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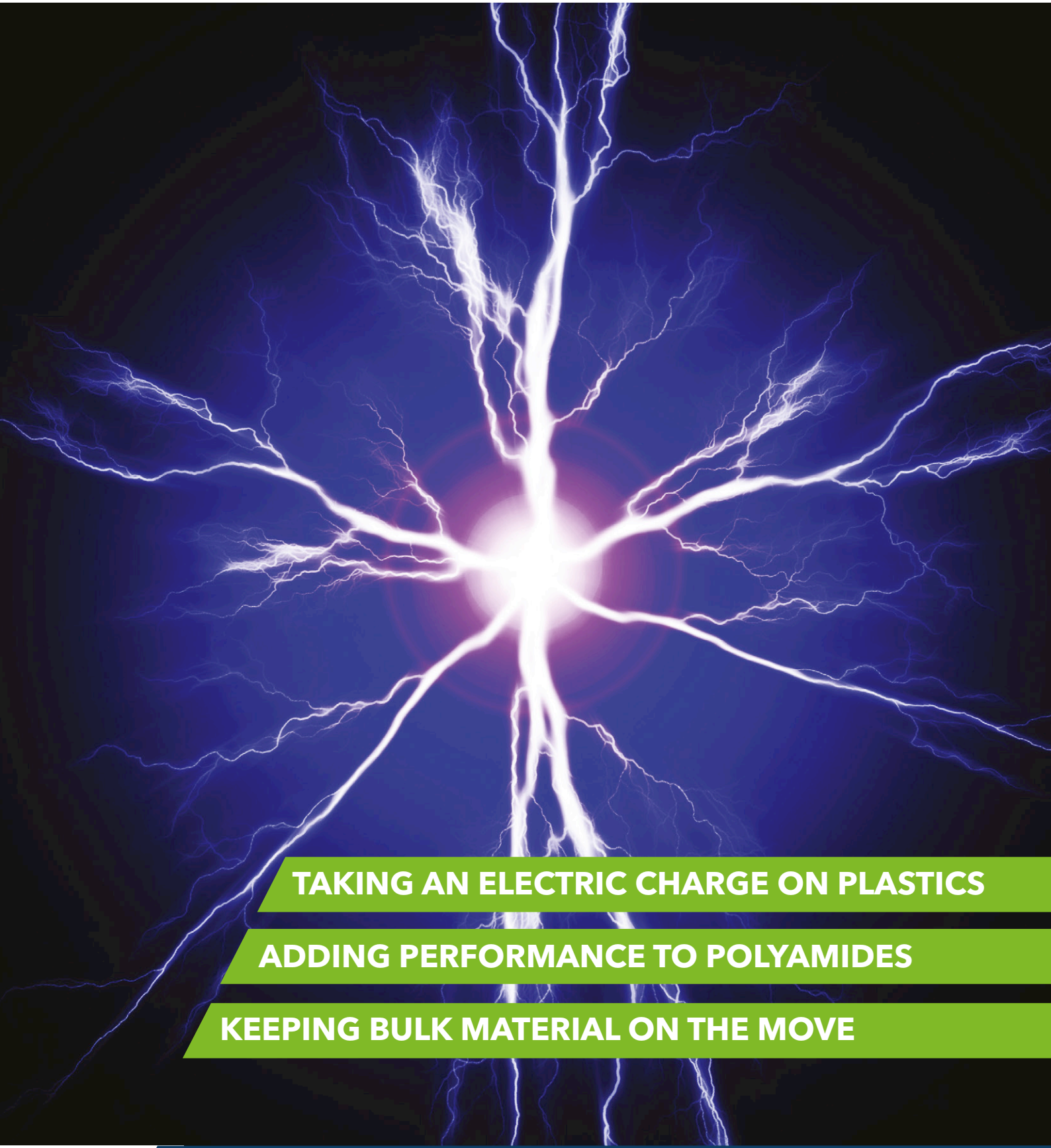
Compounding WORLD



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SABIC secures stake in Clariant

Saudi Arabian petrochemicals giant SABIC has acquired a 24.99% stake in Clariant, making it the largest shareholder in the Swiss company.

SABIC acquired its stake from investor groups White Tale and 40 North. White Tale was the main opponent to Clariant's proposed merger with Huntsman, ultimately forcing termination of the plan in November 2017. It had increased its stake to more than 20% and, with other shareholders also opposed, Huntsman and Clariant ultimately decided that they were unlikely to achieve the required two-thirds majority for approval.


PHOTO: SABIC

Clariant and White Tale subsequently met "to identify possible ways to work together" but without reaching agreement.

SABIC is already a partner with Clariant in the catalysts joint venture, Scientific Design. The two companies said they are now speaking "in order to discuss the new situation and explore possible ways to create value".

■ In a separate move, Clariant officially opened its new masterbatch production facility in the city of Yanbu, Saudi Arabia. Clariant Masterbatches Saudi Arabia is a joint venture between Clariant and Rowad, a major plastic products manufacturer and part of Saudi Arabia's Tasnee.

The 38,000m² site, in Yanbu Industrial Zone 2, will focus on production of white masterbatches. Clariant said that it will enjoy easy access to key raw materials and to downstream plastics industries serving the Middle East region. Clariant Masterbatches already has a Saudi Arabian production site in Riyadh.

› **www.sabic.com**
› **www.clariant.com**

2017 revenues up at PolyOne

PolyOne announced a 10% increase in full year revenue to $3.2bn for 2017. Adjusted earnings per share increased by 7%, which the company said was the eighth consecutive year of EPS growth.

"Over the last three years, we have increased our sales, marketing and R&D resources by nearly 20%. These investments have improved collaboration and service levels … leading to accelerated and sustained growth," said Chairman, President and CEO Robert Patterson.

The growth was 7% organic and 3% from acquisitions. During the year, PolyOne acquired IQAP Masterbatch, a Spanish maker of speciality colorants and additives, which is expected to add some $45m in revenue in 2018.

Earlier in 2017, it had bought SilCoTec, Rutland and Mesa, three US colorants makers. As a result, the Colour, Additives & Inks business recorded the strongest growth last year.

› **www.polyone.com**


PHOTO: POLYONE

PolyOne Chairman, President and CEO Robert Patterson

Morssinkhof to build new recycling plant

Morssinkhof Rymoplast Group has announced plans to build a plastics recycling plant at the Haskerveen Business Park in Heerenveen, Netherlands. The facility is expected to begin operations in 2019.

The new facility will be located next to a plastic packaging waste sorting plant being built by Omrin, HVC and Midwaste. It will process PP and HDPE waste from that plant, as well as other post-consumer waste from the Netherlands and other countries, into secondary raw material for high-end applications.

"The new plastics recycling facility is an excellent example of supply chain cooperation and a joint effort to truly realise a circular economy," said Morssinkhof Rymoplast owner Eric Morssinkhof.

The company, which has been active for more than 50 years, already has 250,000 tonnes/year of processing capacity, although the capacity of the new facility was not disclosed.

› **www.morssinkhofplastics.nl/**

Kraiburg adds capacity in Europe

Kraiburg TPE has started up a new extrusion line for thermoplastic elastomers (TPEs) at its headquarters site in Waldkraiburg, Germany.

The investment brings the company's total capacity to 56,000 tonnes/year – 36,000 tonnes at the German site and 10,000 tonnes each at its production sites at Buford in Georgia, US, and Kuala Lumpur, Malaysia.

Kraiburg said demand for TPEs is increasing worldwide, "showing constant growth in the automotive, industry, consumer and medical markets". It said the new capacity will guarantee its ability to deliver its TPE products, which include the Thermolast, Copec, Hipex and For Tec brands.

› **www.kraiburg-tpe.com**

PHOTO: KRAIBURG TPE

Memolex acquired by Krahn

Krahn Chemie has acquired the French plastic additives distributor Memolex, which it has renamed Krahn France.

Krahn Managing Director Axel Sebbesse described the move as a "strategically important acquisition" that would enable the group to expand in the French market. The existing Memolex team has been retained and the firm will continue to operate out of its site near Paris.

› **www.krahn.de**

Duromer targets water sector with polyketone compounds

Australian compounder Duromer Products has extended its range of polyketone compounds with a new glass-filled polyketone grade that carries US NSF 61 Commercial Hot 82° certification.

The Durateck PK10G grade was developed for a specific project for an undisclosed customer but is now available as a standard. It has a glass content of 10% and is said to offer very good hydrolysis and chemical resistance, tensile strength, toughness, and low levels of impurities.

According to Duromer Products General Manager Andrew Stewart, the new grade is expected to find applications where PES, PPSU or PEEK has previously been required to withstand long term hot water exposure. Already certified to the US NSF standard, he said the company is midway through certification to the Australian AS/NZS 4020.

Duromer's site at Prestons in New South Wales has three twin screw compounding lines producing mostly engineering compounds. Its annual capacity is around 9,000 tonnes. The company also claims to be the only Long Fibre Thermoplastic (LFT) producer in Australia, running a pultrusion line with an annual capacity of 2,200 tonnes. That uses Plasticomp technology and produces LGF PP, PA and TPU products with glass contents ranging from 20-70%.

Duromer also operates a standalone masterbatch business in Vietnam – Duro-Colour Vietnam – supplying into the local market and to Indonesia and Malaysia.

› **www.duromer.com**

UK's Enva Group buys WEEE recycler Blue Sky

Enva Group, a UK and Ireland-based supplier of waste management and waste materials services, has acquired Blue Sky Plastic Recycling (BSP) for an undisclosed sum. BSP will become the fifth operating unit within Enva Group and will continue to be led by its Managing Director and main shareholder, Chris Riddle.

Based in Bourne in Lincolnshire, UK, BSP is focused on recovering plastics mainly from waste electrical and electronic equipment (WEEE) and reformulating it into regrind and compounds by means of its advanced separation technologies. These technologies are said to be "a new strategically important dimension" for Enva.

Formerly known as DCC Environmental, Enva was bought out by Exponent Private Equity and its management team in a deal worth over €225m in June 2017. The company also owns the William Tracey Group, Wastecycle, Enva Ireland and Oakwood Recycling.

› **https://enva.com/**

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Polymax TPE adds more capacity in the US

Polymax Thermoplastic Elastomers, a manufacturer and custom compounder of thermoplastic elastomers (TPEs) based in Waukegan, Illinois, US, is to add 3,600 tonnes/year of capacity.

The company says the new capacity will enable it to meet growing demand for its products, particularly from the automotive and food packaging markets. Its engineered TPE materials are used to produce injection and blow moulded extruded parts, such as interior and exterior automotive trim, consumer grips and handles, beverage closures, over-moulded gaskets and seals, and sporting goods.

The investment comprises a Leistritz twin-screw extrusion system with underwater pelletiser from Gala Industries. The equipment is able to make a full range of TPEs, including SEBS, SBS, TPO and alloy products, and will be fully operational in Q1 2018. The 3,900 m² Waukegan facility also houses a twin-screw pilot line for testing and small production runs, plus a laboratory.

PHOTO: SHUTTERSTOCK

PolyMax is investing to meet automotive demand for TPEs

Polymax is the sister firm of Nantong Polymax Elastomer Technology of Nantong, China, which has about 13,600 tonnes/year of TPE capacity and claims to be among the largest Chinese TPE suppliers. The two operate independently but collaborate on material development.

› **https://polymaxtpe.com/**

Univar names Jukes as new CEO

Global distribution group Univar has selected David Jukes to become its President and CEO from 9 May this year, taking on the responsibilities of current Chairman and CEO Stephen D Newlin, who becomes Executive Chairman of the Univar board.

Jukes joined Univar in 2002 and has held a succession of posts within the company including President of Univar EMEA, President of Univar USA and Latin America and, most recently, President and COO of Univar Inc. Before joining Univar, he was Senior Vice President of Global Sales, Marketing and Industry Relations at Omnexus.

PHOTO: UNIVAR

David Jukes takes on Univar CEO role from Stephen D Newlin

Newlin said Jukes was "uniquely qualified" to take on the Univar leadership role. "He is a 35-year veteran of the chemical distribution industry and has held multiple leadership positions within Univar. He designed and executed a successful go-to-market strategy yielding double-digit growth in EMEA. He is a transformative leader who shares my vision and goals for Univar and has earned the respect of our employees, supplier partners and customers," he said.

› **www.univar.com**

NEWS IN BRIEF...

Ube Industries, JSR Corporation and Mitsubishi Chemical have announced that their planned Japanese ABS resin joint venture **Techno Polymer** will commence operation on 1 April 2018. The new venture is 51% owned by JSR and 49% by UMG ABS (a 50/50 joint venture between Ube Industries and Mitsubishi Chemical).
www.techpo.co.jp/en

Long Fibre Polypropylene Compounds is a new multi-client report from **AMI** that provides analysis of granule, directly compounded and in-line moulded LFT PP materials by application, compound producer and geographical region. The report also considers the success of LFT PP relative to LFT PA and examines the increasingly international demand and recent investments in China (Asia accounted for 40% of total LFT PP demand in 2016).
http://bit.ly/LFT_PP

DuPont Performance Materials has announced availability of its 3Dprinting filaments in China through a new partnership with **Shenzen eSun Industrial**. The company will be able to supply two Hytrel grades (3D4000FL and 3D4100 with respective hardnesses of 40 and 60 Shore D) plus Zytel 3D1000FL polyamide.
www.3DPrintingSolutions.DuPont.com
www.esun3D.net

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Clariant installs medical line in US

Clariant has started up a new compounding line at its facility at Lewinston, in Maine in the US, that will allow it to offer faster delivery of large (3,000-6,000kg) batches of its Mevopur pre-coloured medical compounds.

The new line, which includes a twin screw compounding extruder, materials handling and weighing stations, is the final element in a major investment at the site that has seen it expanded by 40%. It follows the installation last year of a smaller line for production of fluoropolymer compounds such as FEP, ETFE and PVDF.

The Lewiston plant is one of three global Clariant sites capable of producing materials for medical devices and pharmaceutical packaging (the others are located at Malmö in Sweden and Singapore). "Demand continues to grow worldwide for these specialised compounds and masterbatches," said Eric Rohr, North America Segment Manager, Medical and Pharmaceutical for the company.


PHOTO: CLARIANT

Separately, Clariant announced that it has completed testing of ingredients used in its Mevopur and Remafin-EP colour and white masterbatch and compound ranges to bring them into full compliance with the new USP 661.1 standard for pharmaceutical packaging and drug delivery devices.

