphorus and brominated based flame retardant and showcased its Currenta testing facilities.

Dr Heiko Tebbe, Head of Application Technology Polymer Additives EMEA said its phosphorous FR products are mainly organic phosphate esters and are typically supplied as clear low viscosity liquids. They are predominantly used in polar polymers, with applications including flexible PVC (where they also act as a plasticiser), rigid and flexible PU foams and TPUs.

The latest additions to the product line include Levagard 2000 and 2001. Levagard 2000 is a higher molecular weight oligomeric alkyl phosphate ester with a 16.4% phosphorous content that offers reduced emissions; Levagard 2001 is a reactive organic phosphate with an 18.4% phosphorous content that chemically bonds to the polymer and is claimed to eliminate emissions.

Brominated flame retardants are widely used in electrical and electronic applications. Dr Thomas Facklam, Head of Application Technology Business Line Polymer Additives, said the trend in terms of brominated FR technology is towards reactive and polymeric additives that are non-migrating and offer low volatility. Solutions are available for use in PA, PET, PBT, PC and PC/ABS blends, as well as PU, epoxy and styrenics.

He cited the example of the company's Emerald Innovation 3000 FR, which provides an alternative to HBCD for EPS and XPS building insulation – HBCD (hexabromocyclododecane) has been identified as an SVHC under the EU REACH regulation. It is a brominated styrene-butadiene polymer with a high molecular weight (more than 100,000 g/mol) and a bromine content of 65%.

Tests carried out by the company on XPS construction boards show that Emerald Innovation 3000 provides LOI and flammability performance (DIN 4102 B2) equivalent to HBCD at the same bromine content.

› **www.lanxess.com**

M Holland to distribute Borealis polymers

M Holland Company has been appointed North American distributor for Borealis polymers.

Under the agreement, the company will distribute filled PP products manufactured at the new Borealis compounding facility at Taylorsville in North Carolina, as well as imported PP and PE grades and the Queo range of polyolefin plastomers and elastomers.

› **www.mholland.com**

› **www.borealisgroup.com**

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Turnkey boom helps sales break $1bn at Coperion

Coperion's Extrusion Days event at its headquarters in Stuttgart last year marked a milestone $1bn sales result. Chris Smith learnt more from senior executives Ulrich Bartel and Peter von Hoffmann

PHOTO: COPERION

Main image: Attendees viewed demonstrations of Coperion's latest equipment during tours of the company's Stuttgart technical centre

Last year proved to be a landmark for compounding machinery maker Coperion, which saw sales break the $1bn barrier for the first time in its history. Speaking to *Compounding World* during the company's Extrusion Days customer event at its headquarters in Stuttgart in Germany in November, Coperion President Compounding and Extrusion Ulrich Bartel attributed the growth to booming plastics industry demand as well as some major turnkey contract successes.

"One of the big drivers was twin screw extruders for the polyolefin area. These are big machines and huge capacities are being built up. Growth in this area is more than 50%," said Bartel. The new projects are focused on North America, where he says the US policy of re-industrialisation together with the cost efficiencies of the shale oil and gas industry have reversed many years of almost no polyolefin investments. "What we see now is polyolefin customers coming to us and talking about projects of more than $50m."

PHOTO: COPERION

Above: Coperion General Manager Business Unit Engineering Plastics and Special Applications Peter von Hoffmann (left) with President Compounding and Extrusion Ulrich Bartel

Turnkey installations have long been a key part of Coperion's business, Bartel says, but these huge polyolefin projects mean that share is moving from a historical level of around 10% to 15-20% of its order intake. "But we are not only a big system company," he emphasises. "We are also interested in smaller customers and smaller equipment – one rotary valve or one feeder."

Sales of standalone machinery items and provision of service account for more than 50% of Coperion's business, according to Bartel. The plastics and chemicals sectors currently account for around 80-85% of the company's order intake ($1.1bn last year), with the remainder coming from the pharma and food industries. The latter present good growth opportunities but also provide insulation from the historical ups and downs of the plastics industry. "Everyone in the plastics business is very happy right now but we know this market goes in cycles. We haven't had a down for some time but when it happens it is good to have another business," he explains.

Recycling potential

Coperion also sees considerable future potential in the area of recycling, both for traditional mechanical

recycling projects and for chemical recycling of waste plastics to fuel or feed-stocks. "We are seeing more and more of these projects where you are changing the materials – it's partly lab scale but we are supplying some production machines to go on-line soon," he says.

Recycling falls under the remit of Peter von Hoffmann, Coperion General Manager Business Unit Engineering Plastics and Special Applications. "There is an evolution going on in recycling," he says. "Companies first developed a raw material system, then they bought machines and made pellets. But more and more of them are now looking at compounding to add value to their product. That is where the trend is going – from recycling to compounding. They need a twin screw compounder to do that. It's more expensive than a single screw but if they want to incorporate fillers or fibres or are devolatilising they need it."

Bartel says Coperion benefits from its global footprint and its broad equipment range, which means it is able to supply compounders regardless of their technology and volume requirements. The company's top-of-range ZSK compounders are manufactured at its Stuttgart headquarters, its entry-level CTE and mid-range STS models are manufactured at its facility at Nanjing in China (established in 2004).

PHOTO: COPERION

Above: More than 200 compounding customers attended the Coperion Extrusion Days in Stuttgart in November

CTE machines are aimed at emerging plastics markets where price is a key issue (they are not CE-marked so are not marketed in Europe where the entry level would be an STS model). "They give us a chance in areas such as Africa where customers are not so highly financed and cannot afford high level technology. If we had not started [the CTE] business we would have lost business," Bartel says.

Bartel emphasises that the difference between the machines is in specification, not quality. Much of the manufacturing and inspection equipment used in Nanjing, for example, is the same as that used in Stuttgart. An example is the company's use of flash spectrophotometry to check the composition of incoming steels. "The CTE is still the most expensive machine made in China and we will never beat [local competitors] on price, only on technology. But we don't need to be two or three times the price," he says.

Coperion also has screw element and machine assembly capacity at its Pitman facility in the US. The US operation was established as a global manufacturing centre for screw elements up to 100mm in diameter but that strategy has changed a little with the recent introduction under the Trump administration of 25% tariffs on imported steel. "To make the screw elements in the US we have to ship the steel from Europe as we have not found suitable suppliers there," says von Hoffmann. The tariffs make the US location less attractive for export work so the facility is focusing more for the moment on production for the US market.

Lean manufacturing

Aside from the high levels of investment in the plastics industry over the past decade, Bartel says that a significant part of Coperion's recent business growth can be attributed to the adoption of the lean manufacturing and target-driven business strategies of its US parent Hillenbrand. It acquired the materials handling group K-Tron in 2010 and then compounding machinery maker Coperion in 2012, merging the two into a single group using the Coperion and Coperion K-Tron brands in 2013.

Hillenbrand owns one of the leading producers of funeral caskets in the US – Batesville – and has developed its own lean manufacturing system. This Hillenbrand Operating Model has been applied across the Coperion business. It draws heavily on automotive industry practices and aims to improve efficiency, speed decision making, and develop the capabilities of employees.

"We look to apply lean and to develop talent – we look at each individual and develop their skills to take them to the next level," Bartel explains. "This has moved us from a good German machinery company to a company that is data-driven. We make decisions on where to invest based on that data. We

PHOTO: COPERION

Above: Compounding World Editor-in-Chief Chris Smith takes a close-up look at one of the demonstration exhibits

focus on what value it brings to the customer; if it brings value they will buy it."

Targeting leadtimes

One area Coperion is currently addressing is lead times. Extended delivery and material and component shortages have presented a problem for all plastics equipment machinery makers but especially so for its production of its high performance machines (von Hoffmann explains that orders for the highly specialised aerospace-grade steels used for its ZSK extruder shafts may typically have to be placed a year in advance).

To ease capacity bottlenecks the US operation has taken on additional sub-assembly work while assembly of some of the larger ZSK models has been relocated from the Stuttgart factory to an assembly partner in the east of Germany. In addition, one of the Stuttgart test bays has been convereted to an assembly cell, adding capacity for a further two machines.

Von Hoffmann says these moves, together with the decision to increase inventories for some key components, means it has been able to reduce leadtimes by up to half on its most popular machine sizes, albeit with some impact on the specification available. That limitation is due to the sheer number of options available; across the ZSK range there are 45 barrel types, 2,900 design and 11,800 screw variants. "For the customer it's a choice. Do they want a specialised machine or do they have an advantage to have a machine faster," he says.

The Extrusion Days event also gave Coperion the opportunity to show its latest technical developments. Key among these were the company's Involute screw elements. Unlike the classic constant radius self-wiping profile, originally developed more than 70 years ago by Rudolf Erdenger and that remains in use today, Involute elements feature a changing radius that means elongational stress in the melt can be varied. This is said to be particularly beneficial in processing of highly filled formulations – PP or PE with up to 85% $CaCO_3$ or up to 50% talc – where output rates can be lifted by more than 50% in some cases.

Coperion also demonstrated the use of its throughput-lifting Feed Enhancement Technology (FET) on a ZSK 58 Mc18 compounding line running a 20% silica-filled PET antiblock masterbatch. The line was equipped with a semi-automatic SCP strand conveyor and SP200 strand pelletiser and was running at up to 2 tonnes/h. FET uses porous elements in the wall at the feed zone and is claimed to improve intake of feed limited products by up to three times.

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Additive approach to films

*Additives hold the key to improving the performance of films for many applications. **Peter Mapleston** looks at some of the latest additive and masterbatch introductions*

Today's film products are highly engineered structures designed to meet exacting standards. Additives are critical in achieving the levels of performance required for effective production, processing and in-service performance and the latest introductions address a wide range of issues, ranging from slip and static management, through to fogging and optics and even anti-counterfeiting. This article explores some of the latest developments.

Dow Performance Silicones, now a business unit of DowDuPont's Specialty Products division, recently introduced Dow Corning MB25-235 Masterbatch, a new silicone-based technology that it says significantly reduces the coefficient of friction (CoF) of low density polyethylene (LDPE) packaging and agricultural films. The supplier says the new masterbatch addresses the traditional drawbacks of organic additives, "delivering stable, long-lasting slip performance and avoiding migration to the film surface." It is approved for food contact in the European Union, US, and China and is well suited for use on high-speed form-fill-seal (FFS) equipment.

The new masterbatch is the latest in a growing range of silicone-based masterbatches for flexible packaging and complements the Dow Corning HMB-6301 Masterbatch for reducing CoF in bi-axially oriented polypropylene (BOPP) film, which was introduced in 2017.

According to Christophe Paulo, Industrial and Consumer strategic marketer, EMEA, Dow Performance Silicones, the Dow Corning MB25-235 Masterbatch "far surpasses traditional organic additives by delivering a consistently low, stable CoF that is unaffected by time duration or temperature." He says it maintains critical mechanical properties such as tensile and tear strength. Zero migration between film layers or between the film and package contents helps to prevent impact on downstream operations, such as printing and

Main image: The agricultural sector is seeking performance films developed to offer extended lifetimes and improved yield

Right: Dow Performance Silicones' MB25-235 masterbatch is claimed to improve slip characteristics at low addition rates

metallization and potential contamination of food or other contents. The new product is also claimed to be cost-effective, since it only needs to be incorporated into the outer layer of multi-layer films. In addition it helps reduce haze.

Agricultural films

The MB25-235 Masterbatch is also well suited for use in agricultural mulch film, greenhouse film and silage film. Céline Chevallier, Product Development Engineer for **Multibase**, another part of DowDuPont Specialty Products, discussed this application at the Agricultural Film 2018 Conference, organised last September in Madrid by *Compounding World* publisher AMI. She presented test data on the dynamic and static CoF and mechanical performance of three-layer blown film, the outer layer of which was treated with the new grade (together with a talc antiblock commonly used with slip additives).

Chevallier said that optimum results are obtained at an addition rate of between 2 and 4% by weight in the skin layer. Comparisons with organic slip agents depend on whether film/film or film/metal CoF is measured. Tensile properties (strain and elongation at break, tear strength) are unaffected by the additive.

Also working on alternatives to conventional organic additives is **Ampacet**, which has developed a new antiblock masterbatch for use in production of BOPP films. Seablock 4S is said to provide the antiblocking and permanent slip properties of organic antiblock solutions while avoiding scuffing of the particles and preserving the low slip properties, whatever the converting steps and speed.

When converting BOPP films at high speed, some extraction of organic antiblock particles from

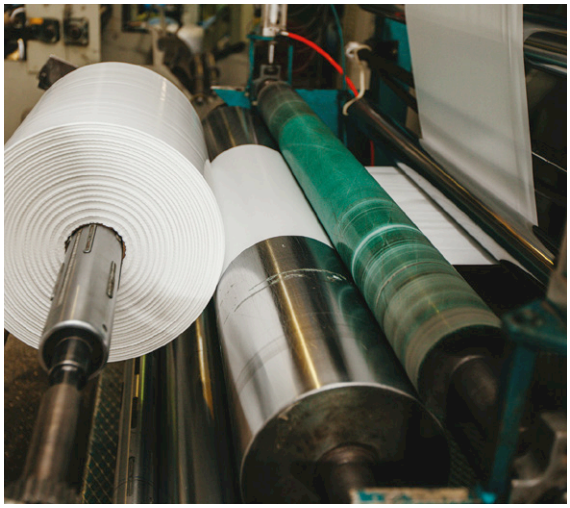


PHOTO: DOWDUPONT

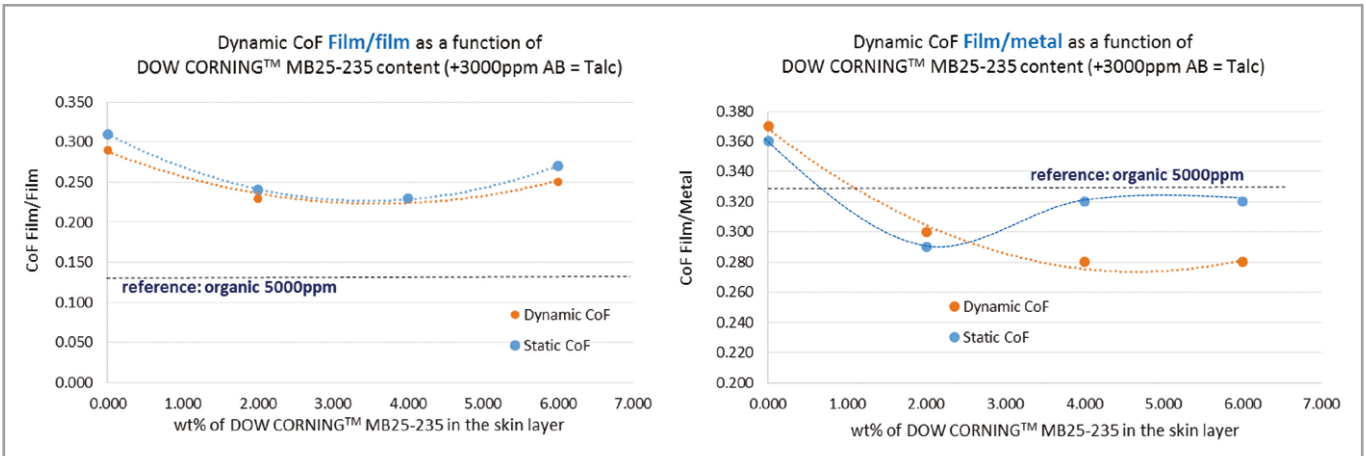
the film is a common problem. This scuffing can lead to accumulation of dust on the film surface and unpredictable variations of slip properties during converting. Ampacet says Seablock 4S allows BOPP film producers to manufacture high-quality films with permanent and predictable slip performances for smooth and consistent film converting.

"Thanks to superior particle anchorage, Seablock 4S reduces scuffing and leads to a low level of dust accumulation during high speed film converting," the company says, adding that the additive shows a good heat stability with "unmatched" low die and extruder fouling. Optical properties of the films are also said to be very good.

Anti-stat development

Ampacet has also been adding to its range of additives to reduce the build-up of static electricity in films. Permstat 232 is specifically designed to reduce problems in printing, converting and labelling operations for bi-oriented films.

"The labelling industry has been searching for permanent antistatic features for decades to



The effect of addition of Dow Performance Silicones' MB25-235 masterbatch on coefficient of friction (CoF) when used in the skin layer of a three-layer LLDPE/LDPE blown film. Film/film CoF (left chart) is higher than the reference but film/metal CoF (right chart) is lower

Source: DowDupont

PHOTO: SHUTTERSTOCK

Above: Antistatic additives can improve processing, printing and performance of films

replace conventional migrating antistatic solutions, which lead to unpredictable performance, being strongly dependent on storing time and conditions," the company says. "Permstat 232 provides immediate and consistent antistatic performances, independent from storing conditions (for example time, temperature and relative humidity). Permstat 232 offers outstanding optical properties allowing its use in clear no-label-look applications." The additive is approved for food-contact applications in Europe.

Croda International is working in the antistat area too. Just over a year ago, it acquired IonPhasE, a supplier of advanced anti-static additives headquartered in Tampere, Finland. These additives help to prevent damage to electrical components, increase the safety of chemical and food packaging and improve the long-term appearance of consumer appliances. The products encompass electrostatic discharge protection (ESD) and inherently dissipative polymers (IDPs), which work to release static electricity in a controlled way.

Maarten Heybroek, President Performance Technologies at Croda, said at the time that IonPhasE's products were a natural extension to its existing product portfolio. He said bringing together the expertise of both firms' research and development teams, Croda would be able to offer a broader and more diverse range of products to its customers through its dedicated global marketing and sales force.

IonPhasE additives are based on a co-continuous ion conductive polymer phase. Ions acting as charge carriers within the additive dissipate the static by making the charges mobile. Croda says the fSTAT products are suitable for polyolefin multi-layer and stretch films for applications where static control is vital, such as electronics manufacturing and packaging, chemical packaging and protective sheets. IonPhasE PE0108M FCC is also available where certain food contact approvals are needed.

Benefits in film extrusion include immediate and permanent anti-static effect, humidity independence, highly consistent homogeneous performance and heat stability. Echoing Dow, Croda says they are particularly effective in multi-layer film applications where static control is required only on one side of the film. This allows for a reduced addition level.

Targeting counterfeits

Israeli materials firm **Kafrit Group** is also looking to benefit from recent M&A activity. It acquired **Polyfil Corp**, a maker of masterbatch concentrates based in Rockaway in New Jersey in the US last November. Kafrit (which already owns Germany-headquartered Constab Polyolefin Additives) says, with the acquisition of Polyfil, the firm "is significantly expanding its footprint as a global leader in the masterbatch arena."

Polyfil describes itself as the largest independent US manufacturer focusing solely on the development and production of performance enhancing additive concentrates for polyolefins. Its product line includes antistats, and also antifogs, chemical foaming agents, UV stabilisers, purge compounds, processing aids, antioxidants, mineral filled concen-

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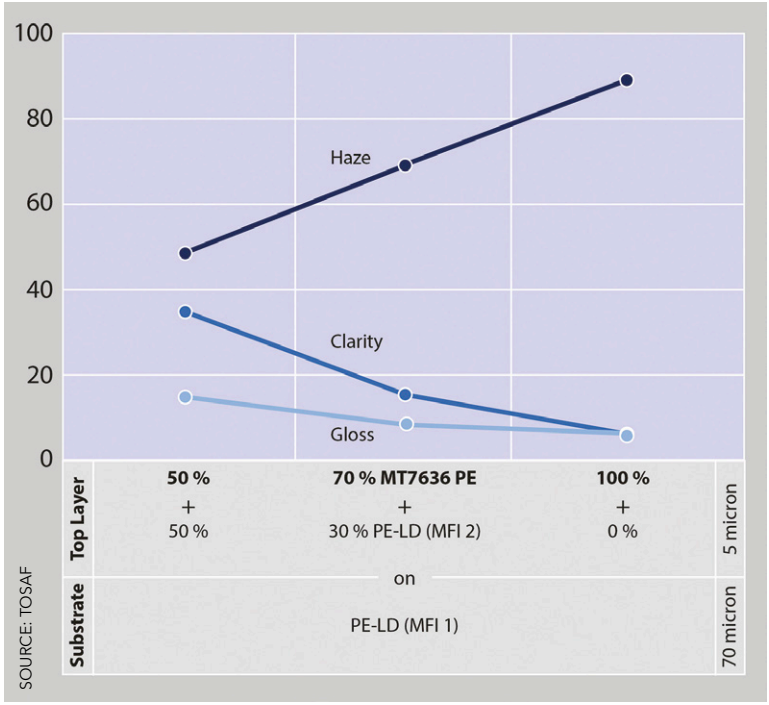


Above: Addition of Tosaf's new MT7636PE to an ultra-thin PE top layer significantly changes the visual appearance of a PE-LD film in terms of haze, clarity and gloss

trates and multifunctional additive concentrates.

At the beginning of this year, Kafrit announced that Polyfil would begin offering its Tracer anti-counterfeit technology in the US for use in plastics packaging and other parts. Kafrit sees big potential in this application – it forecasts that by 2020, $284bn dollars will be spent by government and corporations to combat counterfeiting. Nadav Goldstein, Vice President of Business Development and Innovation for the Kafrit Group, says he expects Tracer technology to play an important role in preventing the sale of imitated consumer goods.

Tracer technology involves the use of chemical-based codes or markers and a user-friendly reader. The chemical-based codes are compounded into masterbatches/concentrates and added to a resin during fabrication. They can be used at low concentrations without affecting product properties.

"The technology offers thousands of codes that can be used in the patented system increasing the security of the marked package or part," Kafrit says. "In addition, Tracer has the unique ability to provide data embedded or linked to the code like month of production, production location, intended market or country of origin."

Handheld readers are personalised so that only clients can authenticate their company's products, making it impossible for counterfeiters to imitate, the company claims. A Blockchain system enables secure tracking and tracing throughout the supply chain.

Tracer technology, which requires no changes in the production process, is compatible with all plastic production methods and compatible with various additives and all polymers. It is also compliant with industry regulations for food contact, REACH and others.

Matt enhancements

A novel product from **Tosaf** is MT7636PE, a matt additive to create thin (2 to 5 micron) skin layers on oriented and non-oriented polyolefin films, combining high haze (approximately 80%) with extremely low gloss (<10). Specific areas with matt effect can be made transparent by applying a lacquer coating or by gluing a clear label on top of the matt layer.

Based on an undisclosed polymer mixture which does not contain fillers, MT7636PE is said to provide advantages that include full control of haze/gloss properties on demand; a cost-saving matt effect without the need for an additional converting process; excellent rheology for easy processing; and low die build-up. It is suitable for PE and PP films.

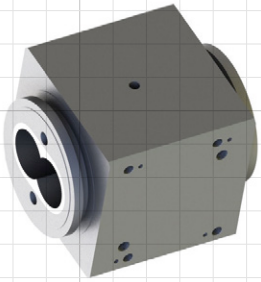
Tosaf says that converters using MT7636PE "can easily achieve a luxurious look thanks to a uniformly continuous light transmission with a perfectly consistent transparency level over the entire surface." It says the new additive also provides a perfect substrate to be printed with a clear lacquer, providing areas with complete transparency. Thanks to its high surface roughness, MT7636PE supports good adhesion of such lacquers and other inks to the film. Typical applications of MT7636PE include food packaging, mainly dry food such as pasta and bread, as well as pet food.

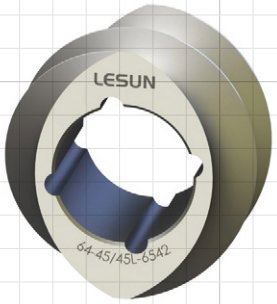
Outdoor innovations

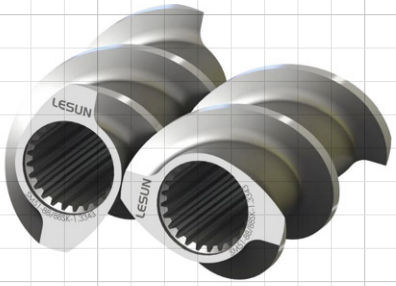
New additive introductions for agricultural films include Ampacet's Proflow 1000400-E, a masterbatch designed to assist in the processing of blown films intended for outdoor use. It outperforms the most well-known competitive process aids and

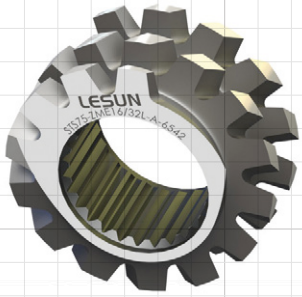
PHOTO: AMPACET

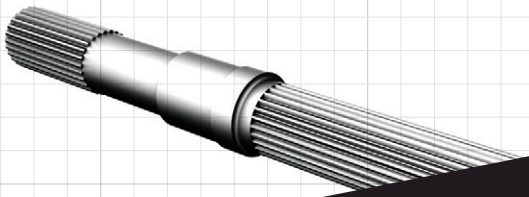
Right: Ampacet's Proflow 1000400-E masterbatch is a performance processing aid for blown films intended for outdoor use, such as silage wrap











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Film layer thicknesses (microns)	Dart impact strength (g)	Avg. MD tear resistance (g)	Avg. TD tear resistance (g)	OTR @23°C, 0%RH (cµm3/m2/24h)
8/4/8	55-60	412.5	625	66
22/6/22	230	1215.7	1870	48
20/10/20	90-95	895.7	526.7	23
50/50/50	100	443.3	1345.7	64
70/10/70	800	>3200	>3200	25

Mechanical properties and oxygen transmission rates of films produced with Tosaf's BR7503PE/BR7562PE. The masterbatch was added to the core layer at 70%, except for the fourth film, where it was added at 50% owing to the high core layer thickness
Source: Tosaf

market references in blown films, according to the company.

Some outdoor applications, such as greenhouse and low tunnel film, silage stretch wrapping film and industrial packaging, require the combined use of processing aids and hindered amine light stabilisers (HALS) to allow the use of high-performance resins while extending the service life of the film. However, the HALS may affect the efficiency of the processing aids. Ampacet designed Proflow 1000400-E for optimised performance in the presence of UV light stabilisers. "It demonstrates minimised interactions with various UV HALS stabilisers, with excellent results in preventing die build-up and shark skin effects," says the company.

Last year, **PolyOne** said it had been collaborating with agricultural films manufacturers to help growers reduce food waste by incorporating OnCap anti-fog additives into their films. "Agricultural films manufactured with OnCap anti-fog additive solutions help reduce the possibility of condensed water falling on growing fruits and vegetables," says Christoph Palm, Vice President and General Manager, Color and Additives EMEA & India for the company. "The same attributes that reduce fog from forming on the films used to pack fresh foods for display in stores also create tremendous value for farmers growing fresh produce by reducing the possibility of condensed water contacting the produce."

OnCap anti-fog concentrates are said to be easy to handle and can be added at a film extrusion machine with no extra equipment required.

Below: Improved anti-fog, UV barrier and extended lifetimes are some of the benefits available to agricultural film producers

PHOTO: SHUTTERSTOCK

Improving barriers

Staying with agricultural film, BR7503PE and BR7562PE are new PE-based masterbatches from Tosaf that provide a high barrier to oxygen and fumigants. They enable production of barrier silage and mulch films using a three-layer extrusion line. BR7503PE is intended for blown film where bubble stability is crucial, while BR7562PE is for cast film or where sealing is needed.

Agricultural barrier films most frequently use EVOH in the barrier layer and, because it is incompatible with polyethylene, a tie layer is required. The accepted method for producing these films involves a five-layer extruder. "Film producers that do not have suitable extruders find themselves out of the barrier film market," says Agriculture Product Manager Dr Meirav Fleischer. The new masterbatches are in advanced approval stages with customers.

Tosaf has also launched a UV masterbatch, UV8915PE, with high chemical resistance. This is in response to demand for agrifilms with longer lifetimes, even when used with high concentrations of pesticides. It enables the production of greenhouse film with a three-year useful life and capable of withstanding up to 5,000 ppm of sulphur, which is commonly used for greenhouse fumigation. Greenhouse film typically withstands a maximum of 3,000 ppm over the same period.