USP 661.1comes into effect in May 2020. Clariant said it has acted now to future-proof any packaging launched in the interim and to be able to offer data to support the ICH-Q3D guidelines for risk assessment.

Replacing the current USP 661, the new standard modernises testing and enforces more robust risk assessment. Food contact statements that have long been used to support the use of many materials in drug packaging will be deemed 'insufficient' to support their future use, Clariant said.

› **www.clariant.com/mevopur**

Birla Carbon appoints for EMEA


PHOTO: BIRLA CARBON

Carbon black supplier Birla Carbon, a subsidiary of India's Aditya Birla, has named John Davidson as its new President for Europe and Africa. He will report to COO John Loudermilk.

Davidson has more than 28 years of industry experience. He joins Birla from Lanxess, where he led the Bromine & Derivatives business following its acquisition of Chemtura.

› **www.birlacarbon.com**

Mexichem pays $39m for Sylvin

Chemicals and plastic pipes group Mexichem has acquired Sylvin Technologies, a niche PVC compounds manufacturer based in Denver, Pennsylvania, US, in a deal with an enterprise value of $39m on a debt-free basis.

Sylvin posted sales of about $29m in 2017, mainly from the supply of PVC resin, plasticisers and stabilisers to the wire and cable, electrical, industrial, automotive, medical and food products markets. It will become part of Mexichem's Vinyl business group, which had sales of $2.2bn in the year to September 2017. This in turn is part of the Mexico-headquarted company's Compounds business unit, which supplies PVC compounds.

Mexichem said Sylvin's customer-focused business model and application development capabilities will allow it to add greater value to US customers, while also bringing synergies in raw materials. CEO Antonio Carrillo called the move "a further step towards downstream integration in speciality products with higher margins".

› **www.mexichem.com**

Carbodeon gains US nano approval

Silicon Sense, the US-based representative for nanotechnology firm Carbodeon, said it has been granted registration by the US Environmental Protection Agency (EPA) to import the Finnish company's detonation nanodiamonds for industrial purposes.

Carbodeon's detonation nanodiamond additives are said to be suitable for a number of industrial applications, including modification of thermal and electrical conductivity of polymer compounds. The new registration covers four product ranges – three mono-functionalised and one multi-functionalised.

The EPA has granted LVE [Low Volume Exemption] registration for all Carbodeon proprietary nanodiamond materials currently supplied in the USA," said James Meriano, Vice-President of New Hampshire-based Silicon Sense.

› **www.carbodeon.com**

› **www.siliconsense.com**

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Italian machinery makers hit sales record in 2017

Italian plastics machinery association Amaplast said the sector expects 2017 to prove to be a record year, with production likely to hit a value of €4.5bn (up by 5% on 2016 and exceeding its previous record of €4.25bn in 2007).

The association has based the forecast on final data collected for the nine months from January to September last year, which saw exports increase by 16% to €3.2bn compared to the previous period in 2016. Imports increased by 12% over the same period.

About 70% of Italian plastics machinery production is exported and most saw strong growth: thermoforming machines +51%, extruders +19%, flexographic printers +27% and moulds +18%.

European exports increased by 20%, raising its relative share of Italian exports to 61%. This came on the back of strong growth in sales in the three main markets of Germany, Spain and France. Russian sales more than doubled, though from a much lower base.

The Americas saw growth of more than 20%. The US and Brazil were particularly strong, although Mexican sales shrank. Sales to the key Middle East markets of Iran and Saudi Arabia were down, by 5% and 34% respectively, as were sales to China, down by 11%.

› **www.amaplast.org**

Italian market for plastics and rubber machinery, equipment and moulds (€ millions)

	2016	2017 (estimates)
production	4,230	4,500
exports	2,970	3,200
imports	850	900
domestic market	2,110	2,200
trade balance	2,120	2,300

Source: Amaplast

Silvergate tackles cost of TiO_2

UK-based Silvergate Plastics has expanded its Simply White masterbatch products to include a number of additional grades designed to help processors minimise their exposure to rising TiO_2 prices.

"When the price and availability of TiO_2 became a major problem early in 2017, we committed the necessary resource to find a credible alternative solution," said Silvergate CEO Tony Bestall.

The new Simply White grades reduce TiO_2 content by up to 25% without compromising colour or opacity, the company claims. The products are also suitable for food contact use; the range includes FDA compliant grades.

TiO_2 is used in most solid colours, not only whites, and Bestall said the company will be rolling out the cost-cutting technology to other high volume colours during the coming months.

› **www.silvergate.co.uk**

PHOTO: MASTERBATCHVERBAND

Fabian heads masterbatch group

Germany's Masterbatch Association has renewed its board. Dr Martin Fabian of Lifocolour Farben was confirmed in office and elected chairman for a further two years. Michael Thiessenhusen of Clariant Plastics & Coatings (Germany) and Bernd Schaefer of Deifel have been nominated to the board as first and second vice chairman respectively.

› **www.masterbatchverband.de**

NEWS IN BRIEF...

Austria's Starlinger Group has announced the formation of **UniRota Maplan Schwerin** to manufacture plasticising screws, barrels and rotary machine parts up to 12m long. The new company, which is based at Schwerin in Germany, is comprised in part of the assets of Maplan Machining, which went into administration last year. It has been set up as a wholly-owned subsidiary of Starlinger Group company Unistrap.
http://maplan.de/en/

Luxembourg-headquartered **Orion Engineered Carbons** began implementing global price increases across all its specialty carbon blacks from the beginning of this year. The company said the increases vary depending on grade, sales region and end market.
www.orioncarbons.com

Trinseo has announced its second round of price rises for its PS and PC resins and ABS and SAN copolymers in Europe in two months. Per tonne prices of Magnum ABS are to rise by €100, Tyrol SAN by €125, Styron and Styron A-Tech GPPS and HIPS grades by €135, and Calibre PC by €150. The move follows the announcement of price increases of between €60-€200 per tonne across the same polymers in December of last year.
www.trinseo.com

www.kraussmaffeiberstorff.com

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Industry leaders set to debate the future of compounding

The line-up of panellists has been announced for a series of free-to-attend debates at the **Compounding World Expo 2018**, which is being held in Essen, Germany on 27-28 June. They include some of the most influential business leaders from international compounding companies and they will discuss key strategic issues facing different sectors of the market, including technical compounds, masterbatch, PVC and polyolefins.

The first debate will focus on the technical compounds sector and the panellists will include **Heinrich Lingnau**, who is Senior Vice President and General Manager for Europe, Middle East and Africa at the leading global compounder, **A Schulman**. He will be joined by **Bernd Sparenberg**, Vice President of the Technical Compounds Business Unit at **Albis Plastic**, the international plastics distributor and compounder which operates compounding plants in Germany, the UK, the US and China. Also on the panel will be **Dr Oliver Frey**, who is Head of the Compounding Department at **Ensinger**, the German compounder focusing on compounds with special functions, such as electrical or thermal conductivity and tailored tribological properties.

Providing a different perspective will be **Dr Christof Krogmann**, who is General Manager of **Kingfa**'s European operations. Kingfa, which is headquartered in China, has grown to become one of the world's largest compounders and opened its first plants in the US and Germany in 2016.

The future of the masterbatch industry will be covered in a debate on the second day of the Compounding World Expo. The influential panel will include **Yves Carette**, who is President & CEO of leading global masterbatch specialist **Ampacet Corporation**, which operates 24 manufacturing sites in 17 countries. **Clariant**, another leading name in the global compounding industry, will be represented by **Marco Cenisio**, Senior Vice President and General Manager of the company's Masterbatches Business Unit. Joining them on the panel will be **Dr Martin Fabian**, Managing Director of **Lifocolor Farben**, a major European producer with plants in Germany, Poland, the Czech Republic and France. One of the biggest names in compounding and masterbatch, **PolyOne** will be represented by **Gary Fielding**, who is the company's Global Marketing Director Color, Additives and Inks.

High level participants in the debates at Compounding World Expo 2018 include (top row l-r): Marco Cenisio, Senior Vice President and General Manager, Business Unit Masterbatches, Clariant; Mr. Heinrich Lingnau, Senior Vice President and General Manager for Europe, Middle East and Africa, A Schulman Europe; (bottom row l-r) Yves Carette, President & CEO, Ampacet Corporation; and Gary Fielding, Global Marketing Director – Color, Additives and Inks, PolyOne Corporation

The issues facing the PVC compounding industry will be discussed on 27 June by a panel that will feature **Yves Heroes**, who is Director of Marketing at **Kem One**, a major player in the European vinyl industry. He will be joined by representatives from the PVC compounding sector, including Fernando Amaral, who is General Manager of Portugal-based **Automotive Compounding Industry** and the **Perplastic Group**.

The final Compounding World Expo debate on the afternoon of 28 June will focus on polyolefins, and will feature senior representatives from leading compounders of polypropylene. They will include **Peter Torma**, Managing Director of **Inno-Comp**, the major PP compounder with plants in Hungary and the Czech Republic. He will be joined by **Massimo Veronelli**, Director of Strategy & Marketing at **Sirmax**, the Italian headquartered company that also operates facilities in Poland, Brazil and the US. In addition, the panel will feature **Dr Adam Galambos**, Director of Technology in Europe at **Washington Penn Plastic Company**, which has PP compounding plants in the US, Mexico and the Czech Republic.

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

For more information on the Compounding World Expo, including the exhibitor list, floorplan, stand booking details, full conference programmes and online registration for your free ticket, please visit

› **www.compoundingworldexpo.com/eu/**

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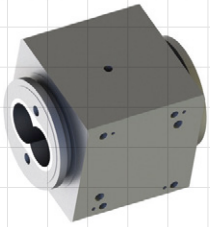

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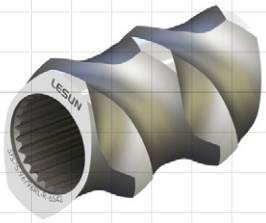

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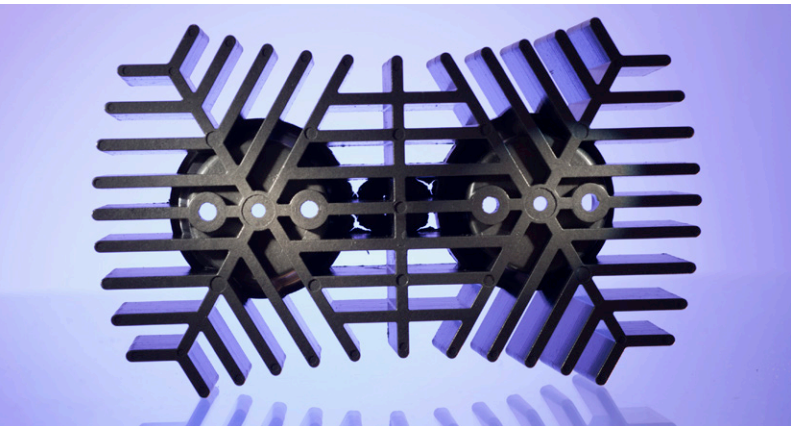

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Already one of the most versatile engineering plastics, polyamides are increasingly being asked to deliver more. ***Jennifer Markarian*** *reviews the role of additives in delivering enhanced performance*

PHOTO: SHUTTERSTOCK

Adding more performance to PA

Polyamides are known as a broad family of high-performing engineering plastics, and a wide range of additives are employed to boost their performance to meet expectations in areas such as automotive and electrical and electronic (E&E) components. Challenges that can be addressed with additive technology include improvement of flow to mould smaller and more intricate parts, as well as better heat and hydrolysis resistance for use in harsh environments. Additives can also be used to restore properties to recycled polyamides.

Functional additives help polyamides meet the increasing thermal, mechanical, and chemical constraints created as the automotive industry is shifting to downsizing, hybridisation and full electrification, says Christophe Paulo, Global Segment Leader Plastics Solutions at **Dow Performance Silicones** (formerly Dow Corning). The company has introduced PA additives such as tribology modifiers and a patented flame retardant synergist (Dow Corning 43-821 Additive) over the past two years. It is currently working on other additive solutions that will improve flexibility and/or water ageing, which it sees being needed for applications such as engine, electrical or industrial parts.

Paulo says the company sees PA as very much the material of choice in the automotive sector and expects compounds based on it to make significant gains in technical applications. "The main development areas for PA are structural and technical parts, with further replacement of metal parts and other plastic materials such as PP," he says. "Thermal mechanical and/or chemical constraints are increasing as the automotive industry is shifting to downsizing hybridation and full electrification. With these moves we can expect further technical improvement in water, chemical, mechanical and thermal resistance. These improvements are essentially made possible with functional additives."

Ascend Performance Materials also sees opportunities in the dynamic electric vehicle (EV) market and in hybrid vehicles, the latter a sector it expects to grow significantly. Alongside developments in EV technologies such as batteries and fuel

Main image: PA additive producers are responding to increasing performance demands from industries such as automotive

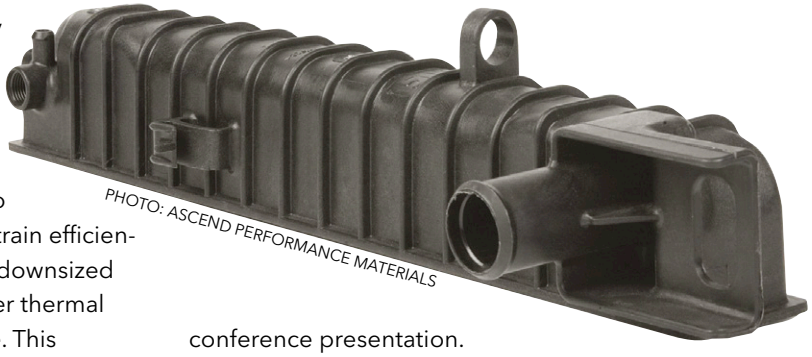

PHOTO: ASCEND PERFORMANCE MATERIALS

Right: Radiator end tanks need improved hydrolysis resistant PAs to operate at today's elevated temperatures

cells, Ascend's Director of Technology Dr Steve Manning said in a presentation at AMI's Performance Polyamides conference in Pittsburgh in the US last year that combustion-engine technology is also advancing rapidly, with higher powertrain efficiency and reduced emissions leading to downsized engine compartments that have higher thermal loads and more limited cooling space. This requires increasing the operating temperature of the cooling system, in turn calling for materials for radiator end tanks, for example, that must display improved hydrolysis resistance.