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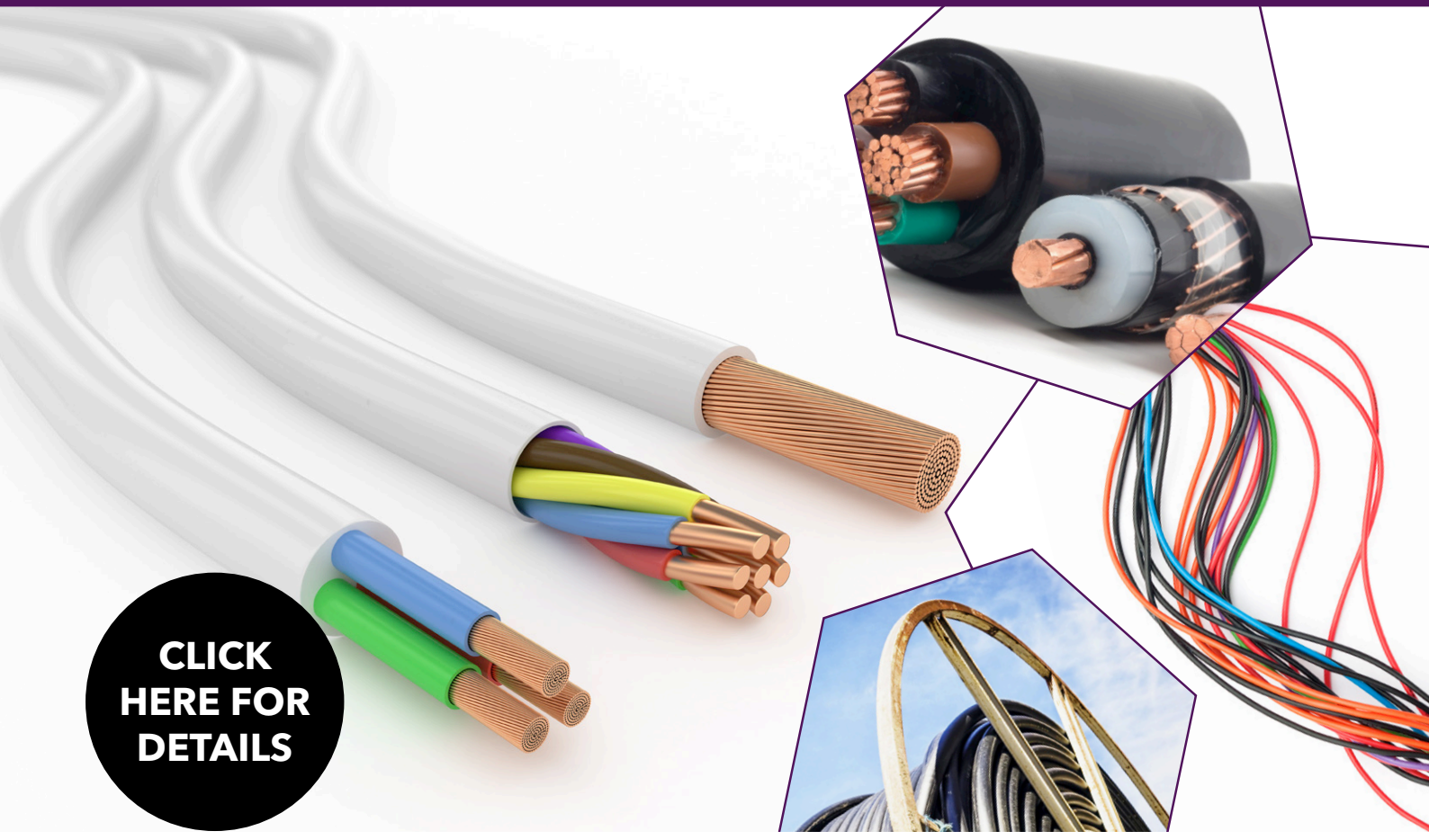

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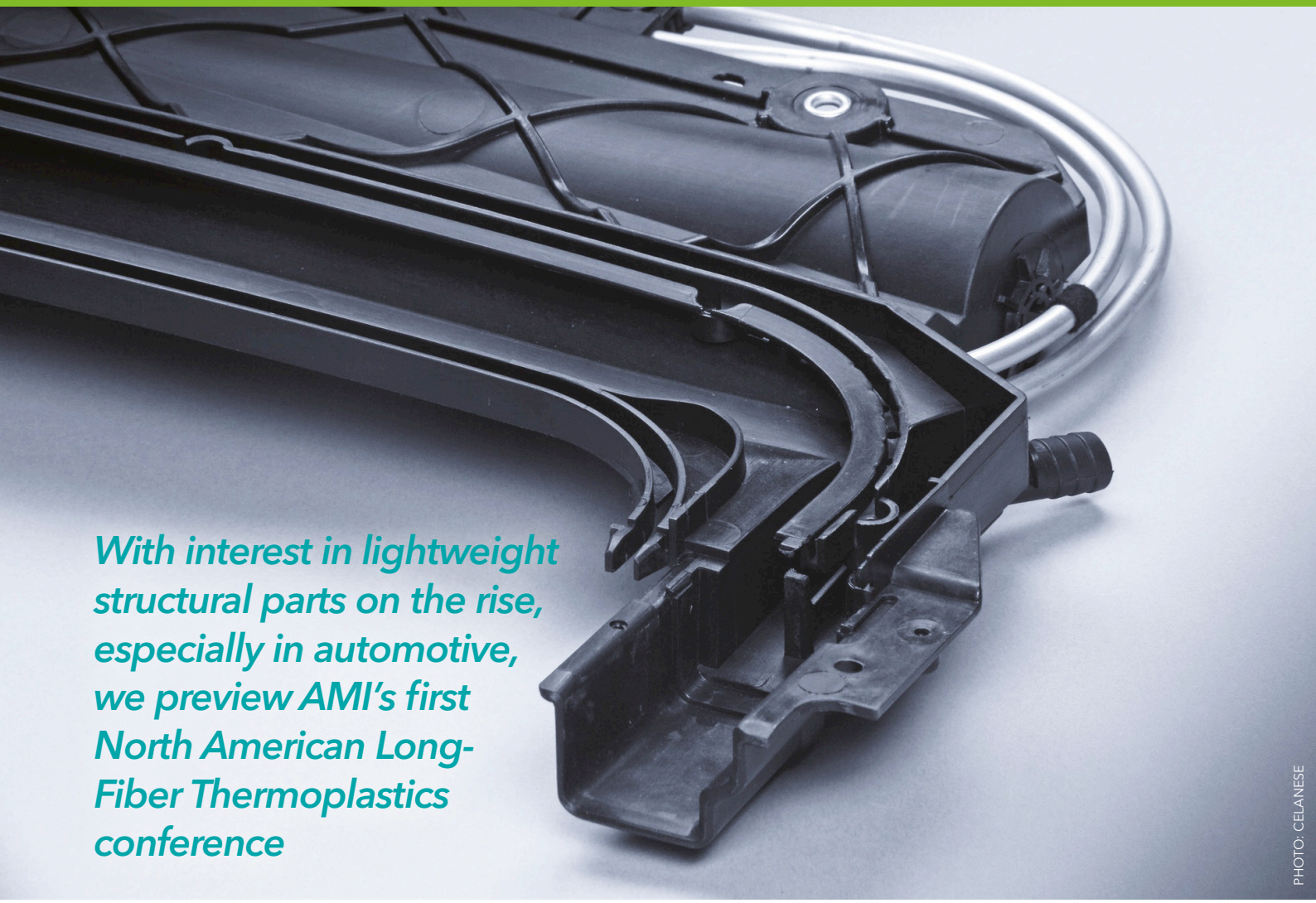

With interest in lightweight structural parts on the rise, especially in automotive, we preview AMI's first North American Long-Fiber Thermoplastics conference

PHOTO: CELANESE

LFTs in the spotlight in US

Main image: LFTs allow structural parts such as sunroof frames to be produced at lower weight and cost due to enhanced part integration

Already established in Europe, AMI launches its Long-Fiber Thermoplastics conference into North America this year. The conference, which will take place in Dearborn, Michigan, in the US on 5-6 March, will bring together key players and industry experts from across the LFT supply chain to explore new advances in LFT materials, processing technologies and applications.

Interest in LFT materials is growing fast, especially in the automotive industry, where OEMs are facing tough global challenges in terms of fuel efficiency and vehicle emissions. LFTs provide new opportunities in terms of strength and mass along with all the productivity and part integration benefits of injection moulded plastics.

The Long-Fiber Thermoplastics expert line up of speakers will share technical and commercial insight into the LFT market, identifying key application sectors as well as analysing end-user and global requirements, and identifying future trends and market challenges. Presentations will cover all aspects of LFT and associated composite innovation, including lightweighting, automotive and appliance applications, LFT production and processing, and reinforcement options.

The conference will open with an examination of lightweight developments in commercial vehicle cockpits, which will be given by **Dr Jeffrey Helms**, Global Automotive Sales Director at **Celanese** in the US. He will be followed by **Jungdu Kim**, Technical Service Manager at **Songwon International** in the US, who will discuss low VOC stabilisation systems for filled PP compounds used in automotive applications.

Dr P K Mallick, Professor at the **University of Michigan-Dearborn** and leader of the Center for Lightweighting Automotive Materials and Processing, will take the discussion beyond LFT with an analysis of development of continuous fibre thermoplastics composites for automotive applications. And **Dr Zhang Chao**, Automotive Engineering Plastics Product Line Manager at **Kingfa** in China, will explore the use of long glass fibre reinforced polypropylene for automotive lightweighting.

Performance matters

The conference will then move on to focus on achieving maximum performance with LFTs. **Dr Jacob Anderson**, Project R&D Engineer at **Nippon Electric Glass** in the US, will provide an insight into the development and optimisation of hybridised glass/carbon composites to balance cost and performance. This hybrid approach will be further considered by **Philip Chu**, Lead Chemist at **Zoltek**, who will discuss production of carbon and glass fibre hybrid composites. Then **Tim Vorage**, Global Market Development Manager at **DSM** in the Netherlands, will look at opportunities for LFTs based on the high performance PA4T resin.

The remainder of the first day takes a more interactive approach, kicking off with an hour-long panel discussion exploring future trends and requirements in LFTs. This will provide an opportunity to share insight across the supply chain. Panel participants include **Maurizio Longhi**, Materials Technology Principal Engineer Resins GSME at **Whirlpool** in the US, and **Sachin Jain**, Managing Director at **SKYiCOMPOSITES** in India.

The panel session will be followed by a series of roundtable discussions running over an hour and designed to give attendees the opportunity to share ideas and brainstorm.

Realising potential

The second day of the conference will be opened by **Dr Eric Martin**, Global LFT Manager at **Solvay Specialty Polymers** in Belgium, who will detail some new performance standards achieved with LFTs. He will be followed by **Michael J Balow**, Senior Adviser at **Asahi Kasei Plastics** in the US, who will discuss hybrid approaches for long fibre applications in PP. Then **Karl Schnetzinger**, CEO of **Advance Polymer Compounds** in Austria, will explain development of a polyamide blend matrix for D-LFT products. And

Expert speakers sharing their insight at Long-Fiber Thermoplastics USA 2019 include, from left, Celanese Global Automotive Sales Director Dr Jeffrey Helms, Kingfa Automotive Engineering Plastics Product Line Manager Dr Zhang Chao, and University of Michigan-Dearborn Professor Dr P K Mallick

Daniel Berg, Global End Use Manager Transportation at **BYK Inc** in the US, will explore the optimisation of coupling agents for LFTs.

Processing technology is the focus for the final session of Long-Fiber Thermoplastics. Compression press development and technology will be covered by **James Geisendorfer**, Technical Sales and Business Development Manager at **Dieffenbacher** in the US. **Robert Roden**, Associate Vice President at **Steer** in the US, will follow with an update on direct compounding of LFTs.

Srikar Vallury, Engineering Manager at **Moldex3D** in the US, will share insight into the latest moulding simulation and mechanical performance prediction tools available for LFTs parts. Then **Willen Sundblad**, Founder and CEO of **Oden Technologies** in the US, will explore how intelligent industrial automation and captured process data can be used to solve quality, downtime and production problems. And the conference will be brought to a close by Dr **Juergen Giesow**, Director of Technology and Engineering at **Arburg** in the US, who will look into the latest technologies available to processors using the latest injection moulding technology.

Long-Fiber Thermoplastics USA 2019

Taking place in Dearborn, MI, US, on 5-6 March, Long-Fiber Thermoplastics 2019 is AMI's first North American conference to focus on LFT technologies and applications. A line up of leading international experts will examine the latest developments in the materials, production techniques and end-use applications that are driving growth in the LFT composites market.

Long-Fiber Thermoplastics 2019 will bring together existing and potential end-users and processors of LFTs with key players in the supply chain to learn more about the utilisation, formulation and processing of these versatile, high performance and light weight polymer compounds.

In addition to two days of formal presentations, the conference will provide extensive networking opportunities during the informal refreshment and lunch breaks and first day cocktail reception. The event also includes a table-top exhibition.

For further information visit the **conference website** or contact Senior Conference Coordinator Stephanie Hume. Tel: +1 610 478 0800; Email: **stephanie.hume@ami.international**

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*Whether for development or quality purposes, reliable polymer characterisation is essential in modern production plant. **Jennifer Markarian** explores the latest developments and learns more about the impact of Big Data*

PHOTO: SHUTTERSTOCK

Polymer analysis moves from lab to production

The ability to analyse the rheology and other properties of polymers and the components of polymer compounds is vital for product and process development and quality control purposes. Tools range from the simple but useful melt flow indexer to more complex instruments such as dynamic-mechanical analysis (DMA). And it is not just about laboratory-based testing – line-side and on-line instruments are growing in importance as testing and integration technology advances and process control systems become more sophisticated. And the ability to collect, store, and analyse ever greater volumes of data is making new ways of thinking about polymer analysis possible.

Sensor and polymer testing equipment group **Dynisco** has expanded its polymer evaluation products for laboratory testing with the release of the LMI5500 Series Melt Flow Indexer for thermoplastics. A unified software platform between laboratory and online production equipment in this latest model is said to enable processors to more easily obtain detailed analytics globally on a single dashboard. Other features for improved ease of use include an easy-to-clean and remove inspection plate; improved access for sample cutting; and a revamped and more intuitive touchscreen. In addition, the new instrument's gravitational correction feature (for which a provisional patent has been obtained) takes into account gravity based on geographical location in relation to the equator, which is said to improve accuracy.

While instruments such as melt flow indexers or capillary rheometers (utilised for measuring apparent viscosity) are used offline in the lab, online rheometers are increasingly being used to provide a continuous data stream of rheological

Main image: The ability to measure polymer properties such as rheology is vital for development and QC purposes, with many now doing that in the lab and on the production line

PHOTO: DYNISCO

Right: Dynisco's LMI5500 Series melt flow indexer uses a unified software platform to simplify handling and analysis of lab and production data

properties at different process conditions, according to Johannes Lorenz, Sales Manager at Dynisco Europe, in a presentation given at AMI's Polymer Testing & Analysis Europe conference in September last year. "These data can be used in many ways," says Lorenz. "Data could provide viscosity as a parameter to be used in the extruder control system – for example to control the dosage of additives or raw materials. They can also be used for in-process quality control instead of, or in addition to, lab tests."

To correlate process and lab data, Dynisco's Internet-of-Things-based platform collects, stores, and visualises data from on-line as well as lab instruments. "Field tests and case studies show that – next to the classical process parameters such as pressure, temperature or motor torque – viscosity or MFR [melt flow rate] can provide a much more sensitive and accurate insight into the process," Lorenz says. He explains that such measurements have been standard in polymer manufacturing but their use has more recently been increasing in compounding and recycling, especially of polyolefins and polyesters.

Dynisco's ViscoIndicator Online Rheometer, for example, can be set to calculate either apparent viscosity or MFR. One of the challenges in correlating online and offline measurements is the difference in temperatures of the tests, says Lorenz. However, he says the company's scientists have been able to calculate an appropriate temperature correlation that gives good agreement between online and offline MFR measurements.

Below: Leistritz claims the patented slit die geometry of its Elongation Rhemometer delivers benefits over capillary types in in-line applications

PHOTO: LEISTRITZ

In-line options

First introduced in 2017, **Leistritz**'s Elongational Rheometer can be used as a standalone instrument or linked to an extruder for on-line or in-line measurement of shear and elongational viscosities along the entire viscosity curve. Developed by Leistritz and the Institute for Polymer Extrusion and Compounding at the Johannes Kepler University in Linz, Austria, the instrument uses a patented slit die approach that is claimed to allow it to provide a more complete picture of melt quality than existing on-line technology using fixed-geometry capillary rheometers.

The rheometer works by diverting a small amount of melt via a bypass into the slot die, which features a hyperbolic narrowing designed to generate constant elongational flow (said to be a first for an online elongational rheometer). Delivery of the melt to the die is controlled by an internal gear pump, providing full independence from the compounding extruder. After the measurement has been made the molten material is transferred back into the process, avoiding any waste.

The device can be used with materials ranging from high viscosity pipe grades to low viscosity fibre or injection moulding grades. It provides online measurement of shear viscosity with shear rates in the range 10 to 10,000 s^{-1} and elongational viscosity with elongation rates in the range 5 to 75 s^{-1}. During the continuous measuring process, the operator can query two measured values of shear viscosity and one value of extensional viscosity.

Leistritz says the unit can be used to obtain viscosity curves in a very short time through targeted variation of shear and elongational rates. It can also indicate the melt flow index, IV value and melt density and can be used to monitor reactive compounding processes.

Goettfert's on-line rheometer product line ranges from bypass and side stream instruments to the Dynamic Online Rheometer (DOR), which attaches to the extruder and, because it also connects to a data collection system, can be considered to be "big data friendly," according to Tim Haake, General Manager of Goettfert. Speaking at AMI's Polymer Testing and Analysis North America conference in 2018, he said: "Connecting instruments via the Internet of Things and starting to collect data now is crucial."

Keeping data relevant by linking rheology data with the lot number and procedure is important for statistical analysis. Haake says that artificial intelligence (AI) can analyse unstructured data but, for now at least, keeping lab and process data in sync and understanding where the data comes from is necessary. Big data techniques can be used to recognise patterns, which can then be used to

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PHOTO: LEISTRITZ

Right: Leistritz's Elongation Rheometer can be used in standalone and in-line applications

used to optimise manufacturing. Big data can also be used to predict material properties and aid development of new materials and compounds. The widespread use of advanced analytics and even AI is not far off, predicts Haake, but for now the task is to collect relevant data that can later be used to feed mathematical models.

Goettfert has also recently introduced the off-line Melt Index Machine mi-Robo 89.16. This is a fully automated melt indexer that can run pellets, powders, or be fed directly with material from the process itself. Automation improves accuracy by eliminating the "human factor" that can create variability. The instrument's electric drive technology is also significantly quieter than the previous version's pneumatic motor.

Austria's iVON offers an online rheometer designed to measure the intrinsic viscosity (iV) of PET. A key benefit of the system is the ability to optimise input material mix and pre-drying times using a feedback control loop based on iV measurement. In addition, the system provides full traceability for documenting quality parameters. The "plug & play" system can be operated as an independent unit or connected with the extruder control system.

DMA for the lab

Anton Paar's new MCR 702 MultiDrive for dynamic mechanical analysis (DMA) combines a new linear motor with the EC drive technology from its MCR rheometers, enabling users to perform DMA in tension, bending, compression, and torsion, as well as thermomechanical analysis (TMA) and rheological characterisation, in one instrument. The motor design, unique to the MCR 702 MultiDrive, has low magnetic hysteresis that enables precise measurements over a broad force range up to 40N. This range enables characterisation of all types of materials ranging from soft to stiff. The large displacement range of the linear motor from 10nm up to 9.4mm is suitable for all kinds of DMA in tension, bending and compression; thermomechanical analysis; and static procedures such as tensile testing.

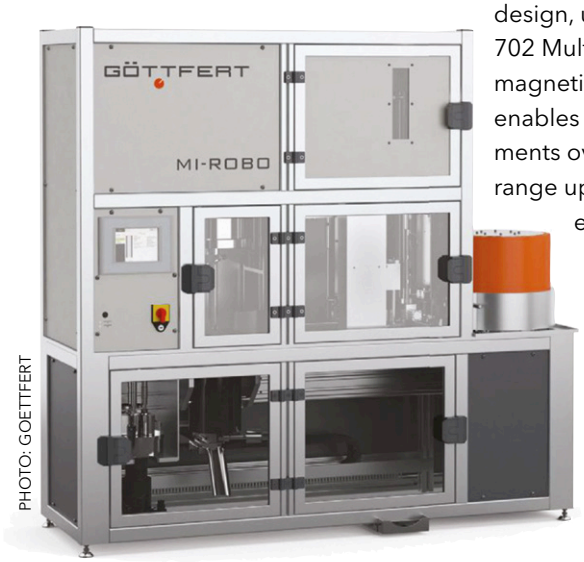

PHOTO: GOETTFERT

Left: The Goettfert mi-Robo 89.16 is a fully automated melt indexer

The MultiDrive can also be used for DMA in torsion or as a research-grade rheometer to characterise polymer melts or polymer solutions by using the top EC motor and keeping the bottom linear motor fixed. As an extra feature for rheological measurement, the two drives can work in counter-movement mode and also in separate motor-transducer mode when combined with an additional EC motor instead of the linear motor. In this configuration, the device enables combined characterisation methods (for example, rheology and microstructural analysis with a microscope), rheological tests at high rotational speed, steady and transient rotational tests, and oscillatory tests.

The instrument provides automatic recognition of measuring systems using an RFID chip in each accessory, which reduces operator error. The system's temperature-controlled chamber (offering a temperature range from -160 to +600°C) has been optimised using computational fluid dynamics to avoid internal temperature gradients, ensuring a uniform temperature across the sample. The measuring system also includes an integrated temperature sensor, which increases the reproducibility of the measurement of the sample temperature.

An existing Anton Paar MCR 702 TwinDrive rheometer can be upgraded to a MultiDrive DMA system by substituting the lower rotational motor with the new Linear Drive and installing a new computer processing unit and firmware. "A user's current setup can easily be adapted to this functionality. This set-up saves space in the lab as well as the cost of two different instruments," says Anton Paar USA Sales Manager, Norbert Ponweiser.

Multivariate analysis

Polymer scientists have developed considerable understanding of how molecular structure and morphology, combined with processing variables, affect the properties of polymers and their end-use performance. Univariate (one variable) analysis is of some use, but since the relationships between

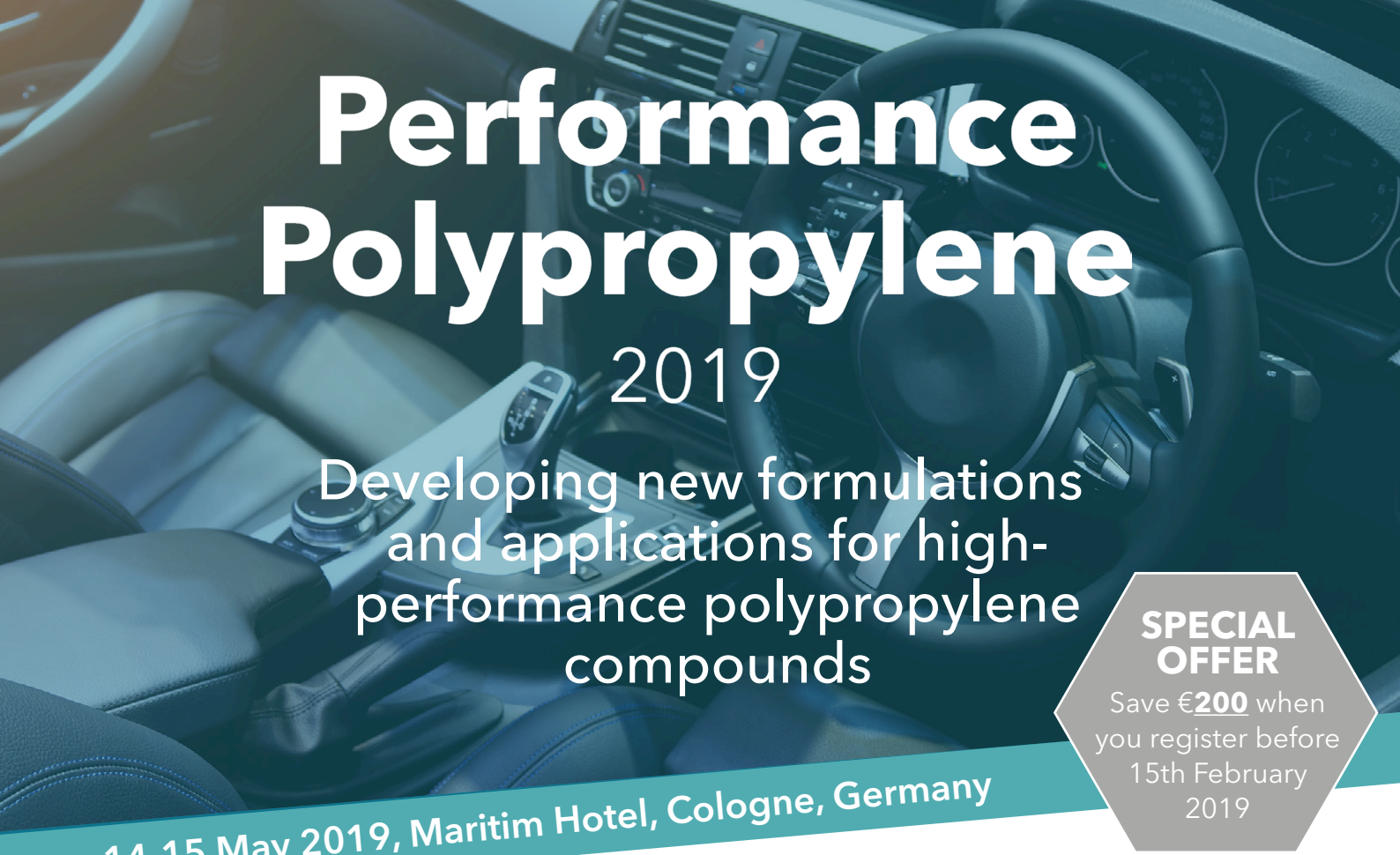

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PHOTO: SHUTTERSTOCK

Above: Big Data is opening up new opportunities for process analysis but will require new data analysis tools

the variables are actually complex and interrelated (correlated), multivariate data analysis (MVDA) methods are more appropriate in providing greater accuracy and a more thorough explanation of the variables' relationships.

At the Polymer Testing & Analysis North America conference in September last year David Fiscus, Senior Chemist at **ExxonMobil**, shared an example of how MVDA was used to develop structure-process-property relationships for polyethylene blown films. A big dataset was developed and analysed using multivariate linear regression methods to solve the multitude of simultaneous equations relating the variables.

The method of analysis was explained based on traditional chemometric approaches. Statistical analysis removed differences in the measurement scales of the variables, which enables comparing variable effects on an equal basis. Principal component analysis (PCA) independently relates the variables composing the input space (for example, molecular structure, morphology, and processing variables) with those of the performance space. The data can be visualized in various ways (Figure 1). Principle component regression analysis and partial least squares (PLS) regression analysis relate the variables of the input and output spaces, with both types of analysis mapping the input variables onto the output variables. The results of these forward regression analyses can be inverted, which enables prediction of the input variables needed to obtain any specific balance of performance variables.

MVDA is ideal for analysing big data sets generated during routine operations involving many correlated variables, including correlated data from steps along the value chain (such as the resin manufacturer, compounder, fabricator and end user), says Fiscus. He notes that MVDA can be used to improve compound formulations and optimise compounding and processing operations. It can also be used to establish multivariate statistical process control protocols for those processes, and it can be used to analyse data sets generated using design-of-experiments methods.

Various commercial multivariate software packages are available. Now that large amounts of data can be easily collected and stored, and the computing power to analyse big data sets is available, MVDA is likely to be increasingly used.

Pellet analysis

A new system from **Sikora** automates visual inspection and analysis of plastic materials in the lab. The Purity Concept V is an optical offline inspection and analysis system. As material on a tray moves through the inspection area, a colour camera records images for analysis. Contamination, such as black specks inside transparent pellets as well as on the surface of opaque and colored

Figure 1: Principal component analysis (PCA) of machine and transverse direction ultimate properties of blown PE film

Source: ExxonMobil

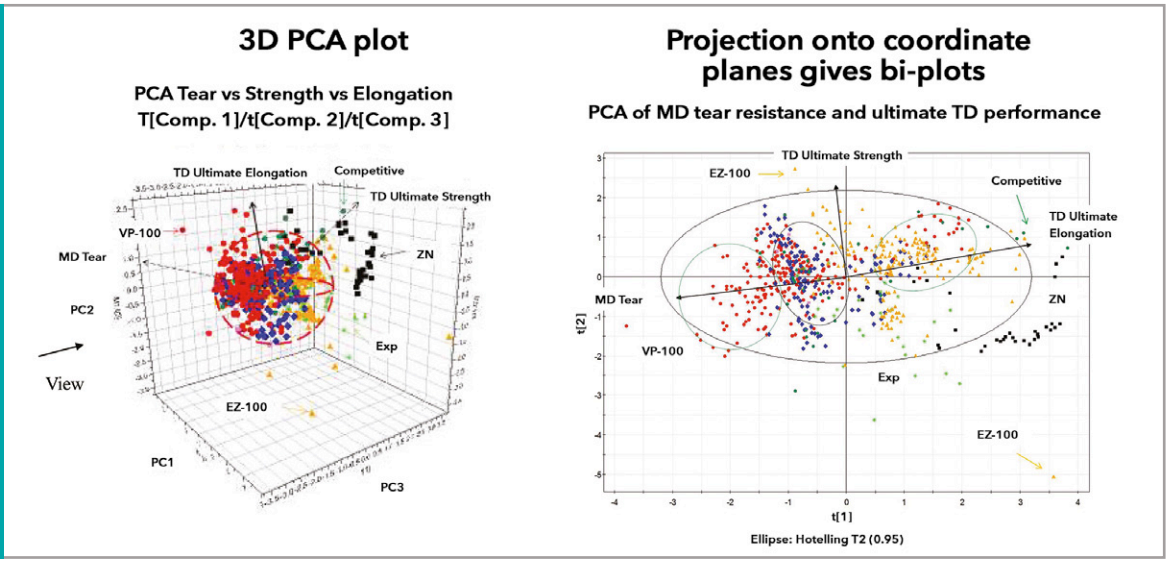

PHOTO: SIKORA

Right: The Purity Concept V system from Sikora fully automates lab-based pellet inspection

material, is automatically detected, visualised, and evaluated. The automated offline system is more accurate and more reproducible than an operator using a manual light table, says Sikora. The system determines the size of contamination, which is useful for quality control and process optimisation.

For online inspection and sorting of plastic material, Sikora recommends its Purity Scanner Advanced, which combines X-ray with optical technology to detect contamination inside plastic pellets as well as on their surface. The system uses an adaptive camera concept, with up to three optical cameras depending on the expected contamination and application. For example, an X-ray camera detects metallic contamination inside pellets; optical cameras identify yellow discolorations or black specks inside transparent and on opaque pellets; and colour deviations are detected by colour cameras. Contaminated pellets are sorted out automatically. The combination of online and offline inspection, sorting and analysis benefits quality control, and the data can be used to improve processes and to avoid future contamination, noted the company.

In 2018, recycler and compounder Minger Kunststofftechnik added Sikora's online Purity Scanner Advanced system to its lines for recycling technical and high-performance polymers (including fluoropolymers, PEEK, PA, PE, and PP) at its site at Appenzell in Switzerland. The company uses the inspection system to ensure high material purity. Black spots, foreign particles, and metal particles are eliminated by the automated system.