Polyamides are already handling challenging conditions, and PA66 (mostly glass reinforced but some with alternative fillers) is widely used in power train and cooling systems as well as other areas, said Manning. To meet the new performance specifications presented by increased operating temperatures, Ascend has developed its Vydyne HR (which stands for hydrolysis resistant) series of PA66 compounds using a combination of technologies, including glass fibre reinforcement and additives. The new material's properties are said to approach those of PPA (polyphthalamide) but offering better weld strength.

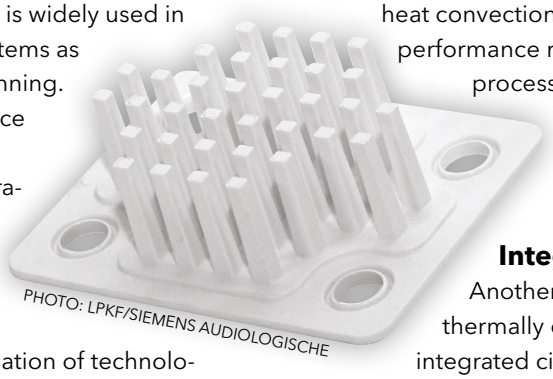

PHOTO: LPKF/SIEMENS AUDIOLOGISCHE

Right: A thermally conductive polymer heat sink designed to optimize performance

With the trend to increased temperatures and tighter spaces, additives that make polyamides more thermally conductive are growing in importance in automotive and E&E components, and they can be used to tackle the increasing problem of malfunction or recalls caused by overheated electronics—or even an overheated battery—in a car, said Péter Sebö, Head of Marketing and Market Development at **HPF The Mineral Engineers** (a division of Quarzwerke), in a recent conference presentation.

Below: PA with high thermal conductivity fillers can replace metal heat sinks but part designs must typically be re-examined

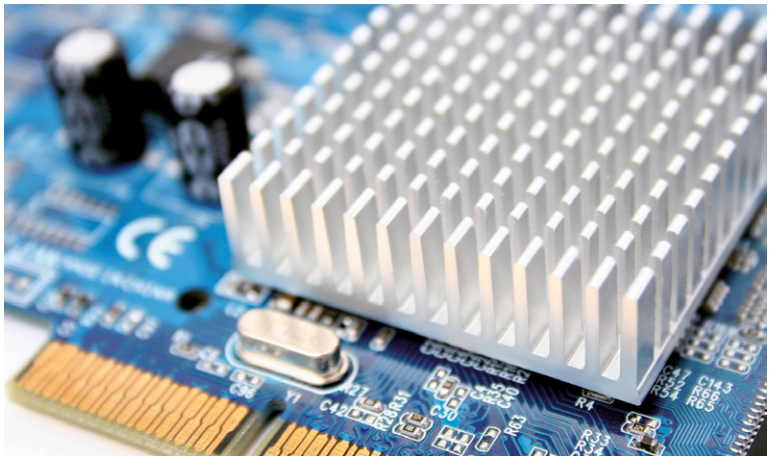

PHOTO: FOTOLIA

Polyamides with thermally conductive additives can be used to replace metal for parts such as heat sinks for LED lamps and covers for batteries in electrical vehicles, but Sebö said that it is not just a simple material swap. Redesign of the part is typically necessary to take advantage of heat convection to obtain the thermal performance required. That redesign process can often also result in improved part functionality, ease of assembly and lighter weight.

Integrated solutions

Another key application for thermally conductive polyamides is in integrated circuitry, for example, in molded interconnect devices (MIDs) used in micro E&E components such as sensors and switches. These tiny parts are injection moulded before a metallic path for electrical conductivity is added on the surface, usually by some form of selective metal plating. The plastic material must be thermally conductive but electrically isolating, while the thermal expansion of the polymer should be as low as possible to minimise the difference between it and the metallic part. This is essential to avoid breakage at the polymer-metal interface, according to Dr Oliver Frey, Head of the Compounding Department at **Ensinger** in Germany.

Additives such as graphite, copper, boron nitride, and aluminum oxide can add thermal conductivity, says Frey. The company has evaluated mineral and ceramic fillers for reducing the coefficient of thermal expansion (CTE) of PPA and found that these fillers can be effective, depending on the use temperature of the part. Some fillers, such as aluminum oxide, can increase thermal conductivity and at the same time reduce CTE.

Polyamides modified with additives are also enabling hydrogen tanks for fuel cell electrical vehicles (FCVs). Although FCVs are currently a niche area, they are growing in interest in various countries. Japan, for example, aims to build nearly 160 hydrogen stations and get 40,000 FCVs on the

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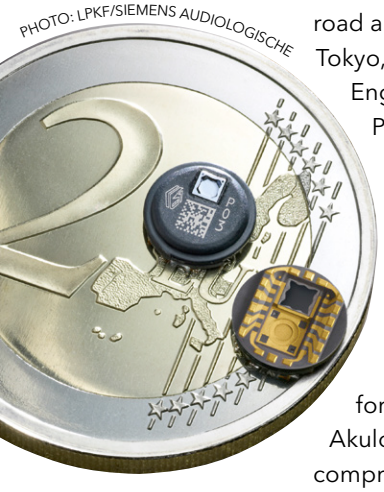


Above: Electronic components produced with integrated electrical circuits by LPKF

road ahead of the 2020 summer Olympic games in Tokyo, said Keiichiro Harada, Technical Service Engineer at **UBE**, in a presentation at the Performance Polyamides 2017 conference. UBE Nylon 1218IU (an impact-modified PA6 material) is already used as an inner layer in the hydrogen tanks for the Toyota Mirai FCV, where it provides a good balance of hydrogen gas barrier and mechanical properties at low temperature, said Harada.

DSM also identified one of its PA6 grades for hydrogen fuel tank applications last year. Akulon Fuel Lock has already been used for compressed natural gas (CNG) tanks but the company has since tested the technology for higher pressure hydrogen tanks for automotive use (hydrogen is stored at pressures of 350-700 bar against a typical 200-250 bar for CNG). The material is optimised to remain ductile at low temperatures, which is also important for hydrogen storage applications. DSM foresees an Akulon Fuel Lock tank can being reinforced by wrapping with unidirectional continuous fiber reinforced thermoplastic tapes made of EcoPaXX PA 410.

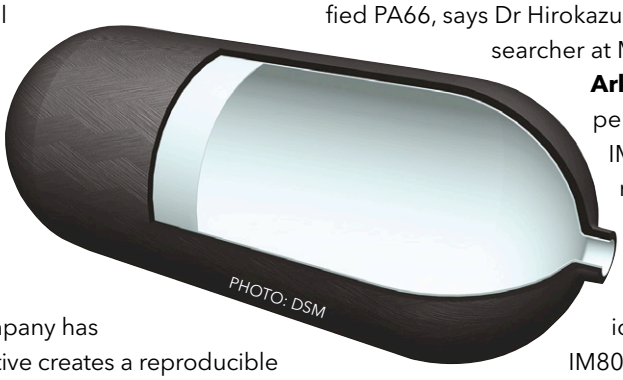
Recycling ideas

Using recycled PA helps companies in their quest for sustainability and reduces raw material costs, but additives are needed to adjust the molecular weight for processability and properties. These can include chain extenders to increase viscosity or additives to reduce viscosity, and compatibilisers to blend different materials. ZeMac copolymers from **Vertellus** and Nexamite technology from **Nexam Chemical**, for example, can both be used for chain extension and branching to increase the relative viscosity of polyamides.

Brüggemann Chemical's new Bruggolen TP-M1417 allows the molecular weight of high-viscosity PA66 scrap to be adjusted to an appropriate viscosity range for injection moulding. Regrind from PA66 fibre waste with a relative viscosity of more than 3, for example, can be brought down to 2.7 for injection moulding (Figure 1). Brüggemann has found that mechanical properties of an upcycled PA66 with its additive exceed those of a standard virgin PA66 injection moulding grade of the same viscosity.

Using gel permeation chromatography, the company has determined that the additive creates a reproducible shift in molecular weight distribution (and thus relative viscosity). "This reproducibility and consistency is extraordinary for reactive additives," says Dr Klaus Bergmann, Polymer Additives Business Unit Manager at the company. TP-M1417 can also be used to tailor relative viscosity of virgin polyamide during compounding, giving polymer manufacturers broader flexibility and potentially reducing the amount of off-spec material.

Brüggemann Chemical also offers the additive package Bruggolen P31, which improves properties of polyamide recyclates such as processing stability, tensile strength and demoulding behaviour. "Use of recyclate is growing in importance, but a lot of people are not aware of what can be achieved using additives. Not only can polyamide be recycled and re-used, but additives allow it to be upcycled to a more valuable use," says Bergmann.



Right: DSM says its Akulon Fuel Lock PA6 meets the requirements for hydrogen storage

Improving impact

Addivant has recently introduced Royaltuf 527, an improved version of its Royaltuf 498 impact modifier for polyamides. The modifier is designed for toughening down to -40 °C, with its higher melt flow index and efficiency allowing it to be used at a lower addition level. In general, impact modifiers tend to reduce flow, the company says, which is an unwanted side effect as the industry trends towards smaller, lighter parts with thinner walls. The objective in designing this product was to use as little impact modifier as possible to obtain the impact needed while maintaining flow, flex modulus, hydrolysis resistance, and thermal stability, says John Yun, Business Development Manager at Addivant. The new impact modifier also has a lower yellowness index.

The Tamfer M impact modifier series for polyamides from **Mitsui Chemicals** comprises acid modified ethylene/1-butene copolymers optimised for various properties, such as flow and thermal stability. MH7510 was introduced in 2016 for high flow and flexibility and, in PA66, this high flow and good dispersion results in a surface finish and high gloss that is close to that obtained from unmodified PA66, says Dr Hirokazu Tanaka, Senior Researcher at Mitsui in Japan.

Arkema added high performance Orevac IM300 and Orevac IM800 maleic anhydride-grafted polymers to its range of impact modifiers for polyamides in 2016. Orevac IM800 is designed for

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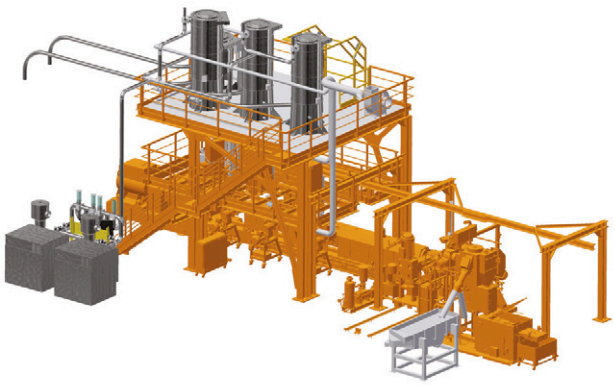

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demanding applications at low temperatures (-40°C), such as those found in the automotive industry. The Orevac IM300 grade, due to its high fluidity, is recommended for injection moulding of small and intricate parts. Both grades are designed for high flow injection moulding applications.

Balancing the properties of formulations with impact modifiers can be a challenge. Impact modifiers reduce heat-deflection temperature (HDT) and tensile and flexural properties, but improved HDT is crucial in automotive applications, especially for parts in the engine compartment. **Vertellus** says its ZeMac copolymer can be added to mitigate the effect of impact modifiers. The company has found that ZeMac can recover most of the lost HDT, tensile and flexural properties, as well as improving hydrolysis resistance. The company says it is continuing to test several properties – including long-term heat aging, low-temperature impact, and abrasion and wear - of formulations produced with ZeMac. These performance characteristics are important for engine-compartment and E&E applications, says Ashok Adur, Global Commercial Development Director for Plastics at Vertellus.

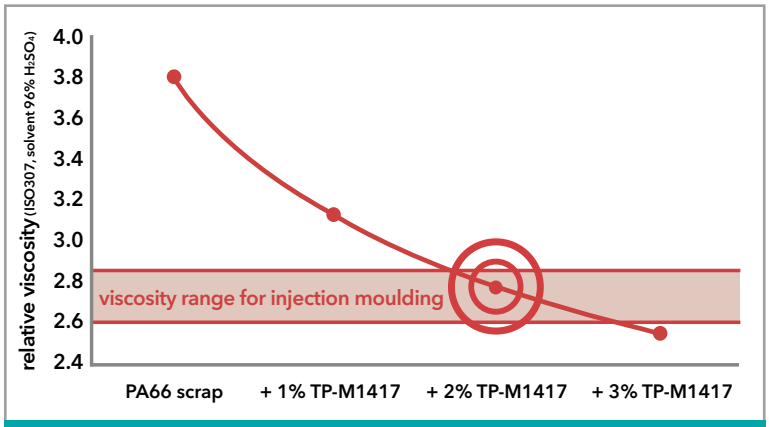

Figure 1: Adjustment of relative viscocity of PA66 fibre waste using Bruggolen TP-M1417
Source: Brüggemann Chemical

Adding crosslinks

Another established way to increase heat resistance—as well as mechanical, electrical, and chemical properties—is via crosslinking. It is possible to add and activate a small amount of a crosslinking additive during melt processing, but it can be challenging to control the level of reactivity. An alternative approach is to add a crosslinking additive

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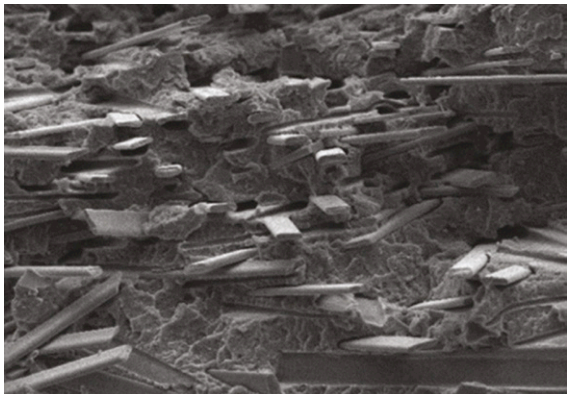

PHOTO: CPIC

Right: SEM image showing Chongqing PolyComp International's new flat glass fibre reinforcement

that is activated after the melt-processing step.

Teknor Apex puts a crosslinking additive into compounds to allow crosslinking by exposure of the final, moulded product to e-beam radiation in a secondary step, said Dr Hartmut Elsässer, Global ETP Technology Director for Teknor Apex Germany, in a presentation at AMI's Performance Polyamides conference. When used in the E&E sector, crosslinking allows parts to retain their shape under higher use temperatures, which in some cases enables OEMs to switch from thermosets to crosslinked thermoplastics.

This crosslinking method is now expanding from E&E to automotive, says Elsässer. In gear inserts for a motor cycle water pump, for example, crosslinked PA66 can replace metal to reduce noise. Although this method adds some complexity with its additional processing step, he said e-beam radiation is a widely available service (it is used for industrial sterilisation of medical devices).

One of **Nexam Chemical**'s Nexamite additives offers the ability to remain inert during compounding but can activate crosslinking through post-process exposure to heat, either in a separate heat-activation process or in-service, such as in a hot engine component. The company cites the example of a glass-filled PA66, where the crosslinked formula showed a higher tensile strength after heat aging, corresponding to a longer service life at elevated temperatures.

Fibre options

While glass fibre reinforcements would not normally be considered additives, the latest introduction from Chinese manufacturer **Chongqing Polycomp International Corp** (CPIC) deserves a mention. It has introduced a family of novel glass fibers with a flat (rather than round) cross-section, which it claims facilitates higher fibre loadings and better mechanical properties.

"The flat glass enhances thermoplastic processing by lowering resin shear, providing better fluidity (increasing spiral flow), reducing friction and viscosity build-up, and lowering fibre entanglement and breakage since the flat fibres tend to flow in planar sheets like mica rather than rolling and tumbling like conventional round glass filaments," the company says. "This in turn helps provide for a more isotropic dispersion and also allows higher fibre-volume fractions (FVFs) to be achieved with no other change because the fibres pack more closely." The products are offered in E-glass form (chopped or milled) and are treated with sizing for use in various polymers, including polyamides.

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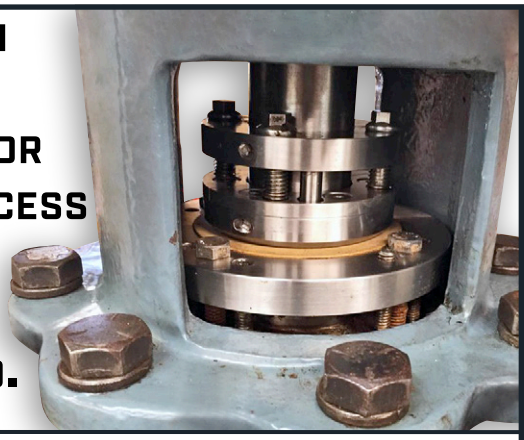

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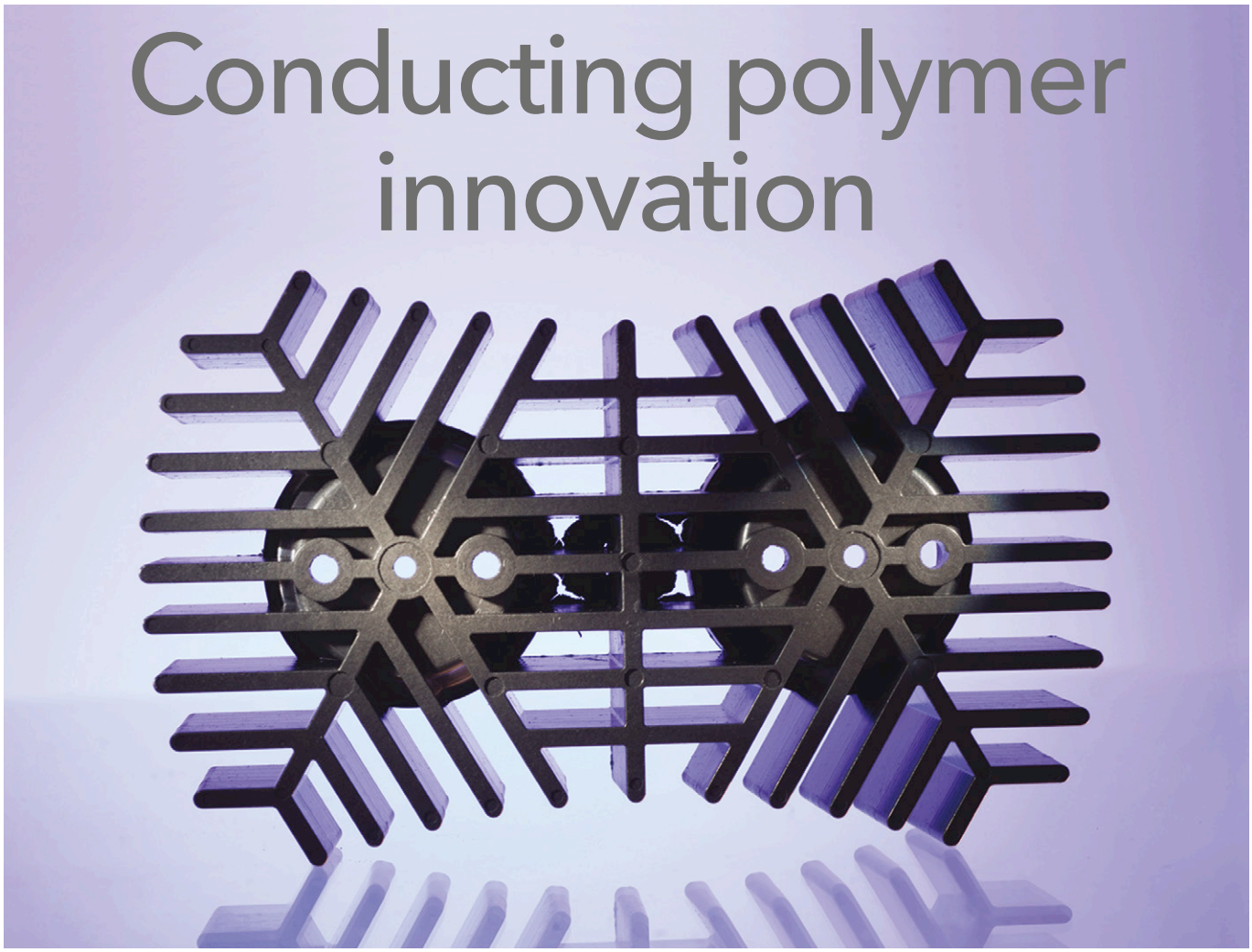
Conducting polymer innovation



AMI's upcoming Conductive Plastics USA conference in Pittsburgh provides an opportunity to update on the latest developments in modification of electrical and thermal properties of plastics. We preview the event

Electronics play a vital and growing role in modern life. Whether it's smart appliances, autonomous vehicles, energy efficient LED lighting, or mobile information devices, more and more products today include electronic components and that is placing new challenges on designers and manufacturers. Sensitive electronic components must be protected not only from physical damage but also from electromagnetic interference, static charge and thermal overload. And that protection must be provided in an effective and affordable manner.

Plastics are well-proven challengers to conventional materials such as metal where, in many cases, designers have harnessed their unique performance and processing benefits, including their high levels of electrical and thermal insulation. However, many emerging electronics applications require plastics that offer improved conductivity in either or both areas. Fortunately, additive solutions are available that can deliver electrical and/or thermal conductivity in a wide range of base polymers and the latest developments in this area will come under the spotlight at AMI's second North American Conductive Plastics conference, which is supported by *Compounding World* and *Injection World* magazines.

Taking place on 20-21 March 2018 in Pittsburgh, PA, US, Conductive Plastics USA 2018 is a two-day event that brings together expert speakers to explain the latest advances in electrically and thermally conductive additives, and how they can be used to design and develop plastics that offer a

Main image: Increasing penetration of electronics into everyday products is driving interest in polymer-based parts such as heat sinks

novel set of performance characteristics.

The conference will be opened by Chris Smith, Editor-in-Chief at AMI Magazines and Editor of Compounding World, who will present a brief introduction to conductive plastics, highlighting some of the key areas of application today and for the future. Then **Dr Michael Claes**, Chief Technology Officer and Global Strategic Account Manager at **Nanocyl** in Belgium, will open the event's technical programme with a presentation looking at examples of how and where multi-wall carbon nanotubes (MWCNTs) are being used to improve electrical conductivity.

Switching the focus to the future, **Dr Xiao Zhong**, Analyst at **Lux Research** in the US, will discuss 3D printing of electrically conductive plastics, reviewing market opportunities, industry strategies and some of the likely enabling technologies. **Luigi Alzati**, Market Leader Americas at **Imerys Graphite & Carbon** in the US, will discuss carbon black-based solutions for production of conductive electronic packaging. And **Jukka Hillberg**, Research and Technology Manager at **Croda** in Finland, will explain the functioning and application of inherently dissipative polymers for electrical modification (Croda recently acquired the **IonPhasE** IDP business).

Thermal options

The conference will then move over to thermal conductivity modification, beginning with two examples of formulated compounds. **Terry Davis**, Principal Engineer/FTR Manager at **Covestro** in the US will present a review of some thermally conductive polycarbonate polymer grades developed for applications in LED lighting. **Darin Grinsteinner**, Product Developer at **Celanese** in the US, will follow that with a discussion of how the thermal and impact performance of polymer compounds can be improved for automotive heat sink applications.

Additives for thermal conductivity enhancement are next on the agenda with **Péter Sebö**, Head of Marketing and Development at **Quarzwerke** in Germany, sharing some of the latest developments in thermally conductive fillers for development of white and coloured compounds. He will be followed by **Kerry Smith**, Product Manager Americas with **Nabaltec** in the US, who will look at how mineral flame retardants and conductive fillers can be combined to achieve fire retardant thermally conductive compounds. **Dr Martijn Mies**, Research and Development Manager at **Huber Engineered Materials** in the US will end the session with an examination of the use of aluminium oxides to enhance thermal conductivity in polyamides.

The final session of the first day of Conductive Plastics turns the spotlight onto some of the emerging additive technologies. **Dr Daniel Stolyarov**, President of **Graphene 3D Lab** in the US, will open with a discussion of the use of graphene nanoplatelets in high performance electrically conductive polymer composites. **Dr Eugeniy Ilin**, Head of the Department of Polymer Materials and Vice President at **OCSiAl** in Russia, will explain how single-wall carbon nanotubes (SWCNTs) can be used to enhance conductivity and to reinforce thermoplastic compounds. And **Dr Edward Chan**, Vice President at **Global Graphene Group** will detail how graphene can improve the thermal properties of thermoplastic and thermoset polymers.

About Conductive Plastics USA 2018

Conductive Plastics USA 2018 is AMI's fourth conference focused on this fast developing market sector and the second to be held in North America. It takes place on 20-21 March 2018 at the Pittsburgh Marriott City Center hotel in Pittsburgh, PA, US, and is sponsored by **Modern Dispersions Inc** and **Premix Oy** and supported by *Compounding World* and *Injection World* magazines.

The conference will bring together a variety of expert speakers to detail the latest additive and process developments available for enhancing the electrical and/or thermal conductivity of plastic compounds.

Aside from the formal presentations, Conductive Plastics USA 2018 will include a mini-exhibition and will provide extensive networking opportunities during the break-out sessions and refreshment breaks. All attendees are also invited to attend the informal networking cocktail reception at the end of the first day of the conference.

To find out more about attending, sponsoring or exhibiting at Conductive Plastics USA 2018, contact the conference coordinator, Christina Winegarden. Email: **Christina.winegarden@ami.international**, Tel: +1 610 478 0800, or visit the **conference website**

EMI and ESD

The second day of the conference will commence with a review of some of the latest developments in the area of EMI (electromagnetic interference) and ESD management (electrostatic discharge). **Elijah Grant**, Product Development Engineer at **RTP Company** in the US, will open the session with some guidance on how to select a thermoplastic material for use in hazardous and ATEX environments. **Dr Dimitri Rousseaux**, Composites and Compounds R&D Manger at **Total Research & Technology** in Belgium, will discuss the development and application of carbon nanotube modified compounds in ATEX and ESD applications. And **Kari Alha**, R&D Director at **Premix** in Finland, will speak about electrostatic discharge attenuation in electrically conductive carbon black loaded compounds.

Achieving high levels of electrical and thermal conductivity in plastics can require working with high filler loadings and very often needs careful dispersion and handling of additives. The conference will consider how this can be achieved in compound preparation. **Dr Paul Andersen**, Process Engineering Consultant at **Coperion** in the US, will explain some of the difficulties that producers of conductive plastics may face and detail some of the techniques that can be applied in twin screw compounding to overcome them. Then **Slayton Altenburg**, Application Specialist at **Technical Process & Engineering (TPEI)** will discuss compounding of conductive masterbatches using continuous mixer technology.

The final session of Conductive Plastics is focused on the challenges of measuring thermal conductivity. **Justin Wynn**, Application Engineer Thermophysical Properties at **TA Instruments-Waters** in the US, will detail the use of steady-state and flash diffusivity measurement techniques to measure out-of-plane and in-plane thermal conductivity. Then **Alex Makitka**, Applications Manager at **Linseis** in the US, will bring the conference to a close with an explanation of the use of the transient hot bridge (THB) technique for high speed measurement of thermal conductivity in polymer pads and parts. **Download the brochure**

Conductive Plastics USA will bring together a line-up of expert speakers including (from left, top) Lux Research Analyst Dr Xiao Zhong, Covestro Principal Engineer/FTR Manager Terry Davis, Quarzwerke Head of Marketing and Development Péter Sebö, OCSiAl Head of the Department of Polymer Materials and Vice President Dr Eugeniy Ilin, (bottom row) RTP Company Product Development Engineer Elijah Grant, Coperion Process Engineering Consultant Dr Paul Andersen, TPEI Application Specialist Slayton Altenburg, and AMI Magazines Editor-in-Chief Chris Smith

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Keeping materials on the move

Reducing downtime, enhancing flexibility and providing a safe working environment are all key elements of a cost-effective and efficient bulk materials handling system in the compounding plant. Mark Holmes finds out more

An efficient compounding operation requires resins, fillers and additives, as well as finished compounded materials, to be in the right location in the plant at the right time. Pneumatic conveying and handling of materials on the shop floor is an essential tool in achieving this. However, materials such as calcium carbonate, barium sulphate, magnesium hydroxide and alumina trihydrate - all commonly used in the compounding industry to provide opacity, improve surface finish, increase impact strength and stiffness, and improve flame retardant properties – can provide particular handling problems.

"Most of these fillers are in a particle size range of 200 microns to less than 1 micron," says Dr John Lawrence, Research Director at the **Bulk Solids Innovation Center of Kansas State University** in the US. "At this particle size range, these materials exhibit high cohesive strength and are difficult to flow into the hoppers used to feed material in a pneumatic conveying system."