The scanner, combined with a processor to analyse and visualise the sorting, provides statistical evaluation of detected contamination sorted by number, size and frequency as well as an image gallery of contaminated granulates. This information is saved, and data such as the duration of the order, material type, throughput and rejection rate are also recorded, allowing full traceability after a project has been completed. "We use the production data as reference for future orders. Furthermore, we forward the information as a final report to our customer, who receives absolute technical transparency about his product and the production process," says Minger CEO Bruno Ofner.

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.dynisco.com**
- **www.leistritz.com**
- **www.ivon.at**
- **www.goettfert.com**
- **www.anton-paar.com**
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- **https://sikora.net/en/**

Below: Sikora's automated pellet analysis is said to be more accurate and repeatable than manual light table techniques

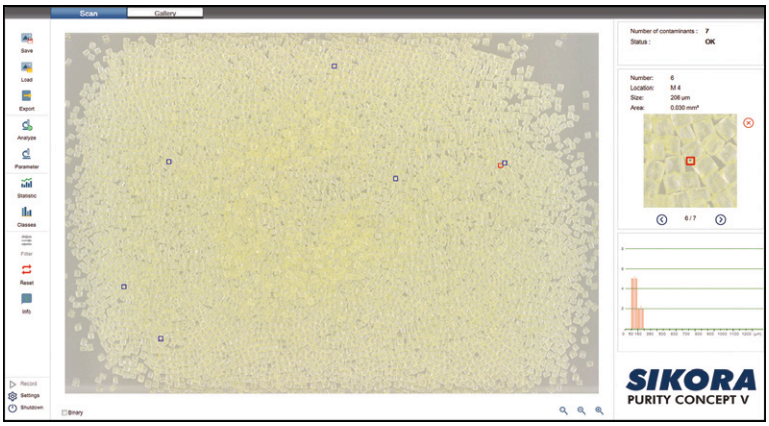

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PHOTO: INTELLIGENT PELLETIZING SOLUTIONS

Getting the cut right

*Selection of the most appropriate pelletising system is important in running an effective compounding operation. **Mark Holmes** learns more about the latest developments*

Compounding operations are far from standard and manufacturers of pelletising systems are working hard to meet an increasingly wide variety of demands. Some applications require a pelletising system built simply to manage high production throughputs; others demand flexibility and rapid changeover features for short run production. All, however, must offer reliability and easy maintenance, while seamless interaction with other compounding line equipment is becoming an essential requirement. In addition, more demanding polymer compounds call for new pelleting solutions. Underwater and strand pelletising technologies continue to be the systems of choice for specific applications, but variations on conventional approaches are emerging.

Head of Engineering at **Coperion Pelletizing Technology** Stefan Wygas highlights a number of developments in compounding that are driving changes in pelletising systems, including higher throughputs, automation and flexibility. "Higher throughputs usually require bigger machines," he says. "However, there are disadvantages in the handling and processing of strands with conventional water bath systems. As a result, Coperion has developed the SCP semi-automatic and ASC fully-automatic strand pelletising systems. In particular, these have been designed for highly filled or reinforced materials, which cannot be processed on underwater pelletisers."

Wygas explains that the working principle is the same as for conventional systems – cooling by

Main image: Pelletising systems must be selected to meet the needs of the specific compounding application with throughput, flexibility and rapid changeover top priorities

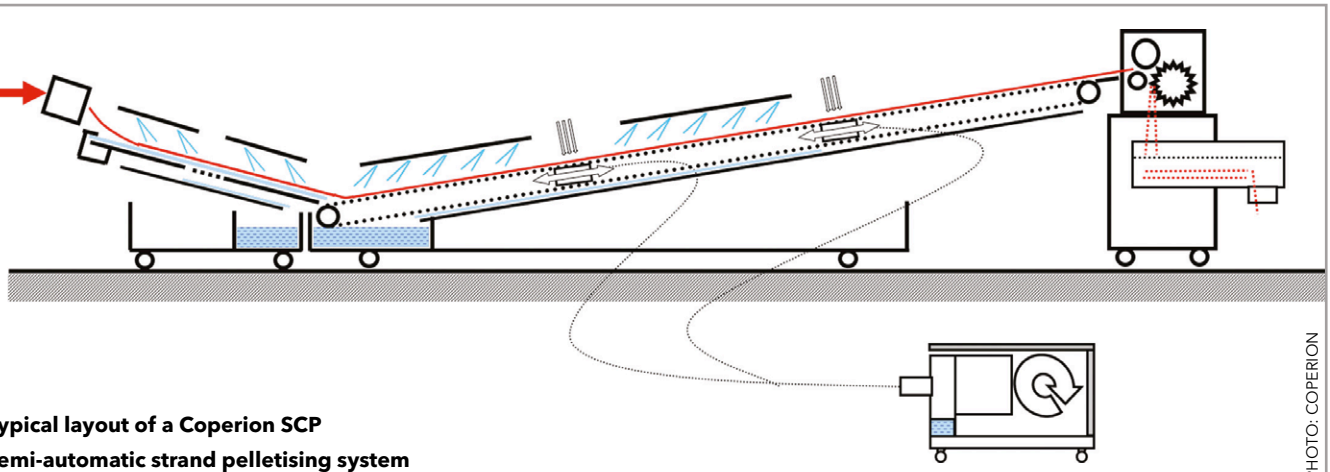

PHOTO: COPERION

Typical layout of a Coperion SCP semi-automatic strand pelletising system

water, drying, evaporation in ambient air and pelletising. "The difference is that the water bath is replaced by a combination of a chute, flooded by water, and a belt section that can be sprayed with water as well," he says. "In the belt section there are suction boxes included for strand drying. The end of the belt is always free of water in order to provide time for evaporation of the remaining water vapour to the ambient air. The belt enters the pelletiser directly."

According to Coperion, the difference between the semi-automatic and the automatic systems is that start-up of the SCP has to be carried out manually by an operator scraping the strands at the die. Following from there, strands are transported automatically by the flow of the water and gravity via the chute to the belt and into the pelletiser. Even if strands break during production, they are transported to the pelletiser automatically with no operator required. The ASC system offers fully automatic start-up.

PHOTOS: COPERION

Right: Water pre-separation locations (top image) and suction ports (lower image) on Coperion's SCP strand pelletisers can be placed to achieve optimal de-humidification

Coperion has also added new technical features to its pelletising systems. "Bigger throughputs and a more expensive labour force have increased the demand for automation," says Wygas. "We have added intelligent communication and interaction with the extruder and other components of the production line. In addition, all components can be adapted depending on the line throughput."

Automation appeal

Automation is intended to eliminate the risk of unforeseen events that could result in blocking of the strands. "The machine recognises large lumps and problems affected by that and can inform the operator or stop the process. There is also continuous supervision of process parameters, such as water and strand temperature, ensuring that the correct documentation can be produced. Water temperature control is automatically adapted to process demands, and heating as well as cooling can be realised," Wygas says.

Stable processes, good usability and easy maintenance are also increasingly important, he says, adding that the company offers a cantilevered single bearing design for the transportation belt on the automatic strand pelletising system, which ensures an easy change of the belt within 10 minutes. "We have also added 'shark fins' between the water chute and belt, as well as brushes or rollers on the belt, in order to stabilise strand behaviour and ensure a good cutting result," he says.

"In addition, because the length of the water chute and the belt are fixed, it is important for customers to be allowed as much flexibility as possible in order to produce a wide range of recipes. Therefore, water pre-separation can be done in different positions on the water chute. Furthermore, the water flow can be adjusted in order to meet product requirements. The belt can also be flexibly cooled down depending on

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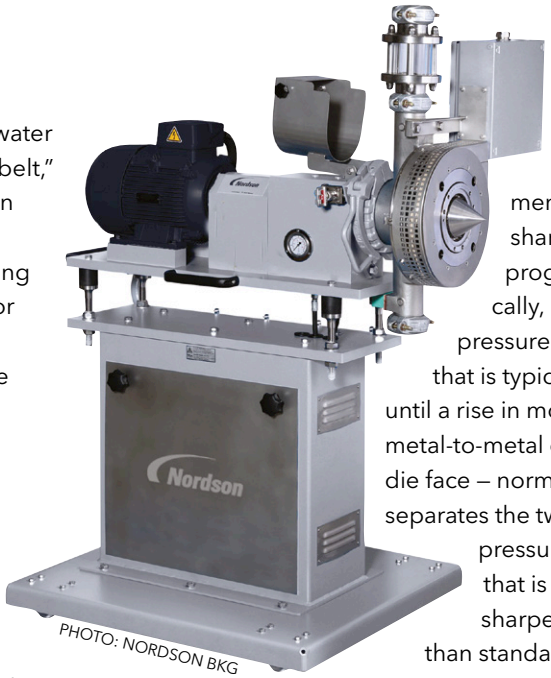

PHOTO: NORDSON BKG

Right: The BKG AH2000 underwater pelletiser from Nordson features hydraulic cutter advance

process requirements with water nozzles installed above the belt," Wygas says. Different suction positions are available to ensure the required remaining moisture level is achieved for the product. On the ASC equipment, positions can be freely selected beyond the transportation belt.

Cutter advances

For its BKG underwater pelletisers, **Nordson Corporation** now offers three options for advancing the pelletiser with its cutting knives into position at the die plate in the cutting chamber, according to Ralf Simon, Managing Director of Nordson BKG. "The basic option continues to be manual operation by means of a hand wheel," he says. "Available for easier operation is the BKG type AH, which automates the hydraulic advancement of the cutter. A third alternative, the BKG type AH D system, is equipped with an automated locking system of the pelletiser to the cutting chamber, for operator safety and hands-free start-up."

The manual pelletiser accommodates throughputs from 5-2,500 kg/h, against 5-5,000 kg/h for the type AH automatic pelletiser. A larger capacity automatic version, the BKG Type AH D, is available for lines of up to 35,000 kg/h. A hydraulic system ensures a constant pressure of the blade on the die plate, which is said to reduce wear to die plate and blades, eliminate "tails" or mal-formed pellets, and minimise operator intervention. "As hydraulic oil is a non-compressible medium, this system avoids a 'hopping' of the blades on the die plate surface," says Simon.

A further benefit of the hydraulic blade adjustment system is automatic blade sharpening, which can be programmed to occur periodically, he explains. "Hydraulic pressure increases from the level that is typical in standard production until a rise in motor torque indicates a metal-to-metal contact between blades and die face – normally a thin polymer layer separates the two. At this point hydraulic pressure drops sharply to a level that is sufficient to carry out sharpening while still being higher than standard production pressure."

Below: Delta Kunststoffe selected IPS underwater pelletising equipment for features such as the swivel cutter and ease of change of the hub

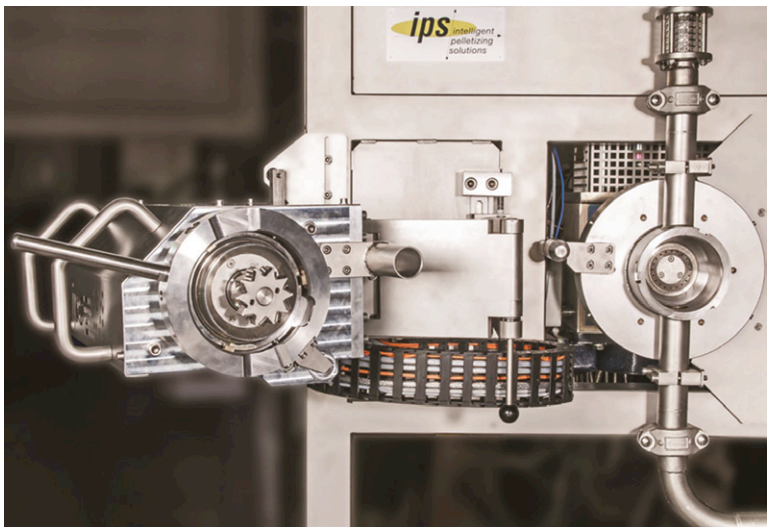

PHOTO: INTELLIGENT PELLETIZING SOLUTIONS

Underwater moves

Intelligent Pelletizing Solutions (IPS) has added underwater pelletising systems to its existing range of customised strand pelletising systems. The first two systems of the IPS-UWG 75 S have now been installed at Delta Kunststoffe at Weeze in Germany. It is a manufacturer of colour masterbatches, electrically conductive plastics, additive masterbatches and special compounds. The compounder already uses several conventional strand pelletising systems from IPS.

According to Manfred Fiedler, Operations Manager at Delta Kunststoffe, the company selected IPS because of the design of its underwater pelletising systems, such as the swivel system and ease of change of the cutter hub. Other factors included the clear layout and user-friendliness of the control system, as well as IPS's ability to integrate a number of user-specific features it required on the machine.

The IPS-UWG 75 S is suitable for production of spherical pellets in the manufacture of thermoplastic raw materials, as well as in masterbatch, compounding and recycling plants. The company says it supplies a complete pelletising system, including melt pump, screenchanger, start-up valve, die plate with pelletising unit, process water system and pellet dryer. "From individual components through to complete solutions, the modular design of our systems both for strand pelletising and for underwater pelletising offer our customers a huge degree of flexibility. Customers get exactly the system they need," says Gerald Weis, Owner and Managing Director of IPS.

IPS also recently delivered four HJCH9 underwater strand pelletising systems with a working width of 900 mm to a German customer. Each of the systems has an IPS-SGK 720 strand die head,

Left: Maag's PEARLO underwater pelletiser delivers high throughputs and a small footprint

which is now fitted with an automatic scraping device. IPS sourced the underwater strand pelletising systems from South Korean partner **Han Jin**, which were then re-engineered to meet CE requirements for the European market. The large working width means that the systems can process up to six tonnes of polycarbonate per hour. In collaboration with Han Jin, IPS supplies complete underwater pelletising systems up to a working width of 1,200 mm and a maximum throughput of 18 tonnes per hour.

Range extensions

New developments from **Maag** highlighted at last year's Fakuma show included the PRIMO 200 E model pelletiser from its WSG dry-cut strand pelletising systems range for production of high-quality standard pellets or micro-pellets. Like all models in the PRIMO E family, the company says that this latest machine features a variable system configuration for processing of soft, brittle or abrasive polymers. Quick tool and roller exchange enables flexible adaptation to specific production demands, delivering optimum flexibility for product changes. The pellets from this system can be infinitely adjusted in terms of weight and length to the specific task at hand. With a 200 mm draw-in width,the new model is designed for draw-in speeds of up to 120 m/min and maximum throughput rates of 1,500 kg/h.