Lawrence says the characteristics of flow behaviour difficulty can be expressed using Andrew Jenike's flow function, which was published in bulletin 123 back in 1964. This detailed flow function and how it relates to the cohesive strength of the material (basically, the higher the cohesive strength of the material, the lower the flow function value). Flow function is defined as the ratio between the applied normal force and unconfined yield strength of the material.

"Plastic compounding fillers exhibit higher unconfined yield strength and flow function values are always small, meaning difficult-to-flow materials," Lawrence says. "For a flow function value of less than 2, the hopper angle for mass flow must always be greater than 80° – a very steep slope. In practice, most hopper angles are between 60 and

Main image: Moving raw materials quickly and reliably is a key requirement in efficient compounding. This image shows Coperion's Test Centre for Bulk Material Handing at Weingarten in Germany

PHOTO: COPERION K-TRON

Right: Internal view of the Coperion K-Tron materials handling test facility at Salina in the US

70°. This means that the material would not exhibit mass flow, where all particles move in the hopper during discharge. Instead, funnel or stagnant flow occurs."

Piping and erratic flow behaviour are very common for funnel flow situations so aids such as vibrators, fluidisers and impactors are used to encourage flow in the hopper, Lawrence explains. "However, uniformity of material flow rate is hard to achieve for these materials. For example, if the expected flow rate was 5,000 lb/h [2,268 kg/h], only a flow rate of 3,000-4,000 lb/hr [1,361-1,814 kg/h] will be achieved, significantly reducing product production rates. There are various factors that affect this reduced flow. These include higher pick-up velocity, high speed rotary valves of a smaller size, vacuum probe feeding, shallow hopper slope and smaller outlet dimensions, temperature and relative humidity. Determining the optimum pick-up velocity and rotary valve speed will minimise these low flow rates."

Lawrence says these parameters can only be obtained by carrying out detailed material testing in a full scale laboratory. Equipment manufacturing companies have test facilities to study this and it is also a service that the Bulk Solids Innovation Center at Kansas State University can provide.

Hopper slope and outlet dimensions need to be ascertained at different temperatures and relative humidity through shear testing, Lawrence says. "Different wall friction materials can be tested to find the best hopper material for uniform flow. Hoppers may have already been purchased at a particular hopper angle, 70° for example. However, if the hopper angle for that material resulting from the test is 80°, then we need to retrofit the hopper with a different bin-insert to minimise the arching dimension."

Lawrence adds that probe feeding using vacuum pneumatic conveying, which is very common for pellets, may not provide a consistent flow rate when applied to powders. The vent in the probe will typically block, which affects the flow rate. This inconsistent feeding can be greatly reduced by switching from probe to rotary valve feeding.

PHOTO: KANSAS STATE UNIVERSITY

The Bulk Solids Innovation Center of Kansas State University in the US

Flexibility

While material handling systems can be designed to work highly effectively with a specific material, a major priority for many compounders is to have a level of flexibility enabling them to respond quickly to changing customer requirements. This is a key consideration for manufacturers of materials handling equipment. "Due to frequent product changes and ever smaller lot sizes, a state-of-the-art compounding line has to be built for quick product change and easy cleaning in-between different products. This allows a reduction in downtime for cleaning and improves the product quality by excluding contamination. At the same time, operational safety can be improved by better cleanability, easy access and facilitated housekeeping," says Matt Burt, General Sales Manager at Coperion K-Tron in the US.

"In addition, with more stringent NFPA (National Fire Protection Association) regulations and heightened awareness of dust explosion, material handling equipment requires more options to meet these needs. What was once considered a low risk factor, such as plastic resin pellets and the dust generated from handling, has now become a concern and requires special considerations like explosion venting or suppression systems. Many additives used in plastic compounding are also explosive."

Coperion K-Tron's materials handling laboratory at Salina in the US allows it to conduct full-scale tests with actual bulk materials and determine the

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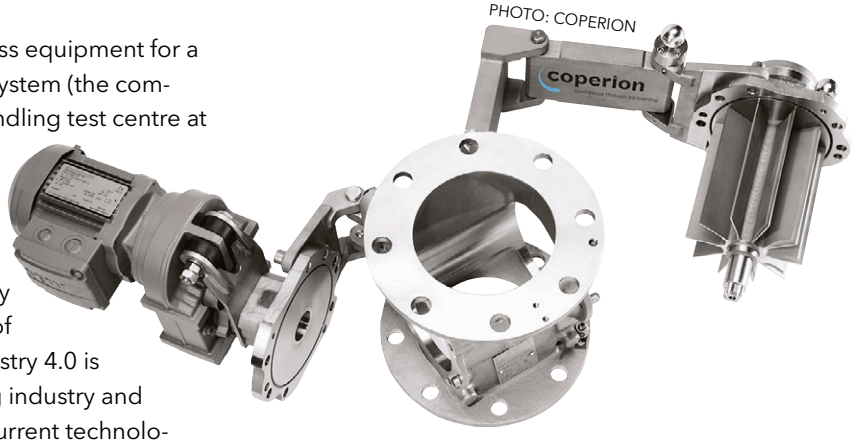

Right: The ZRD rotary valve from Coperion K-Tron is designed for heavy-duty industrial service at pressure differentials up to 1.5 bar and temperatures up to 100°C

best configuration of their process equipment for a particular product or complete system (the company also has a bulk material handling test centre at Weingarten in Germany).

One of the steps equipment manufacturers are taking to address compounders' challenges is the adoption of Industry 4.0 solutions and development of enhanced control systems. "Industry 4.0 is evolving in the material handling industry and becoming more common with current technologies, like smart phones and tablets," says Burt. "Control systems today can be designed to network with a customer's distributed control system (DCS) to provide preventative maintenance feedback, information on inventories of raw materials, and continual status of overall system performance. Customers are requesting equipment that is flexible and easy to clean, the equipment should address all safety and explosion concerns, and include a control system that can provide feedback and make the overall process more efficient."

Burt says that the latter – control systems – is a specific area of focus. "Our equipment and devices are being outfitted with network capable devices and instrumentation. This allows flexibility to work within several different platforms. We continue to develop equipment that is designed for easy cleaning and is adaptable to explosion mitigating devices. We are in the early stages of developing a standard product line of Ethernet capable receivers with web-based accessibility. "

Materials handling specialist **Penta**, part of the Piovan Group, also sees flexibility becoming more important. A company spokesperson says that over the past 10-15 years many plastics compounders have built up processing plants that are capable of high throughputs, but a consequence of that has been reduced flexibility in recipe and colour variations. As a result, these plants are not economic if small production lots are required. However, the current market now needs a high degree of flexibility on colours and different types of product. Penta reports an increasing number of requests to upgrade existing plants on a 'smart' basis – providing easy technical solutions at low cost. However, Penta says that re-designing and re-sizing materials handling systems and equipment is not always a straightforward operation.

The company explains that a further issue it currently faces is that a lot of compounding bulk materials handling systems are at least 30 years old. While the metal is still sound, hardware such as rotating parts, filters and control systems are frequently outdated and this can make the whole material logistics uneconomic. In theory, this means a lot of current systems ideally require a complete re-build, but Penta acknowledges this is unrealistic. It is rarely possible to shut an operation down completely and transfer to a new site, so solutions are needed to install modern systems with the shortest downtime possible.

The main technology issue for any manufacturer of bulk materials handling equipment is flexibility. "For example, this means designing in a way that reduces cleaning downtime to zero or as little as possible," says a Penta spokesperson. "Any materials handling operation, including dosing and weighing systems, also requires precision to minimise the cost of raw materials. This is particularly necessary when trying to reduce costs through the use of fillers, such as calcium carbonate, in products."

Penta says the addition of high amounts of filler requires materials handling equipment that is able to handle a sensitive powder mix. For example, by using a hot/cool mixer process up to 25% filler can

PHOTO: PENTA

Penta's HurryCon provides smooth and gentle conveying of highly-filled blends in continuous operation

PHOTO: PENTA

The VacuPulse from Penta is a low speed vacuum dense phase conveying system for abrasive and sensitive materials

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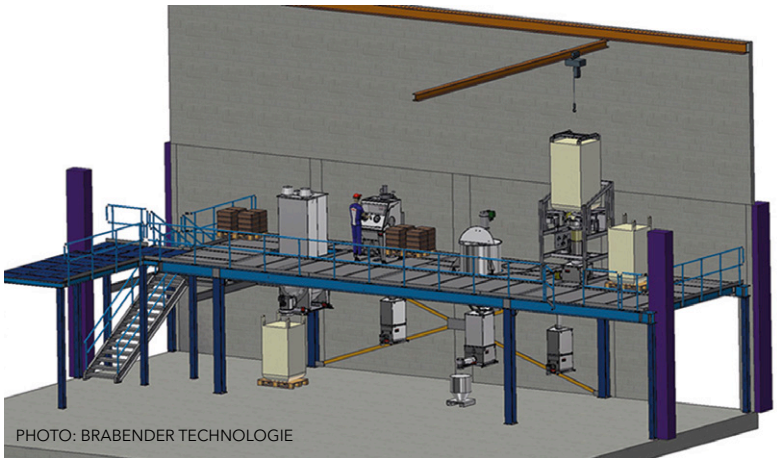

PHOTO: BRABENDER TECHNOLOGIE

Above: Brabender Technologie has commissioned a new Technical Center in Duisburg, Germany, for customer trials

be added to PVC. The company says that it has developed continuous dosing and mixing systems that can add filler to a PVC blend at a later stage, before the processing machines. These systems provide smooth and gentle conveying of these highly filled blends – HurryBatch is its batch dosing and mixing unit while HurryCon is intended for continuous operation. Both units are claimed to homogenise powders without heating them through friction.

A further development at Penta is the VacuPulse system for conveying abrasive and sensitive materials. The low speed vacuum dense phase conveying system can transport abrasive materials with minimal equipment wear, as well as move sensitive materials without damage. An integral dosing unit can provide microbatch additive dosing while the system can have a mirror finish or PTFE coated internal surface, which offers high precision weighing. Cross contamination from different pigments is prevented and cleaning is said to be easy.

Germany-based **Brabender Technologie** has constructed a new Technical Centre in Duisburg that it says will enable it to extend the quantity and quality of the tests it can conduct for customers. The centre has a new feeder filling level and a two-tonne overhead crane that can lift standard packaging such as big bags, silos, drums and sacks. Overall there are four full test lines available, but there is also space for smaller tests that do not require use of the filling level to be carried out. In addition, there is a separate area with hygienic conditions required for food and pharmaceutical applications.

The company says that continuous processes are the most common tests requested, but batching

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applications can also be trialled on large and small scale in the Technical Centre. Batching is of particular interest for clients exploring high-precision applications. Brabender says the individual testing lines can be retooled independently to allow an entire process to be simulated for a customer.

Increased efficiency

Equipment maker **Flexicon** recently supplied materials handling equipment to a Spanish plastics company that collects, sorts and recycles plastic scrap using a recompounding process that involves compounding the recycled resin with a powder mineral additive and then pelletising. Previously, operators manually loaded 25kg sacks of the 10 micron particle size mineral powder into a hopper, from which the material gravity fed into the compounding extruder along with the recycled material. The process was slow, laborious and dusty.

Using a bulk bag discharger and pneumatic conveying system supplied by Flexicon, the powder is now discharged automatically from 700kg bulk bags and conveyed to the extruder pneumatically at high rates. Manual handling has been reduced dramatically, with operators only having to change bulk bags once or twice per shift. This frees them up for higher-value tasks. In addition, the new system generates little or no dust.

Right: A forklift positions a bulk bag alongside a Flexicon BFH-C-X bulk bag discharger at a Spanish plastics recycling plant

PHOTO: FLEXICON

Below: Connecting the bag spout to a Flexicon Spout-Lock clamp ring, which is mounted on a Tele-Tube that promotes material flow

PHOTO: FLEXICON

The process starts with a forklift positioning a bulk bag alongside the Bulk-Out model BFH-C-X bulk bag discharger, from where a hoist and trolley suspended from a cantilevered I-beam lifts the bag into position on the discharger frame. The clean side of the bag spout attaches to the clean side of a Tele-Tube telescoping tube by means of a Spout-Lock clamp ring. The tube maintains constant downward tension on the bag as it empties and elongates, easing material flow into the 226 litre hopper and containing dust. A Flow Flexer agitation device raises and lowers the edges of the bulk bag to aid the flow of mineral powder into the hopper. An agitator is also installed in the hopper to promote the flow of material into a rotary valve at the pneumatic conveyor inlet.

A Power-Cincher flow-control valve cinches the bag spout concentrically, allowing partially empty bags to be tied off and removed with no leakage. The operator reports that the flow-control valve allows more flexibility in production, as a partially emptied bulk bag can be removed and replaced with another material required for producing a different type of plastic pellet.

The 75mm diameter, 38m long stainless steel

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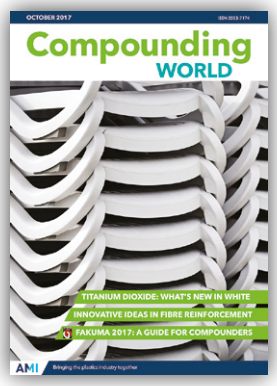

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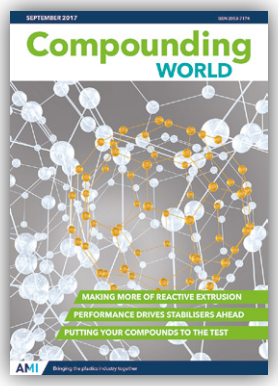

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Right: The net5 system material conveying system from Wittmann

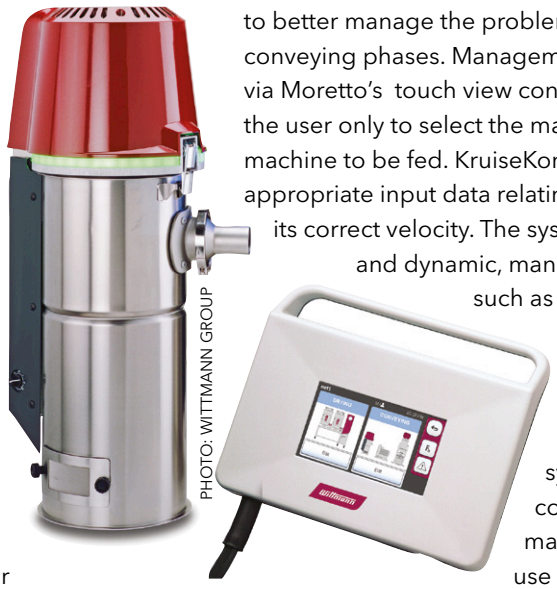

PHOTO: WITTMANN GROUP

conveying line in the Pneumati-Con pneumatic system delivers up to 1,000 kg/h of material to a filter-receiver and receiving hopper located above the extruder. The mineral powder is separated from the air stream by a filter-receiver that includes a 220 litre capacity receiving hopper. Four air-jet fluidisers in the bottom of the hopper assist the flow of material and a volumetric feeder meters it into the extruder. System operation is under PLC control, including timed filter cleaning, starting and stopping the pneumatic conveyor based on level sensor readings, and opening and closing of valves.

The Spanish customer says that the bulk bag discharger and pneumatic conveying system have reduced the manual handling that its workers have to do and have helped clean up the plant. It reports that the equipment has improved efficiency, as when the hopper above the extruder runs low, the controller alerts the operators, who then load another bulk bag, thereby reducing downtime.

Granular conveying

Below: KruiseKontrol is an automatic system from Moretto for control and management of velocity in plastics conveying

Italian materials handling firm **Moretto** has developed its KruiseKontrol system for automatic control and management of plastic granule conveying velocity. The company says KruiseKontrol is designed to constantly optimise the system, transporting granules at the appropriate speed without the creation of angel hair and dust, as well as avoiding pipe wear and increasing productivity.

The system is claimed to maintain the correct material velocity for different polymers and is said to better manage the problematic initial and final conveying phases. Management of the system is via Moretto's touch view control, which requires the user only to select the material type and the machine to be fed. KruiseKontrol is then sent the appropriate input data relating to the material and its correct velocity. The system is fully automatic and dynamic, managing parameters such as vacuum level and air flow as required.

PHOTO: MORETTO

Meanwhile, **Wittmann** says it has developed its net5 system material conveying system for maximum flexibility in use and application (it can be used, for instance, to control a single difficult-to-reach material loader or a mid-sized conveying system of up to 24 loaders). In addition, the net5 system can control the material conveying system through one of the company's Aton Plus series dryers. Up to four touch-screen controls can be used in this way and, when a system consists of three Teachbox Basic controls and a dryer, each console can be used to imput commands. Administration of the system can also be executed via any of the four control displays.

Wittmann says a further advantage of the Teachbox Basic is in the ability to position it anywhere within the net5 system. For example, it is possible to connect one control unit to the system at the beginning of a conveying line and a second one somewhere in the middle of the system. This means the operator is free to arrange short distances for material handling in the system, or to reserve a particular control unit for a particularly critical component.

The concept of the control unit allows for unrestricted flexibility, even when the system is fully engaged. For example, the Teachbox Basic can be connected to a central pump and then later to any conveying unit. All the settings that define the suction process and the conveying times (and the 2-component valve settings) are stored directly in the conveying unit.

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.bulk-solids.k-state.edu (Kansas State University)**
- **www.coperion.com**
- **http://penta.piovan.com**
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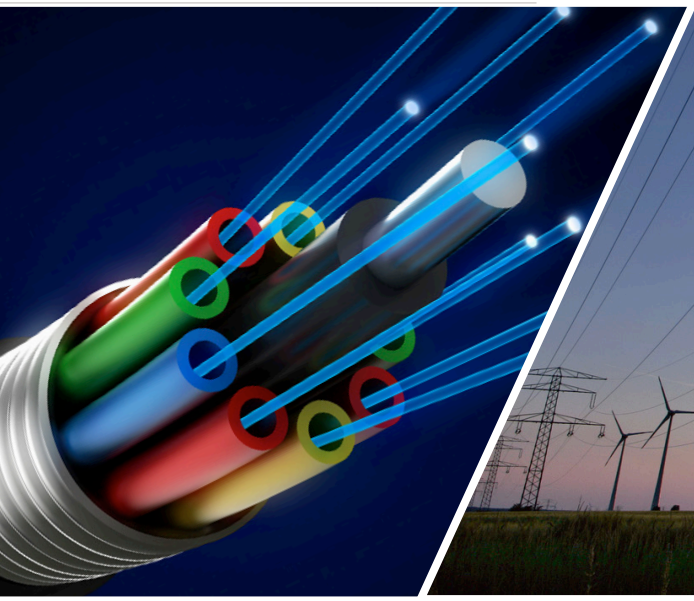

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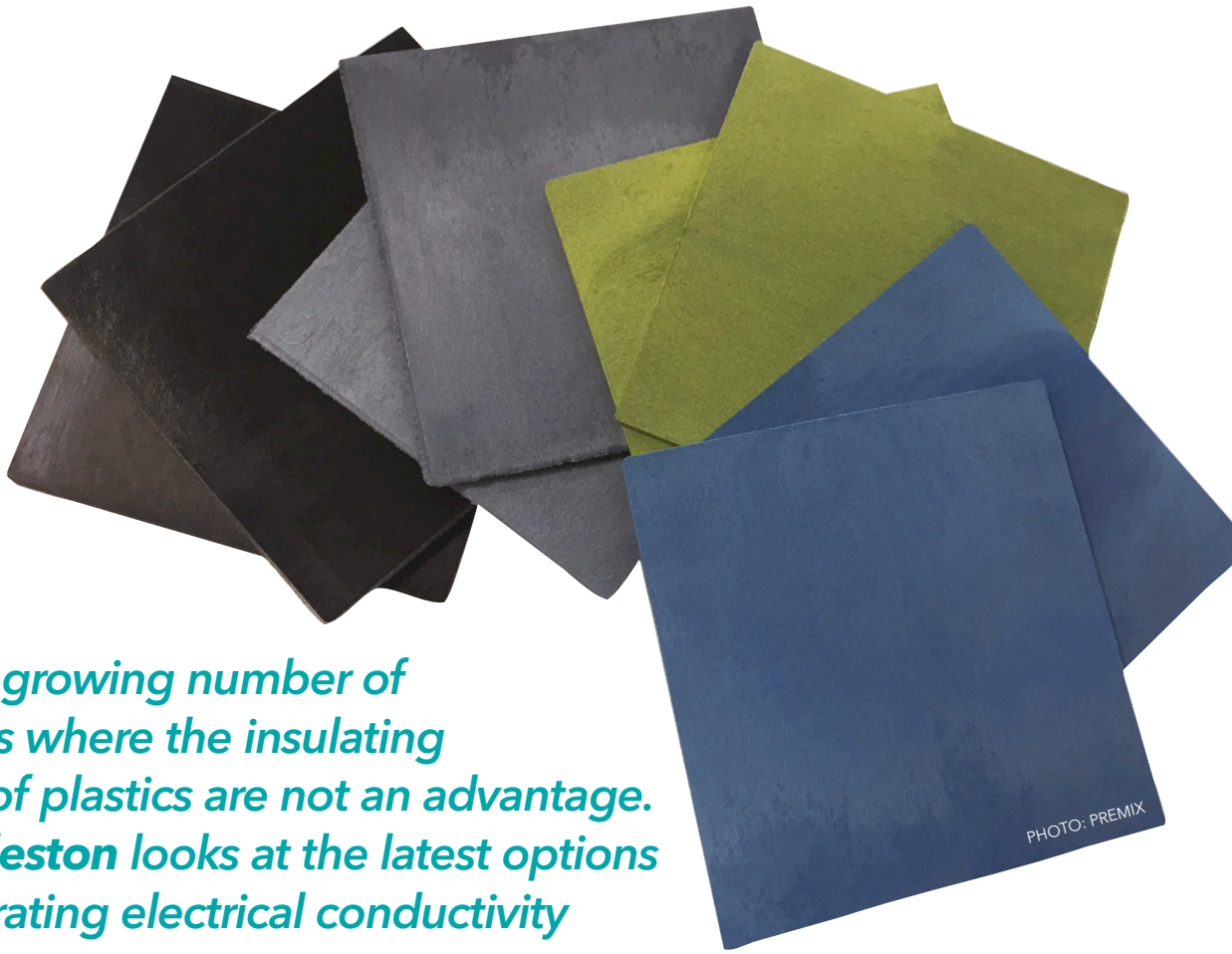

There are a growing number of applications where the insulating properties of plastics are not an advantage. Peter Mapleston looks at the latest options for incorporating electrical conductivity

Taking a charge on plastics

Plastics are, for the most part, excellent electrical insulators and there are countless applications across many markets where that particular property is not only an advantage but is essential. However, there are also many applications that call for other essential features of plastics – their low weight, design flexibility, good physical properties, aesthetics, to name but a few – but that would also gain from some level of electrical conductivity.

Applications for electrically conductive plastics include stress-relieving conductive layers for power cables, packaging to prevent sparks when handling electronic components, battery components, touch displays, and novel electrical heating systems. The list is growing longer and, as it does, the capabilities of the most traditional way of increasing electrical conductivity – addition of carbon black – are being stretched. As a result, newer solutions are being sought and are gaining in popularity.

That is not to write off carbon black, however. The material offers all sorts of advantages - it delivers performance in a highly cost-effective way and carbon black producers continue to make improvements, as examples later on will show. But not everybody in the market for conductive or antistatic plastics materials and end products wants or can accept the colour (or more accurately the lack of it). Others are also interested in conductive additive systems that do not have to be used in such high doses and that, as a consequence, have less effect on mechanical properties. Cleanliness in production may also be an issue, although carbon black producers have made significant progress in this area. So what are the alternative options? Well, to repurpose Henry Ford's famous words: any additive, as long as it's carbon.

Nano finds its niche

Carbon nanotubes seem to have been talked about for quite some time - in fact, they first became available over 30 years ago. But – even if a little goes a long way – they are still available in relatively limited supply volumes. Capacities are rising and prices have fallen in recent years, and may possibly fall further, but these additives are always likely to be expensive. "A certain sustainability of the offer side is required if the customers want supply certainty," is how the head of one major CNT supplier, that did not want to be named, describes the situation. ›

Main image: These carbon fibre filled electrically conductive TPU compounds from Premix are hard wearing and can be supplied in a range of, albeit darker, colours

PHOTO: SHUTTERSTOCK

Right: Carbon nanotubes will be critical in development of fast charging EV batteries, says Nanocyl

The likelihood is that, unless something truly radical happens in production and handling technologies, CNTs will remain as relatively niche products. In fact, the same un-named company executive said that we have likely reached a point of equilibrium in the markets for various carbon blacks and other conductive additives and carbon nanotubes. That said, there is still a lot of CNT activity to report on.

"Carbon nanotubes stand, in terms of conductivity, on top of the pyramid of carbons," says Laurent Kosbach, CEO of Belgian producer **Nanocyl**. "For example, they are the additives that will be required for fast charging EV batteries." The company has been supplying multiwall carbon nanotubes (MWCNTs) for some 15 years and currently has a capacity for its NC7000 product of 460 tonnes/year.

"Interestingly, though, what we have seen is a growing approach for synergies between all materials," Kosbach says. "Researchers and applications developers have more materials to combine. The right recipe takes time to fine tune but [our experience] in automotive, electronics, energy, industrial and composite industries confirms that route. With this growing presence and increasing market demand it is not surprising that we will have in the coming years to consider plans to add additional capacities."

Below: LG Chem's 400 tonne/year carbon nanotube production plant at Yeosu, South Korea. The company is mulling further capacity expansions

Nanocyl has more than 15 highly diverse industrial applications, according to CTO Michael Claes. "NC7000-based electronic packaging – injection mouldings or thermoformed sheet products – have become a standard in the industry thanks for their very low outgassing factor together with low particle count and high electrical and mechanical robustness and their cleanroom certification," Claes says.

In automotive, NC7000-based thermoplastic compounds are said to be widely used either for their capability to enable painting or plating at low loading without primer or pre-treatment or for their high chemical resistance and oligomer wash-out resistance in fuel system applications. "Those systems are vastly replacing metallic or carbon black based elements," Claes claims.

PHOTO: LG CHEM

Preparing for growth

Other MWCNT suppliers are also said to be mulling more product capacity. According to a recent Korean news organisation report, **LG Chem** is considering expanding a new CNT manufacturing facility in Korea that has not yet reached full capacity in response to expected future demand for batteries for EVs and portable electronics. LG estimates that some 80% of global CNT output will go to make rechargeable Li-ion batteries, mostly for electric vehicles (EVs), by 2020.

LG's 400 tonne/yr capacity plant started up in early 2017 and is only likely to become fully operational later this year. This potentially puts the company in the leading ranks of CNT producers, among companies like Showa Denko (whose main focus appears to be on lithium-ion batteries) and C-Nano, which both manufacture in the Far East, and Nanocyl, Hyperion Catalysis and Arkema, who produce their products in the Europe and North America. Between them sits OCSiAl, which is headquartered in Luxembourg but produces in Russia – and concentrates on single-wall carbon nanotubes (SWCNTs).