PEARLO forms part of a new family of Maag high-performance underwater pelletising systems. The product line was developed for production of spherical plastic pellets and combines technologies from Gala and Automatik for highly efficient and flexible deployment in high-end applications at throughput rates starting in the single-digit

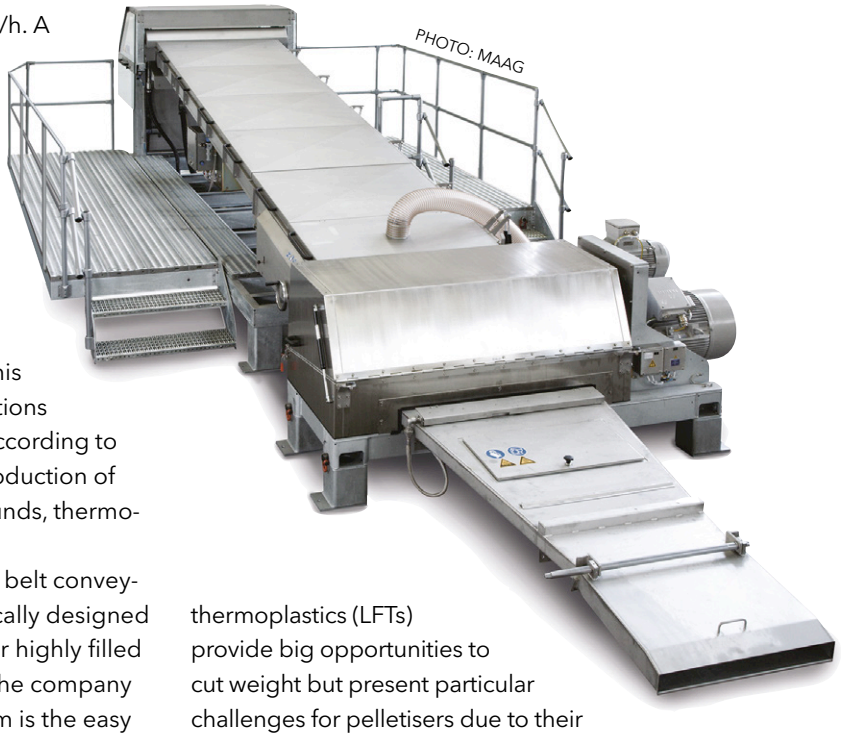
PHOTO: MAAG

Right: Hainan Huasheng has selected Maag pelletising technology for its new world-scale polycarbonate plant in China

range and extending up to 36,000 kg/h. A PEARLO 160 model presented at Fakuma 2018 provided a throughput of 1,000-6,000 kg/h.

Compact and modular in design, PEARLO systems are said to require only a small production footprint. Features include the electronically controlled EAC technology, which ensures precise positioning of the pelletising knives during operation. This means long run-times free of interruptions with consistently high pellet quality, according to Maag. Typical applications include production of wood- and natural fibre-filled compounds, thermoplastic elastomers, and rubbers.

Maag has also developed the EBG belt conveyor pelletising system, which is specifically designed for compounding of water-sensitive or highly filled (greater than 60%) fragile products. The company says one advantage of the EBG system is the easy handling for start-up and line cleaning due to its lightweight design and quickly exchangeable mesh belt. The machine is said to be well suited to the production of brittle highly filled compounds because of the reduced stretching and stress placed on the strands and the active conveying from extrusion die to pelletiser intake. The belt system also prevents strand breakages by continuous take up without any strand deflection.

Maag recently secured a contract to supply equipment, including pelletising systems as well as pumps and screenchangers, to Hainan Huasheng New Material Technology. When completed in 2020, the facility will be one of China's biggest polycarbonate plants and will be capable of producing up to 260,000 tonnes/yr (573m pounds) of polycarbonate for applications in electronics, automotive, aircraft, railway and security components, construction materials, and data-storage devices.

Maag says that it was chosen by Hainan Huasheng for the new facility because of the reputation it has built up since the 1980s for systems used in the production of polycarbonate. Around 90% of polycarbonate produced globally is manufactured using Maag equipment, the company claims. It says it has more than 200 production lines in operation, some of which include pelletising systems capable of producing up to 14 tonnes (28,000 pounds) of polycarbonate per hour.

LFT pelletising

The automotive industry's focus on emission reduction has seen a growing interest in light weight materials and designs. Long fibre reinforced thermoplastics (LFTs) provide big opportunities to cut weight but present particular challenges for pelletisers due to their high rigidity and glass reinforcement content. With its P-Series pelletisers and haul-offs, US-based **Bay Plastics Machinery** (BPM) has developed a strong position in the North American LFT production sector. The company's Vice President of Sales Jim Forgash says it is now looking to replicate that success in the European market.

The P-Series machines have been engineered specifically to handle tough pultruded LFT strands. Cutting geometry has been optimised to provide a clean cut with minimal wear on the blades while an isolation coupler eliminates rotor deflection. Dual flywheels increase the intertia while digital pellet length control allows on the fly adjustment. More than 100 P-Series units have been delivered to the market for applications ranging from laboratories up to production models offering a 1,000mm cutting width capable of handling up to 200 3mm diameter strands at feed rates of up to 135 m/min.

LFTs also present some unique feeding challenges, especially in high volume production. BPM's P-Series Pultrusion puller is designed to grip and convey the highly rigid LFT strands to the pelletiser without bending them, avoiding the risk of internal fibre separation and cracking which can lead to compromised final part performance.

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PHOTO: SHUTTERSTOCK

New resin and additive developments are allowing the performance of foamed plastics to be ever more focused to the task. Peter Mapleston finds out more

Expanding options for foams

Polymer and additive producers are making significant progress in developing new formulations for foamable thermoplastic compounds in applications that span packaging, automotive, building and construction, and broader industrial uses. Compounders and foam producers now have more options than ever for fine-tuning their products to suit performance and cost requirements.

SABIC, for example, continues to build up its range of polymer building blocks for foam. Among its most recent offerings are metallocene-catalysed linear low density ethylene-octene copolymers, which now go under the Supeer banner, as well as Cohere polyolefin plastomers (POPs) and Fortify polyolefin elastomers (POEs) – also produced using metallocenes.

Emanuel van der Ven, Global Technology Leader, Foam & Lightweighting at the polymer giant, sees these copolymers improving flexibility of foams across various applications. They can be blended "to give you the opportunity to play with properties," he said during a presentation at the Polymer Foam conference organised by *Compounding World* publisher AMI in Hamburg last November.

Typical uses for Supeer are in protective packaging, while Cohere is aimed more at applications in building and construction, such as pipe insulation and floor underlay; yoga mats and shoe mid-soles are among products being targeted for Fortify.

SABIC Fortify C11075DF, for example, is designed as a low density and high-performance copolymer modifier to provide superior resilience and compression-set properties. Also aimed at foam applications are Fortify C1055D and C1070D, which provide superior impact properties and flow characteristics.

HMS developments

SABIC also offers a high melt strength polypropylene, SABIC PP-UMS, launched in late 2017. With a melt strength of over 65 cN, this is claimed to enable an "unprecedented" level of light-weight-

Main image: The options for foaming plastics are extending, with new resins and additives allowing fine tuning of performance and processing

Table 1: Typical properties of SABIC Fortify C11075DF (physical properties measured from specimens cut from compression moulded plaques)

Property	Typical value
Density, kg/m³ (ASTM D1505)	868
Melt Flow Rate @ 230°C/2.16 kg, g/10 min (ASTM D1238)	2
Melt Flow Rate @ 190°C/2.16 kg, g/10 min (ASTM D1238)	1
Shore A hardness (1 second) (ASTM D1238)	71
Flexural Modulus (1% Secant), MPa (ASTM D790A)	13
Tear Strength (Type C), kN/m (ASTM D624)	39
Peak Melting Temperature, °C (SABIC method)	62
Glass Transition Temperature (Tg), °C (SABIC method)	-52

Source: SABIC

Table 2: Key properties of SABIC PP-UMS HEX17112 (*Speed of testing: 1 mm/min; **Speed of testing: 50 mm/min; ***Flat wise (test bar 80x10x4mm))

Property	Typical value
Melt Flow Rate (230°C, 2.16 kg), g/10 min (ISO 1133)	2.5
Density, kg/m³ (ASTM D1505)	905
Tensile modulus*, MPa (ISO 527-2 1A)	1925
Elongation at break**, % (ISO 527-2 1A)	15
Izod notched impact strength at 23°C, kJ/m² (ISO 180/1A)	2.2
Melt Strength, cN (SABIC method)	68
Heat deflection temperature at 0.45 MPa (HDT/B)***, °C (ISO 75)	110

Source: SABIC

ing. At the time of the launch, Frank de Vries, SABIC's global Foam & Lightweight Leader, said that the company's intensified focus on foam technology covers the entire value chain. "We all face many global challenges due to an ever-growing population and increasingly limited resources. Foaming is key to help solving these challenges, by pushing industries to invest in solutions that are both sustainable and cost-efficient, with enhanced material properties," he said.

Borealis is generally recognised as the front-runner in high-melt-strength polypropylenes (which get their strength and extensibility from long chain branching). At the recent AMI conference, Application Development Engineer Antti Tynys discussed the firm's Daploy HMS PP, mainly in extruded foam applications. Depending on the foam density, Daploy HMS PP is suitable for products spanning cups and bowls (80-600kg/m³), automotive components such as door and roof liners, air ducts and impact protection (40-350kg/m³), building insulation (60-200kg/m³), and numerous other areas from HVAC to sports and leisure.

Sustainable solutions

Tynys also addressed the question of whether or not plastic foam can be considered a sustainable and environmentally friendly solution, in the light of several big packaging users turning away from such products (mostly polystyrene) in favour of paper and card-based alternatives. She discussed work Borealis has been doing on the recycling potential for non-crosslinked PP foamed cups – in a project in Taiwan it tracked the PP fraction in the cup waste stream which showed good results. Borealis is also starting up a pilot project in Europe on foamed PP cup recycling.

Another PP major, **LyondellBasell**, is also working in this area. At the US edition of AMI's Polymer Foam conference in Pittsburgh last June, Dr. Vassilios Galiatsatos, Applications Development – Catalloy, talked about developing innovative reactor grades of elastomer-modified PP (TPOs) for foams. The company has been studying the foamability of various existing Catalloy grades using physical and chemical blowing, partly in cooperation with **Reedy Chemical Foam**.

Results to date show that the high molecular weight rubber in Catalloy TPOs provides melt strength for good foamability. The wide range of flexural moduli obtainable with different grades (ranging from 20 MPa for one type of Softell through to 800 MPa for a Hifax grade) makes it possible to produce soft and rigid foams "bridging the continuum between PE and PP," Galiatsatos said. Density reductions up to 60% have so far been achieved, and a range of cell sizes, down to 25 micron. The company plans to carry out further physical property testing and also to work on physically blown foams.

Japan Polypropylene Corp also offers HMS-PP foamable grades. These are based on its metallocene technology and marketed under the Waymax EX banner. The company cites an "excellent balance of MFR and melt strength, and strong strain hardening." The supplier says the grades enable high expansion ratios and uniform and fine cell structures to be obtained. ›


PHOTO: SABIC

Right: Injection moulded foamed instrument panel carrier produced in SABIC high melt strength PP

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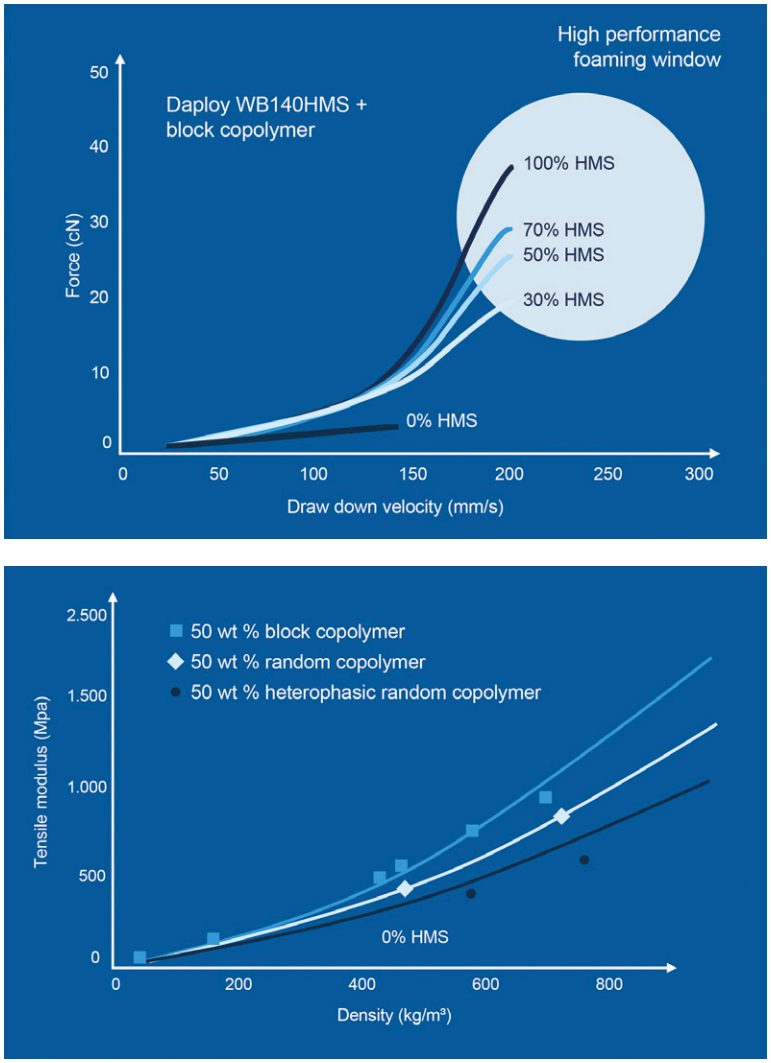


High melt strength and extensibility of Borealis HMS PP grades allows tailoring of foam properties by adding linear polymer component while keeping good foamability. Charts show force versus drawdown (top) and tensile modulus versus density (bottom) **Source: Borealis**

Ionic crosslinking

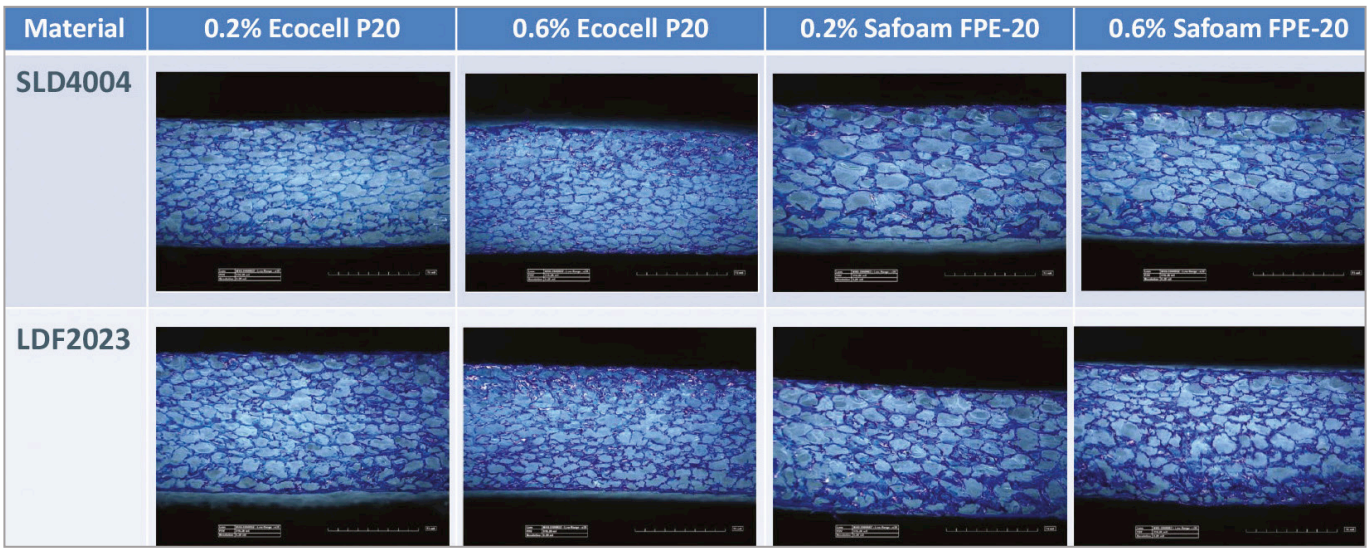
Total Cray Valley continues with development work on the use of its Dymalink acrylate functional zinc salt additives to increase the melt strength of PP through ionic crosslinking during extrusion. The company is in the early stages of developing new applications, with customer validation continuing, says Dr Philippe Lodefier, EU R&D Director.