Among these producers, Hyperion has one of the longest application histories in conductive thermoplastics, having started the ball rolling many years ago with the supply of masterbatches based on its MWCNTs (it calls them Fibrils) to GE Plastics (now SABIC) for its Noryl GTX polyamide/polyphenylene ether blend for on-line paintable automobile exterior panels. However, the company does not comment on its current capacity or applications. ›

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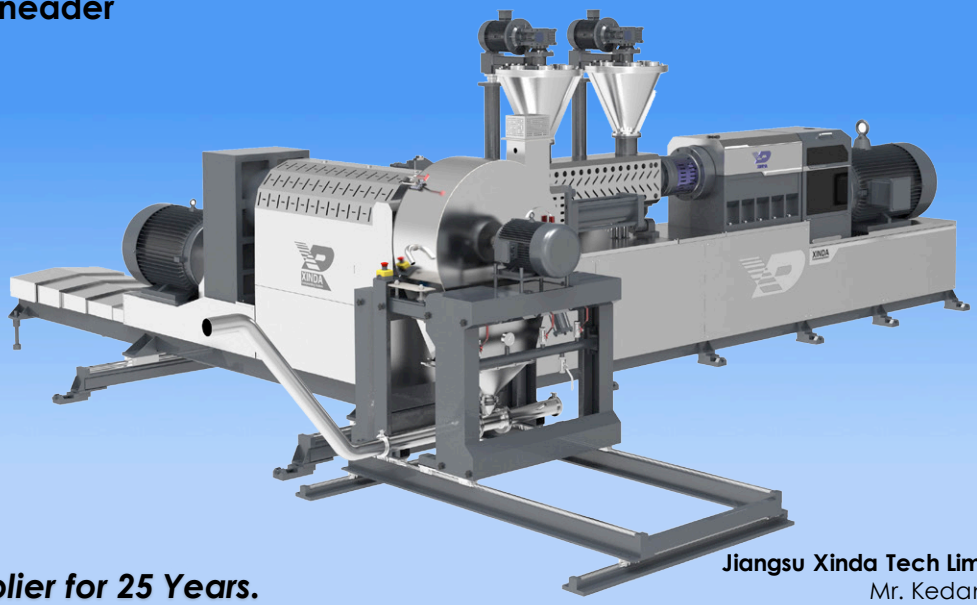

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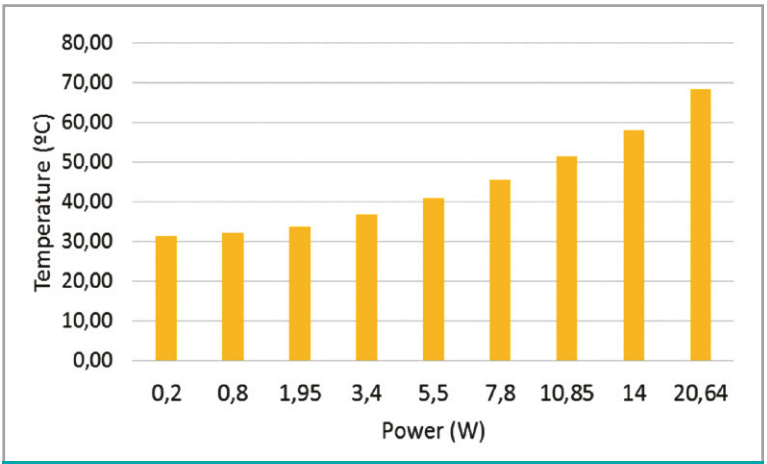

Figure 1: Heating effect of self-regulating polymer films produced within the JosPel project
Source: Aimplas

Developments heat up

As mentioned earlier, CNTs are expected to find application in batteries for EVs. However, there could be another significant EV application for them: heating. The aim of the EU-sponsored JosPel project is to develop an energy-efficient system for optimising interior temperature management in electric vehicles (EVs). The project, which involves 14 partners from nine countries, began in 2015 and ends this October.

JosPel is an acronym of Joule and Peltier, two heating effects that are at the core of the project. Joule heating is the process by which the passage of an electric current through a conductor releases heat. In Peltier cells, heat is produced when an electric current flows through a circuit made from two different metals (or in the JoPel project from suitable composites containing CNTs). Heat is emitted at the upper junction and absorbed at the lower.

The project organisers' premise is that many people will not consider buying an EV unless the operating range increases dramatically (EVs compare poorly to most cars on the market today in this respect). The main ways to extend EV range are to increase the engine efficiency, to improve the battery efficiency, to reduce the mass of the car, and to improve energy use in the car. The latter holds considerable scope for improvement as current HVAC technologies reduce the potential operating range of an EV by as much as 25%.

The main objective of the project is to achieve a reduction of at least 50% in energy used for passenger comfort and 30% for component cooling in extreme conditions (compared with current EVs).

Right: Measuring the heating performance of self-regulating polymeric heating materials produced in the EU-funded JosPel project

Spanish polymer industry research organisation **Aimplas**, one of the project partners, has developed Peltier devices in the form of self-regulating thermoplastic heating plates that will be installed in the doors of the test vehicles. A conductive thermoplastic compound based on CNTs has already been developed and validated, using cast-extruded sheets (Figure 1). As Aimplas is currently patenting the process, it says it is not able to say more about the CNTs it has used.

Focus on single-wall

Before graphene arrived on the scene in 2004 – rapidly taking on the mantle of the "Next Big Thing" – the nano-additive to watch was the SWCNT. For a number of reasons, SWCNTs did not find their place, in part due to cost (they were even more expensive than MWCNTs) but also, according to some, the difficulty of dispersing them in plastics compounds. The indications, however, are that these problems are being overcome. **OCSiAl** has developed a lower-cost production root and, together with a number of key customers, is claiming to have made significant progress in processability. The company claims that the Van der Waal forces that hold the nanotubes together are more or less the same for MWCNTs and SWCNTs, but adds that as MWCNTs are produced as agglomerates they are inherently more difficult to disperse.

OCSiAl advises treating MWCNTs and SWCNTs as two very different materials. "They have hardly anything in common, and thus they impart a number of very different properties," a spokesperson for the company says. "While MWCNTs feature many tubes with decreasing diameter that are coiled inside each other, SWCNTs can be thought of as an extremely thin rolled up sheet of graphene."

OCSiAl produces high-purity SWCNTs under the brand name Tuball. It says the flexibility of its Tuball SWCNTs and the extremely high ratio between their length and mean outer diameter – around 5,000 – leads to an extremely low percolation threshold (the level required to create a conductive network in a matrix polymer). As little as 0.02 wt% of nanotubes is said to be enough to form a three-dimensional, permanent, stable and humidity-independent conductive network in thermoplastics. These ultra-low effective loadings enable bright colours, including white, to be achieved in the final compound.

The introduction of SWCNTs does not lead to degradation of the material's mechanical properties and many even result in

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PHOTO: AIMPLAS

Above: Production of electrically conductive polymer sheet in the Aimplas development lab

improvements, the supplier says. Meanwhile, its recently developed Tuball Matrix concentrates are said to greatly simplify the handling of the nanotubes - OCSiAl emphasises the cleanliness of operations compared to those using carbon black to impart conductivity.

OCSiAl launched its first facility for industrial-scale and low-cost SWCNT production in 2013 and says that, on their launch, the Tuball nanotubes were 75 times cheaper than the nearest analogues. "When considering the price, the ultra-low effective concentration of SWCNTs required should also be acknowledged – it is tens and hundreds of times lower than that of other conventional additives, such as MWCNTs or carbon black," says Zakhar Bolshakov, OCSiAl Vice President for Polymers.

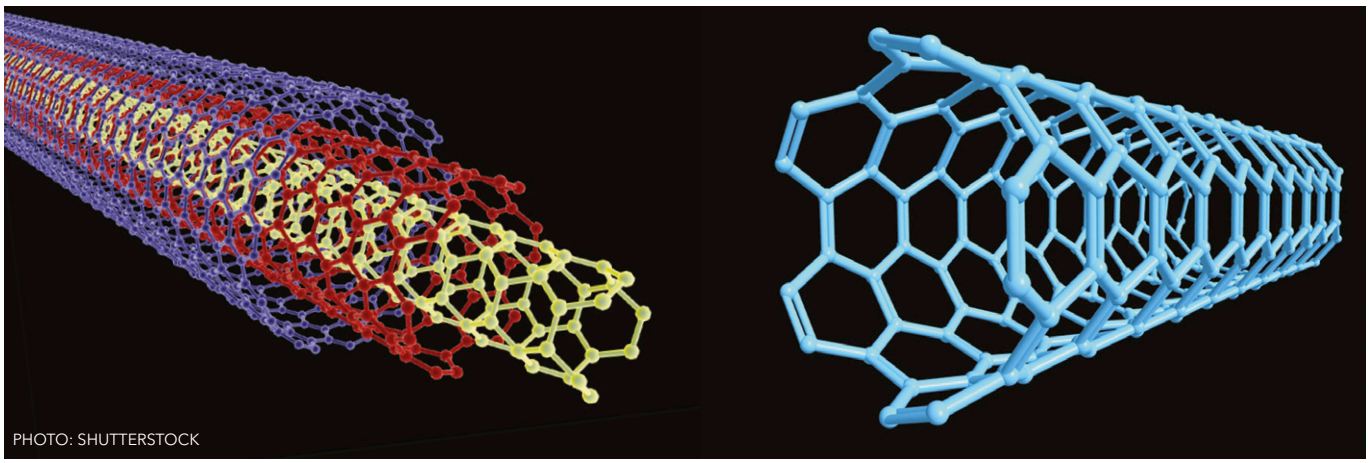
Capacity expansions

OCSiAl has a production capacity of 10 tonnes of SWCNTs per year. This sounds modest but the company claims 90% of the world's total production capacity. Capacity is scheduled to increase to 60 tonnes this year, rising to 320 tonnes in 2020 as OCSiAl opens new synthesis facilities. "These developments will inevitably lead to further price reductions," Bolshakov says.

Bolshakov says the company has taken a number of steps to ensure that its customers are able to make effective and safe use of its products. "Firstly, we mostly supply SWCNTs in the form of easy-to-use and easy-to-dilute masterbatches, so our customers do not face any technical challenges with dispersion of the nanotube powder. Secondly, we provide optimised percolation curves that our customers should be able to achieve. If they can't initially achieve the curve, we provide further technical support and in practically all cases solve the problem," he explains.

The company is also the first SWCNT producer to be registered in accordance with the EU's REACH regulations. It says it is now authorised to start large-volume commercial shipments of SWCNTs to customers in Europe (currently up to 10 tonnes/year), the US and other key global markets. It also says it is investing in health and safety-related research projects conducted by independent laboratories. The company recently revealed the results of a study showing that Taber abrasion tests show hardly any nano-sized particles were released when materials containing SWCNTs were mechanically stressed.

OCSiAl and its partners claim several successes in applying SWCNTs in various thermoplastic compounds. "Some basic and engineering thermoplastics containing SWCNTs have already been launched on the market, but many more are just about to be launched and will enter the market in 2018," says Evgeniy Ilin, OCSiAl Vice President and Head of Department of Polymer Materials. He also says the company is looking for partners to jointly develop next-generation high-performance thermoplastic compounds. ›



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3D rendered images showing the very different structure of multiwall carbon (left) and single wall (right) carbon nanotubes, which results in quite distinct properties

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Right: A producer of anti-static rotational moulded tanks is using OCSiAl's SWCNTs to produce colourable anti-static containers

Most of these existing partnerships are covered by NDAs but one cited by the company relates to the application of Tuball SWCNTs in rigid anti-static packaging produced by rotational moulding. The end-user required a coloured PE packaging container for flammable and explosive liquids and powders that provided a permanent and stable surface resistivity in the range 10^6–10^9 ohm-sq. Using the Tuball Matrix 801 nanotube concentrate at an addition of 0.07 wt% was sufficient to provide permanent surface resistivity of 10^7 ohm-sq in coloured tanks, while 0.1 wt% of Tuball achieved a surface resistivity of 10^6 ohm-sq in the black tanks. Mechanical strength is said to be maintained.

Another OCSiAl client required a semi-conductive compound destined for medium- and high-voltage power cables offering a volume resistivity of less than 20 ohm·cm at 23°C and less than 100 ohm·cm at 90°C. The compound had to provide permanent and stable electrical conductivity while meeting demanding mechanical requirements. Tuball Matrix 801 product has met these requirements, offering the additional benefits of low moisture absorption and reduced density.

OCSiAl says another of its customers is producing PE anti-static blown film using 0.01 wt% of Tuball nanotubes introduced in the form of a concentrate – Matrix 810. This has enabled it to achieve the required level of surface resistivity of 5×10^9–10^{10} ohm-sq.

Right: OCSiAl says PE film containing 0.01 wt% SWCNTs displays a permanent antistatic effect

At the Nanoaugmented Materials Industry Summit 2017 organised last year by OCSiAl, Daniel Florenthal, Joint CEO of Israel-based **Florma**, spoke about a new free flowing, dust free, polymer base powder containing Tuball for conductive compounds that is now being produced by his company. "We used Tuball at 0.2% in ABS and PA with our Fliquid system and achieved very good conductivity," he said. "Our newest development is Fliquid Powder system based on polymer powder blend to allow easy dispersing in various systems."


PHOTO: OCSIAL

Right: Semi-conductive compounds for medium- and high-voltage power cables are being produced with SWCNTs, according to OCSiAl

Alternative nano-forms

A recent entry into the field of nanoparticulate additives is **CarbonX**. This Netherlands-based company makes a product, also called CarbonX, that comprises a 3D network of nano fibres. Daniela Sordi, Chief Technology Officer at the firm, recently said it is preparing a commercial scale-up trial as part of its plan to increase annual production capacity above its current 50 tonnes.

"Six different grades will be available for sampling in March," Sordi says. "The six new grades are especially designed to serve applications in which high electrical conductivity or mechanical reinforcement and static dissipative features are desired." The grades are characterised by medium and very high structure combined with a range of surface areas for different technical requirements and processing needs.

PHOTO: OCSIAL

Also operating on the nano frontier is **The Mackinac Group**. It has developed technology for incorporating nano-scale conductive transition metals directly into the polymer backbone or onto side chains during the polymerisation process. It says conductivity of materials produced this way is much more controllable and uniform than is possible by incorporating conductive additives during the compounding process.