According to Application Chemist Brett Robb, speaking at the US Polymer Foam conference, polar ionic groups created in the polymer tend to cluster together, away from the non-polar back-bone chains, creating entanglements. The salts do not affect melting properties, however.

Dymalink has been used in foams using physical and chemical blowing agents. In physical foaming, it helps stabilise extrusion, produces a more uniform skin, and results in foams with a higher, more homogeneous cell density. With chemical blowing agents, the key differences are a lower density, and smaller, more homogeneous cells.

Braskem added its own branched HMS-PP a little over two years ago, launching the Amppleo family at K2016. One grade, Amppleo 1025MA, is said to offer a unique combination of high melt strength (50cN) and high stiffness (2.27GPa). It is intended for low density foam applications for the automotive and packaging market segments, according to the company.

Braskem says Amppleo HMS-PP products are designed to be used in low and medium density foam applications and with multiple physical and chemical blowing agents. The technology has been demonstrated on tandem and inline extrusion processes.



Microphotographs showing foam cell structure of Braskem bio-based LDPE (SLD4004) and a conventional petrochemical-based equivalent (LDF2023) foamed using two different blowing agents (Ecofil P20 from Polyfil and Safoam FPE-20 from Reedy Chemical Foam) at 0.2 and 0.6%. Results are very similar **Source: Braskem**

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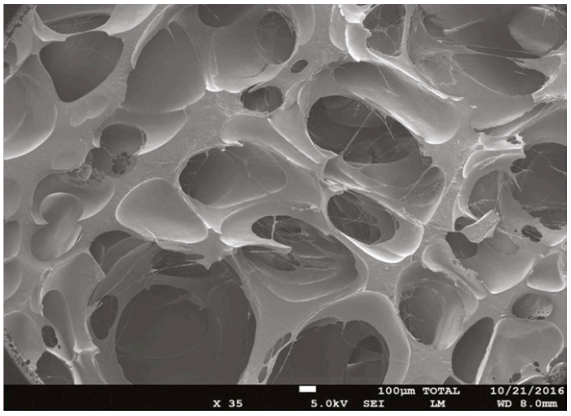
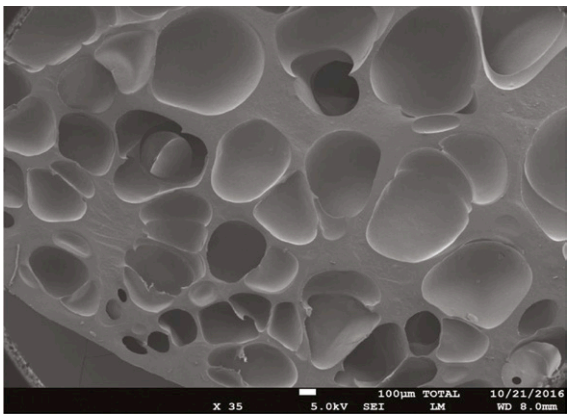
Right: SEM images of conventional PP processed with 0.6mL/min CO_2 at 130 bar die pressure (top image) and modified with 1% Dymalink 9200 under the same conditions





PHOTOS: TOTAL CRAY VALLEY

Bio-based innovations

At the AMI conference in the US last year, however, Braskem put the emphasis on foaming with polyethylene. Thomas Gallagher, Technical Service Scientist with Braskem America, described investigations into the foam performance of bio-based polyethylene, which Braskem produces in Brazil using sugar cane as the source of the ethylene and which has a much lower carbon footprint than fossil-based PE.

Gallagher and his colleagues compared the performance of various extruded foams produced from a bio-LDPE, I'm Green SLD4004, with a fossil-based LDPE also made by Braskem, Idesa LDF2023. The two polymers have similar properties (identical MFIs of 2.1 g/10 min at 190°C, 2.16kg; respective densities of 0.918 and 0.921 g/cm^3; comparable rheological behaviour). The foams were physically blown with CO_2, and the researchers used (separately) nucleators from Polyfil (Ecocell P20) and Reedy Chemical Foam (Safoam FPE-20) at different loadings.

Gallagher concluded that bio-based LDPE can be substituted for standard fossil-based LDPE for foaming applications, with no change in process conditions being required and similar foam properties being achieved. Whatever the source of the ethylene, an increase in foam nucleator reduces cell size, with excessive nucleation resulting in a higher open-cell count. However, the group found no clear correlation between cell size and tensile or tear strength.

Foaming applications

At Ecocell producer **Polyfil**, Renee Lapierre, Technology Manager Foams, says the company's patented foaming agent technology is finding itself in new applications. "Ecocell has been evaluated by several of the major resin producers for use in PP both as a nucleator and as a blowing agent," she says. "As a nucleator for HMS polypropylene, users report smallest cell size, less tendency to over-nucleation and the least number of open cells when compared to traditional endothermic CFAs containing sodium bicarbonate."

New Ecocell grades are also being used as the principal blowing agents to produce foamed PP, PET and HIPS sheet destined for thermoforming, Lapierre reports. "A microcellular structure, less open cell, no blow-outs and an ease of thermoforming are reported by users," she says. "Ecocell has been approved and enjoying commercial success in all mentioned cases."

Chemische Fabrik Budenheim's Budit F Series endothermic foaming agents were discussed by Theresa Wassmer, Business Development Manager, Polymers, at the AMI Hamburg conference. As with other such additives, these are designed for chemical foaming processes to improve the melt flow, control cell formation, and eliminate sink marks in finished parts. Wassmer pointed out that Budit F additives "are eco-friendly due to non-hazardous

Table 3: Comparison of properties of sheet foamed from Braskem's I'm Green SLD4004 and Idesa LDF2023 (US units; tests carried out to ASTM D3575)

Parameter	SLD4004				LDF2023			
Nucleator	**Ecocell P20**		**Safoam FPE-20**		**Ecocell P20**		**Safoam FPE-20**	
Nucleator loadng	0.2%	0.6%	0.2%	0.6%	0.2%	0.6%	0.2%	0.6%
Compression Strength @ 25% (psi)	21	22	26	25	29	22	33	33
Compression Set (%)	9	5	7	7	7	5	11	11
Tensile Strength (psi)	171	203	190	161	172	186	180	213
Tear Resistance (lbs/in)	52	60	63	58	69	55	62	63

Source: Braskem

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The die makes all the difference

Aside from polymer and foaming agents, the extrusion die is also a core component for the production of foamed boards, sheets and tubes, according to equipment maker KraussMaffei Berstorff. "It ensures defined discharge of the melt containing the blowing agent, subsequent foaming and final shaping in the calibration system," the company says. As such it requires in-depth technical design expertise.

While slot dies are used for foam boards, blown film dies are frequently applied for film and sheet. These dies are equipped with slitters to cut the tubular sheet to a flat sheet suitable for winding. Twin or four die heads are generally used for expanded tube production as the simultaneous extrusion of two or four foam tubes substantially enhances cost-effectiveness. All extrusion dies are equipped with an oil-based temperature control system for several zones to achieve the exact temperature profile required for foam products.

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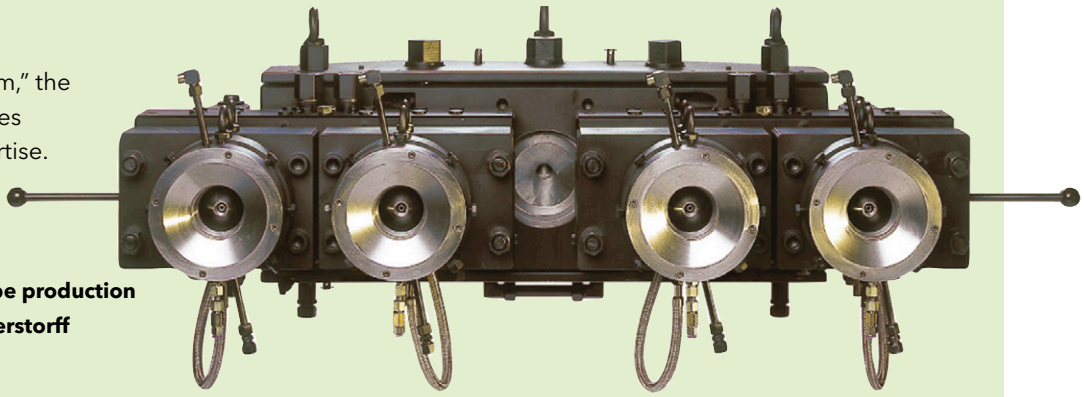
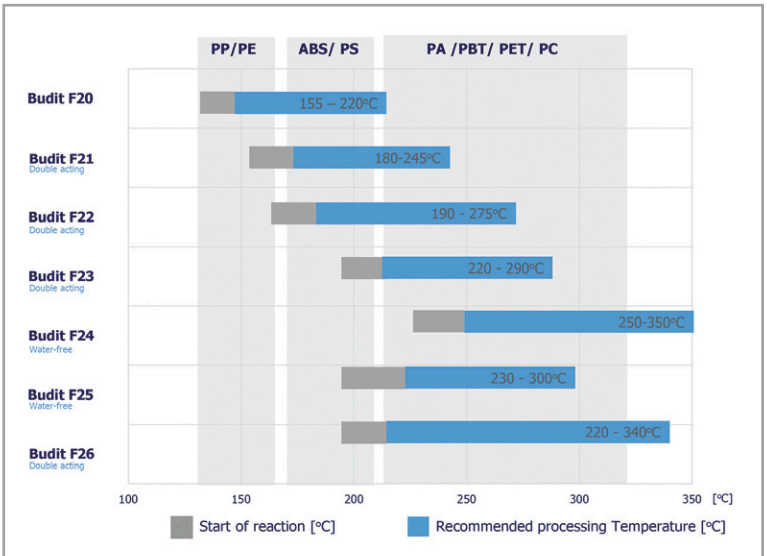


A four-die head for expanded tube production manufactured by KraussMaffei Berstorff
Image: KraussMaffei Berstorff

phosphate chemistry." This is said to make them suitable for food-contact and medical applications.

The Budit F Series provides endothermic foaming ingredients for chemical foaming processes for extrusion and injection moulding. In physical foaming processes, at low concentrations, the cell nucleation can be precisely controlled, says Wassmer. Controlled cell formation can be achieved, thanks to what is said to be unique kinetic reaction profiles, which lead to fewer sink marks and surfaces with improved aesthetics. Budenheim offers solutions for all types of foamable polymers, including silicones as well as polyolefins and engineering plastics.



Typical application and processing temperatures for Budenheim's Budit F series of endothermic foaming agents
Source: Chemische Fabrik Budenheim

Clariant said last year it was seeing strong interest in its Hydrocerol endothermic chemical foaming masterbatches, particularly in the Chinese automotive market where manufacturers have been preparing for tough new fuel efficiency and emission standards. It claims that part mass reductions of between 5-20% are possible in PP, PA and TPO without sacrificing performance or compromising appearance. BMW has exceeded that with a 25% weight saving on a dashboard carrier, the company says.

Using the Hydrocerol masterbatch can also deliver process savings, according to Clariant. The endothermic foaming reaction absorbs heat from the polymer, allowing cycle times to be shortened and productivity to be increased by up to 20%. Sinking and warpage is also reduced.

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Connecting the cable industry

PHOTO: SHUTTERSTOCK

AMI's 19th Cables conference takes place in Dusseldorf in Germany later this year. We take a look at what the event holds in store for attendees

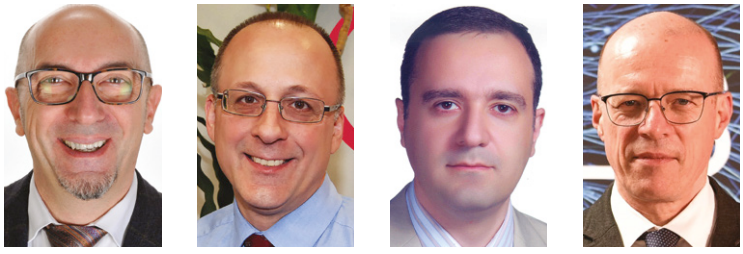
Main image: Around 200 people are likely to attend the 19th Cables conference in Cologne in March

Demand for cables continues to grow strongly. Leading players from across the €2bn-plus European industry's supply chain will be discussing the latest market and technology trends and developments at AMI's 19th annual Cables conference, which takes place on 5-7 March 2019 at the Maritim Hotel in Dusseldorf, Germany.

Current political and business issues create both challenges and opportunities for all companies involved in this demanding market. Cables 2019 brings together an international line-up of expert speakers to identify and explore the latest developments in cable markets, materials, testing, regulation, process technologies and end-use applications.

The event will be opened by **Astrid Aupetit**, Senior Research Analyst**, AMI Consulting** in the UK, who will draw on the company's sectorial market intelligence to provide a global perspective on wire and cable market trends and opportunities. With the trend to digitalisation continuing apace, **Jochen Arms**, Senior Business Development Manager at **Fujikura Europe** in Germany, will share his perspective of the impact this will have on the industry and society. Then **Dr Volker Wendt**, Director Public Affairs at trade body **Europacable** in Belgium, will explain its role in EU policy formulation and standardisation impacting the wire and cable sector.

Turning to material solutions for specialty cable applications, **Fabio Morelli**, Senior New Business Development Manager at **Lubrizol Advanced Materials** in Spain, will discuss high performance TPUs, and **Frank Zelder**, Senior Business manager at **Evonik Resource Efficiency** in Germany, will present new developments in high temperature polymers. Then **Thomas Steffl**, Application Development and Technical Service Engineer at **Borealis Polymere** in Germany, will share new developments in low shrink HDPE for fibre optic cables.



The Cables 2019 speaker line-up includes (from left to right) Lubrizol Advanced Materials New Business Development Manager Fabio Morelli, Underwriters Laboratories RCDD Robert Bellassai, Plexchem Technologies Technical Consultant Mohammad Mohseni, and OCSiAl Europe Sales & Marketing Director Christoph Siara

Fire challenges

Demands for improved fire performance are a key challenge for current and future cable developments. **Markus K Kemmler**, Managing Director of **Kemmler Consulting** of Germany, will present a commercial and technical overview of technological solutions for halogen-free, flame retardant cables. **Esther Hild**, Technical Manager at the German cable maker association **ZVEI**, will discuss the construction products regulation (CPR). Then **Gianluca Sarti**, Group Representative for **PVC Forum Italia**, will

share a new formulation and test comparison for classification of PVC cable under CPR.

Flame retardant cable applications and FR standardisation are next on the agenda. **Dr Günter Beyer**, Consultant Fire & Polymer based in Belgium, will talk about use of silicones for security cables and will share the latest on nanocomposites as a universal HFFR-LS system. Then **Pascal Amigouet**, from **Polyone Corporation** in Belgium, will explain the challenges and possible routes to improve hydrolytic stability of flame retardant solutions for cable applications. The use of natural magnesium hydroxide flame retardants in power and automotive cables will be explored by **Alexender Kulichenko**, Project Manager at **Europiren** in the Netherlands. And **Robert Bellassai**, RCDD at **Underwriters Laboratories** (UL) in the US, will provide a third-party laboratory perspective on the confusion in the cable industry over halogen-free (HF) and low smoke halogen-free (LSHF) product claims.

Production technologies

Day two of the conference will be opened by **Robert Hollosi**, Process Engineer at **Buss** in Switzerland, who will explain the company's latest machine concept for flexibility in cable compounding applications. **Maria Hoelzel**, Senior Process Engineer at **Coperion** in Germany, will speak about a new technology to produce more uniform pellets without fines. Then **Andreas Holt**, European-agent for **Advanced Blending Solutions** of the US, will detail design parameters for high precision gravimetric blending equipment for power cable extrusion applications.

Hohammad Mohensi, Technical Consultant at **Plexchem Technologies** of Singapore, will turn the focus to efficiency and sustainability with a demonstration of the company's model-driven approach to developing efficient cable designs. **Johannes Hueffmeier**, Senior Project Manager at the **RISE Research Institute** in Sweden, will explain a new method for accelerated fatigue testing and reliability prediction of power cables. Then **Erica Lo Buglio** from **PVC 4 Cables** in Italy, will detail some of the sustainability moves made by the PVC cable industry in terms of safer formulations and effective end-of-life management (recycling).

The final session of Cables 2019 examines the role of polymer additives. **Christian Gustin**, Technical Director Europe at **C-Tech Corporation** in Belgium, and **Estelle Cognet**, Senior Industry Manager Europe at **PolyOne** in Belgium, will speak about aversive biocide products for protection of cables against rat and termite attack and will explain the latest obligations for formulators under the biocide product regulation (BPR). **Hans Juergen Eichler**, Manager Technical Services at **BYK-Chemie** in Germany, will discuss new FR-synergists for HFFR cable compounds. And **Christoph Siara**, Sales and Marketing Director at **OCSiAl Europe** in Luxembourg, will detail the use of single wall carbon (graphene) nanotubes in cable applications.

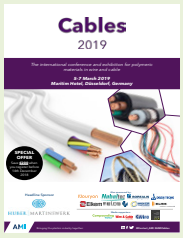
Understand the cable industry

New for Cables 2019 is the 'Journey in to the World of Cables' training seminar, which takes place on the afternoon before the main conference and presents an opportunity for newcomers to the cable industry to get up to speed with its complexities.

Presented by Gerd Allermann, Managing Director of GA Consulting and an expert on cable industry matters, the training seminar is intended to give new joiners at material suppliers, compounders, distributors and machinery makers an understanding of cable constructions, manufacturing, technologies and applications. It will also cover the key standards and codings used across the European industry.

To find out more or to register, visit the **conference website** or contact Conference Organiser Heidi Lesiw. Tel: +44 (0)117 314 8111; Email: **Heidi.lesiw@ami.international**

Cables 2019 – 19 years and counting



Now in its 19th year, AMI's Cables conference is established as the learning and networking location for the European cable industry and typically attracts more than 200 industry professionals.

The 2019 event takes place in Dusseldorf in Germany from 5-7 March 2019 and will bring together expert speakers to discuss the latest market trends, testing procedures, regulatory requirements, cable manufacturing processes and end-use applications. Formal conference sessions are supplemented by informal networking breaks, a table-top exhibition and optional conference dinner.

Cables 2019 will attract attendees from across the cable industry, including cable producers, specifiers, consultants, and material and equipment suppliers. To join them, visit the **conference website** or contact Conference Organiser Heidi Lesiw. Tel: +44 (0)117 314 8111; Email: **Heidi.lesiw@ami.international**

Polymers for Oil & Gas Engineering

Kuala Lumpur / 2019

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BUSS: COMPEO KNEADER

The Compeo is the latest generation of kneader extruder from Buss and is designed to provide the utmost flexibility in application. This 12-page brochure details key features and model specifications.

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COPERION: PELLETISING SYSTEMS

The Pelletising technology division of Coperion manufactures a full range of strand pelletising systems ranging in capacity from 2-6,300 kg/hr. Explore the key system features and benefits in this eight-page brochure.

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CPM EXTRUSION: SYSTEMS AND PARTS

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

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LEISTRITZ: MASTERBATCH SYSTEMS

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

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COMAC: MASTERBATCH LINES

Find out more about the range of twin screw extrusion equipment and feeding and dosing options developed by Comac for production of colour and additive masterbatches in this four-page brochure.

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BAY PLASTICS: STRAND PELLETISERS

Bay Plastics provides strand pelletisers and associated equipment to handle just about for any application. This four-page brochure details its full range of pelletisers, wet and dry-cut slides, water baths, air knives and dewatering units.

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

Learn more about AMI's upcoming conferences

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

THERMOPLASTIC CONCENTRATES 2019

Now in its 22nd edition, Thermoplastics Concentrates 2019 is the essential meeting point for all involved in the production and use of concentrates in North America. The 2019 event takes place in Coral Springs, FL, USA on 29-31 January.

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PIPELINE COATING EUROPE 2019

AMI's 11th Pipeline Coating conference returns to Vienna in Austria on 12-14 February 2019. This high level international event examines the very latest developments in pipe coating materials and application technology.

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PVC FORMULATION USA 2019

Taking place in Pittsburgh, PA, USA, on 26-27 February 2019, AMI's second North American PVC Formulation conference looks at the latest PVC market trends, material innovations and mixing technology.

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CABLES 2019

Taking place in Dusseldorf in Germany on 5-7 March 2019, AMI's 19th Cables conference will explore the key commercial and technical innovations in polymer-based materials for cable industry applications.

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LONG FIBER THERMOPLASTICS USA

This brand new event for the USA explores the technologies, processing and application of weight-saving long fiber reinforced thermoplastics. It takes place in Dearborn, MI, USA, on 5-6 March 2019.

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SINGLE-SERVE CAPSULES USA

The second North American Single-Serve Capsules conference will be held in Atlanta, GA, USA, on 5-6 March 2019, providing an opportunity to learn more about this rapid growing thin wall packaging market.

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Learn more about AMI's upcoming conferences

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POLYMERS IN FOOTWEAR USA

Taking place in Woburn, MA, USA, on 5-6 March 2019, this brand new North American conference explores material trends and application opportunities for innovative polymers in the footwear industry.

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PLASTICS REGULATIONS 2019

Taking place on 6-7 March 2019 in Düsseldorf, Germany, the third European edition of Plastics Regulations will consider how to respond to new and future regulatory developments that will impact on the plastics supply chain.

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MASTERBATCH ASIA

The most established event for the Asian masterbatch industry, Masterbatch Asia returns to Bangkok in Thailand on 14-15 March for its 15th edition. Learn from and network with the industry's leading experts.

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POLYMERS FOR OIL AND GAS ENGINEERING

AMI holds its first Polymers for Oil and Gas Engineering conference on 27-28 March 2019 in Kuala Lumpur, Malaysia, where experts will examine specification, selection, performance and lifetime prediction of oil and gas polymers.

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PVC FORMULATION EUROPE

Taking place in Cologne in Germany on 1-3 April, PVC Formulation will discuss global market trends in the PVC industry and explore the latest developments in rigid and flexible PVC materials, plasticisers, additives and compounding.

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POLYMERS IN BUILDING INSULATION

The second edition of AMI's Polymers in Building Insulation will take place on 9-10 April 2019 in Dusseldorf, Germany. The event will focus on the key trends, challenges and opportunities in construction insulation materials.

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Xenia

Head office location:	Mussolente, Italy
Managing Director:	Mr Fabio Azzolin
Ownership:	Privately owned
Sales 2017:	€2.7m (AMI estimate)
Plant locations:	Mussolente, Italy
Profile:	Established by Fabio Azzolin in 2009, Xenia Materials is a specialist compounding company that focuses on production of reinforced thermoplastic composites for the most demanding applications. Xenia uses glass, carbon and aramid fibre reinforcements and hybrid blends together with functional fillers and additives to produce materials tailored to applications in industries ranging from aeronautical, through industrial to technical sports. The company has a long history of collaboration with universities and other specialist materials companies. The most recent of these was a partnership with Arkema announced in 2018 to develop a range of Kynar PVDF short carbon fibre reinforced compounds designed for injection moulding and extrusion of parts requiring high chemical resistance.
Product line:	Xenia's XeGlass, XeCarb and XeBrid carbon, glass and hybrid fibre reinforced compounds are based on matrix materials including PA6, PA66, PA12, PC, PPA, PPS, PEI, PDVF and PPU.
Product strengths:	An emphasis on research and development both internally and through cooperation and partnership agreements with customers, universities and other research facilities allows Xenia to develop innovative products for demanding applications.

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:

February 2019
Electrically conductive compounds
Materials handling
Additives for polyamides
Surface modification

March 2019
Twin-screw extruders
Natural fibres
Special effect pigments
Computer modelling software

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

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

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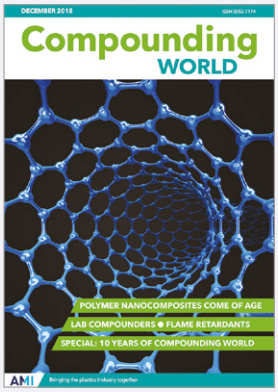

Compounding World December 2018
The 10th anniversary issue of Compounding World in December marked 10 years of the magazine with a look back at the main stories of the past decade. Plus there are features on lab compounders, nanocomposites and flame retardants.

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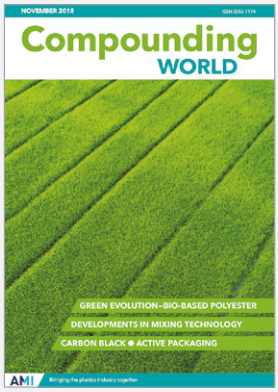

Compounding World November 2018
The November edition of Compounding World contains features on bio-based polyesters, mixing technologies, carbon black and additives for active packaging. Plus there is a review of Fakuma and key findings from AMI's European polymer distribution report.

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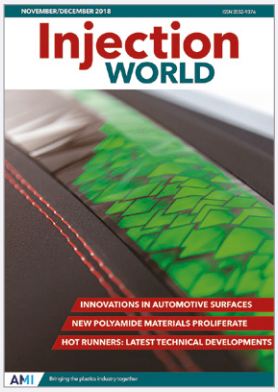

Injection World November/December 2018
The November/December edition of Injection World magazine reviews the latest innovations in automotive surface decoration. It also takes a look at developments in hot runner technology and polyamide compounds.

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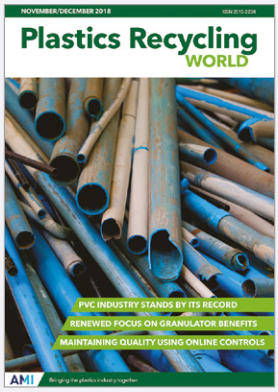

Plastics Recycling World November/December 2018
The November/December 2018 edition of Plastics Recycling World takes a look at the PVC industry's progress in recycling in Europe and Australia. It also reviews the latest developments in process control and plastic granulation.

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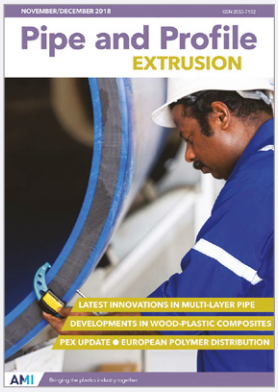

Pipe and Profile November/December 2018
The November/December edition of Pipe and Profile Extrusion features the latest multilayer pipe dies which can make products more flexibly and efficiently. Plus features on PEX and wood-plastic composites.

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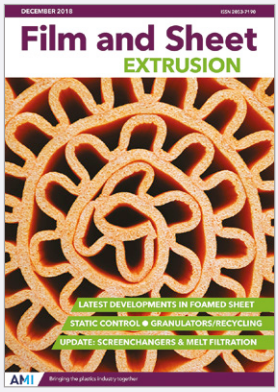

Film and Sheet December 2018
The December edition of Film and Sheet Extrusion magazine reviews the latest developments in foamed sheet technology. It also details innovations in melt filtration, granulation and static management.

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GLOBAL EXHIBITION GUIDE

2019

27-30 January	Saudi Plastics & Petrochem, Jeddah	www.saudipp.com
29 January - 1 February	Interplastica, Moscow, Russia	www.interplastica.de
28 February - 4 March	Indiaplast, Delhi	www.indiaplast.org
10-12 March	Asiamold, Guangzhou, China	www.asiamold-china.com
12-14 March	JEC World, Paris, France	www.jeccomposites.com
12-15 March	Pro-Pack Africa, Johannesburg, South Africa	www.propakafrica.co.za
12-16 March	Koplas, Goyang, Korea	www.koplas.com
19-21 March	EU Coatings Show, Nuremberg, Germany	www.european-coatings-show.com
25-29 March	Plástico Brasil, São Paulo, Brazil	www.plasticobrasil.com.br
26-28 March	PlastPrintPack Nigeria, Lagos	www.ppp-nigeria.com
28-30 March	Mecspe, Parma, Italy	www.mecspe.com
2-5 April	Plastimagen, Mexico City	www.plastimagen.com.mx
8-12 April	Feiplastic, Sao Paulo, Brazil	www.feiplastic.com.br
10-12 April	Utech Las Americas, Mexico City	www.utechlasamericas.com
8-9 May	Compounding World Expo, Cleveland, US	www.compoundingworldexpo.com/na
8-9 May	Plastics Recycling World Expo, Cleveland, US	www.plasticsrecyclingworldexpo.com/na/
8-9 May	Plastics Extrusion World Expo	www.extrusion-expo.com/na/
8-9 May	Plastteknik Nordic Malmö, Sweden	www.easyfairs.com
21-24 May	Chinaplas 2019, Guangzhou, China	www.chinaplasonline.com
21-24 May	Moulding Expo, Stuttgart, Germany	www.moulding-expo.com
16-23 October	K 2019, Dusseldorf, Germany	www.k-online.com

AMI CONFERENCES

29-31 January 2019	Thermoplastic Concentrates 2019, Coral Springs, FL, USA
26-27 February 2019	PVC Formulation USA, Pittsburgh, PA, USA
5-6 March 2019	Long Fiber Thermoplastics USA, Dearborn, MI, USA
5-6 March 2019	Polymers in Footwear USA, Woburn, MA, USA
5-7 March 2019	Cables 2019, Dusseldorf, Germany
14-15 March 2019	Masterbatch Asia, Bangkok, Thailand

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

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