Mackinac President Donald Phillips says the company has two new products using its proprietary nano science. One is an anti-stat sprayable polyurea and the other is a thermoplastic polyurethane (TPU). The polyurea has a surface resistivity of 10^6 ohm-sq while the TPU can be as low as 10^2 ohm-sq (the latter can be made as an ester or ether version and can be extruded or injection moulded). The polyurea is already commercial and the TPU should be ready in either the second or third quarter of this year. Materials with resistivities in the 10^{-3}

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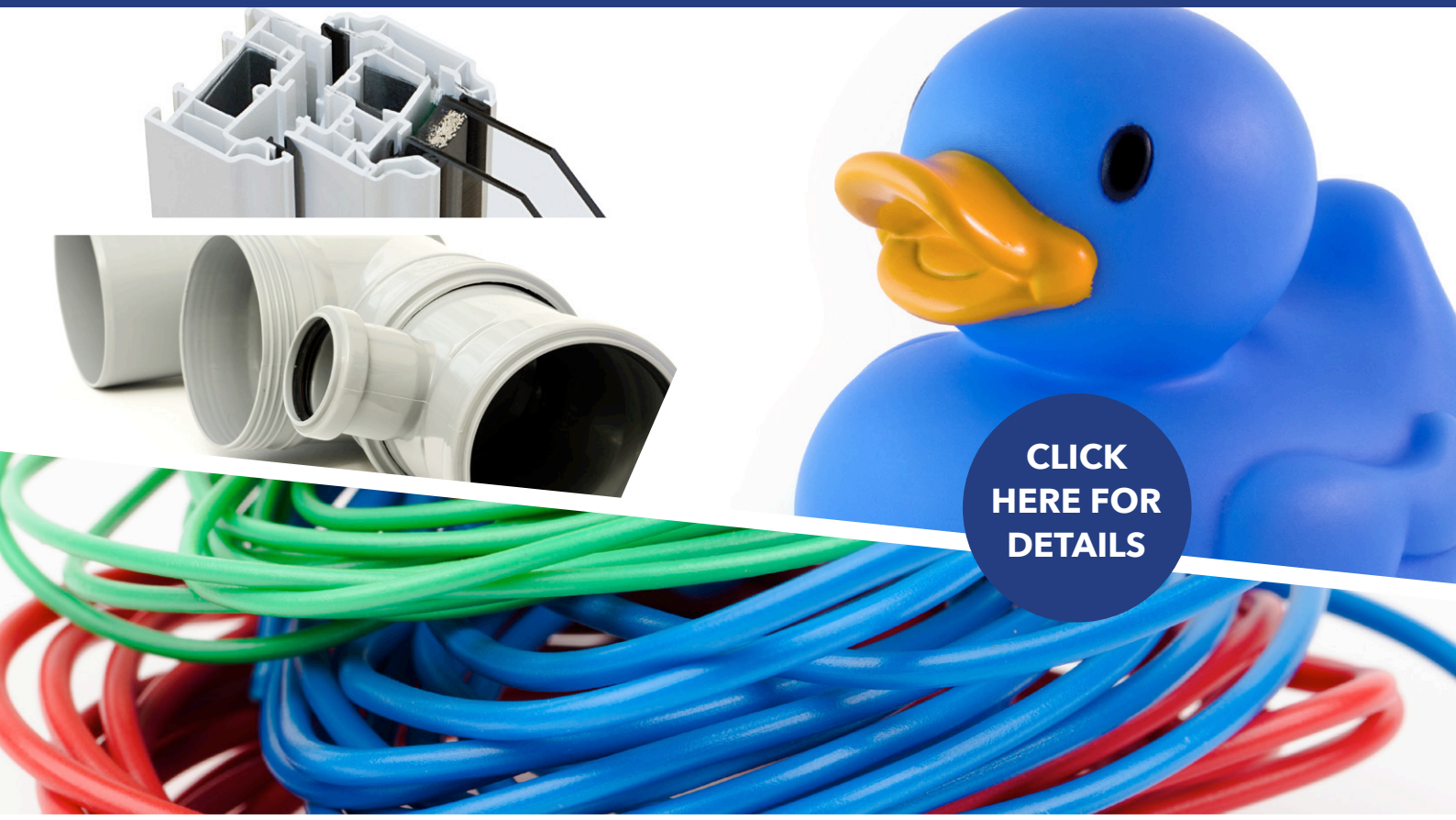

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to 10^{-4} ohm-sq range are in development.

Loading levels of the Mackinac nanomaterial are under 1%. Phillips says the company is targeting automotive, tubing/hose, and packaging applications. It is currently talking to a number of commercial partners to finalise material physical/mechanical/processing characteristics.

Back to black

Carbon black suppliers still, of course, hold the lion's share of the market for conductive additives and by quite some distance. They are continuing to develop products. At **Cabot**, Sebastian Heitkamp, Marketing Manager, Specialty Compounds EMEA, says a new addition to the company's range of conductive compounds has been developed for injection moulding of static dissipative thick section packaging. "The new Cabelec XS6565A compound is specifically tailored for the growing need in this space of conductive plastics," he says.

Above: Mackinac Group is readying a conductive TPU with surface resitivity as low as 10^2 ohm-sq

Heitkamp's colleague Santiague Pierre, Global Applications Lead Conductive Applications at Cabot, says that the company is also currently testing a new PA6-based conductive concentrate based on a super-conductive carbon black. Vulcan XCmax 22 specialty carbon black is an example of a conductive carbon black in this range.

"With many new polyamide applications requiring conductivity without sacrificing mechanical properties, this new conductive concentrate offers a new path for compounders to achieve their target performance at lower loadings compared to conventional conductive carbon blacks," he says. The PA6-based concentrate is highly versatile and can be diluted up to a level of 70% to reach the final volume resistivity requirements (Figure 2).

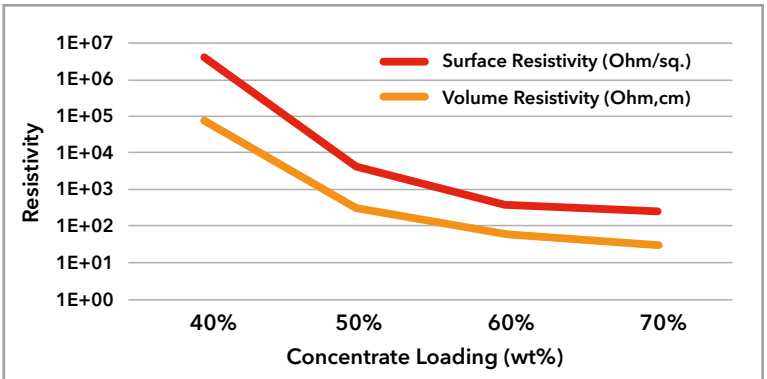

Figure 2: Cabelec PA6-based concentrate loading in PA6 polymer system
Source: Cabot

PHOTO: COLLOIDS

Right: The latest E-TEC conductive grades from Colloids are pitched at demanding anti-static applications, including flexible industrial hoses

Static applications

Discussing static dissipation, Daniele Bonacchi, Application Development Leader at **Imerys Graphite & Carbon**, says the company's Ensaco carbon blacks have proven to be a very good solution for demanding applications. "Our proprietary process enables the controlled production of extremely clean, easily dispersible, low moisture conductive carbon blacks that match the severest purity requirements for low PAH," he claims.

"The specific high structure/low surface area combination achievable by our process helps dispersion as the low surface improves polymer wetting, while the high structure decreases the contact forces between the aggregates. Moreover, Ensaco's low moisture uptake positively influences the dispersion, avoiding at the same time the possibility of bubble formation."

Higher carbon black dispersion means a low machine melt filter change rate with the resulting improved productivity. This is critical in demanding applications such as thin sheet and film application, where very high dispersion is mandatory and melt filtration is most frequently used.

The purity of carbon black is also key in the electronic packaging industry, as soluble ions can migrate and induce corrosion. For this reason, many ESD programs have limits on the ions contained in the final plastic objects. Ensaco carbon blacks are low ash content and have very low metallic impurities. They also display more than one order of magnitude lower content of soluble species than other conductive blacks as well as low sulphur and grit contents, the company claims (Figure 3).

Mix and match

Masterbatch and speciality compound producer **Colloids** says it is developing several new electrically conductive and electrostatically dissipative

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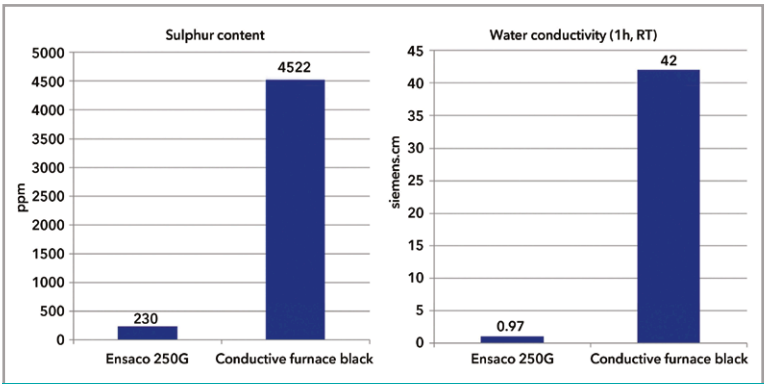

Figure 3: Sulphur content and water conductivity of Ensaco and conductive furnace carbon blacks
Source: Imerys Graphite & Carbon

compound grades, which will be added during the year to its existing E-Tec range. The new, permanent electrically conductive and ESD grades are all particulate based, with percolation characteristics claimed to be excellent. They will have surface resistance performance levels from 1 x 10^9 to less than 10^3 ohm-sq.

"The new grades will offer customers enhanced electrical performance for film, sheet and profile extrusion, injection moulding, vacuum forming and blow moulding, with less mechanical properties trade-off and the added benefit of enhanced process capability, excellent weldability and good aesthetics," a company spokesperson says.

Colloids is targeting medical devices, electrical and electronics, automotive, consumer and ESD packaging. It uses various forms of carbon in its E-Tec range and does not divulge which type is used in any one grade.

Finnish speciality conductive compound maker **Premix** recently extended its product slate with the introduction of an electrically conductive polyketone (PK), which it is targeting at fuel filler and system component applications. The Pre-Elec POK grade benefits from the very low gasoline permeation of PK and can be used as a replacement for PA and POM in multi-layer fuel system components. The company says the use of the new grade can reduce weight and cut complexity by eliminating the need for barrier layers.

Other recent introductions from Premix include a halogen-free and fire retardant electrically conductive PP – Pre-Elec FR-PP – which is aimed at production of anti-static ducting for industrial enviroments. The new material is said to offer a V-0 rating at 3.0mm. Also new is Pre-Elec TPU, a new line of carbon fibre filled TPUs that can be provided in red, blue and a range of dark colours. The materials are said to be soft, abrasion resistant and non-marking and are pitched at applications such as rollers, handles and seating arm rests.

Dissipative acquisition

Last November, speciality chemicals company **Croda International** acquired Finnish company **IonPhasE**, a supplier of static electricity protection products. At the time of the acquisition, Croda said IonPhasE has developed and supplies a unique range of anti-static additives that help to prevent damage to electrical components, increase the safety of chemical and food packaging and improve the long-term appearance of consumer appliances. It said IonPhasE's inherently dissipative polymers (IDPs) release static electricity in a controlled way and are a natural extension to its own product portfolio.

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Conductive Plastics USA 2018

The latest developments in the formulation and application of electrically and/or thermally conductive plastics will be put in the spotlight at Conductive Plastics USA 2018. Taking place in Pittsburgh, PA, USA on 20-21 March, AMI's second North America Conductive Plastics conference will provide expert insight into this fast evolving sector. You'll find a preview of the conference on page 27 of this issue.

To find out more about attending, sponsoring or exhibiting, contact conference coordinator, Christina Winegarden. Tel: +1 610 478 0800 Email: **christina.winegarden@ami.international**. Or visit the **conference website**

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- 22 countries represented
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- More than 20 key medical tubing and device producers
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The international conference on polymer bags for fluid containment in medical applications

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AMI is delighted to announce the launch of ***Medical Fluid Bags 2018.*** This conference will cover the latest advances in the design & production of polymer bags and pouches for fluid containment in medical applications.

The conference will examine:

- The latest developments in the market
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- Design trends and new market opportunities
- Product testing and compliance issues

Medical Fluid Bags 2018 will take place after AMI's Medical Tubing 2018 conference, which is being held at the same hotel on 19-20 June. Special rates are available for delegates and exhibitors wishing to attend both events.

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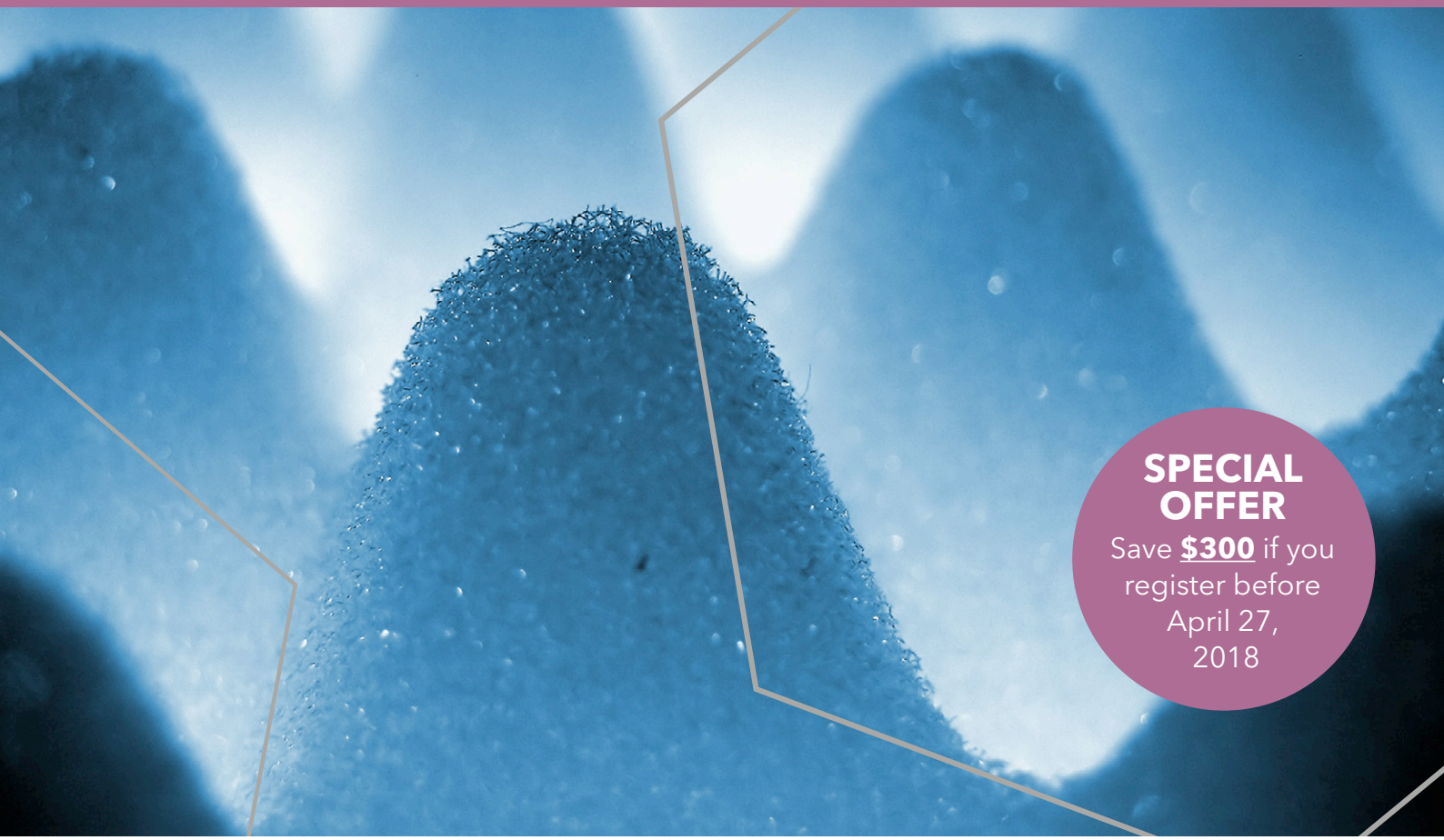

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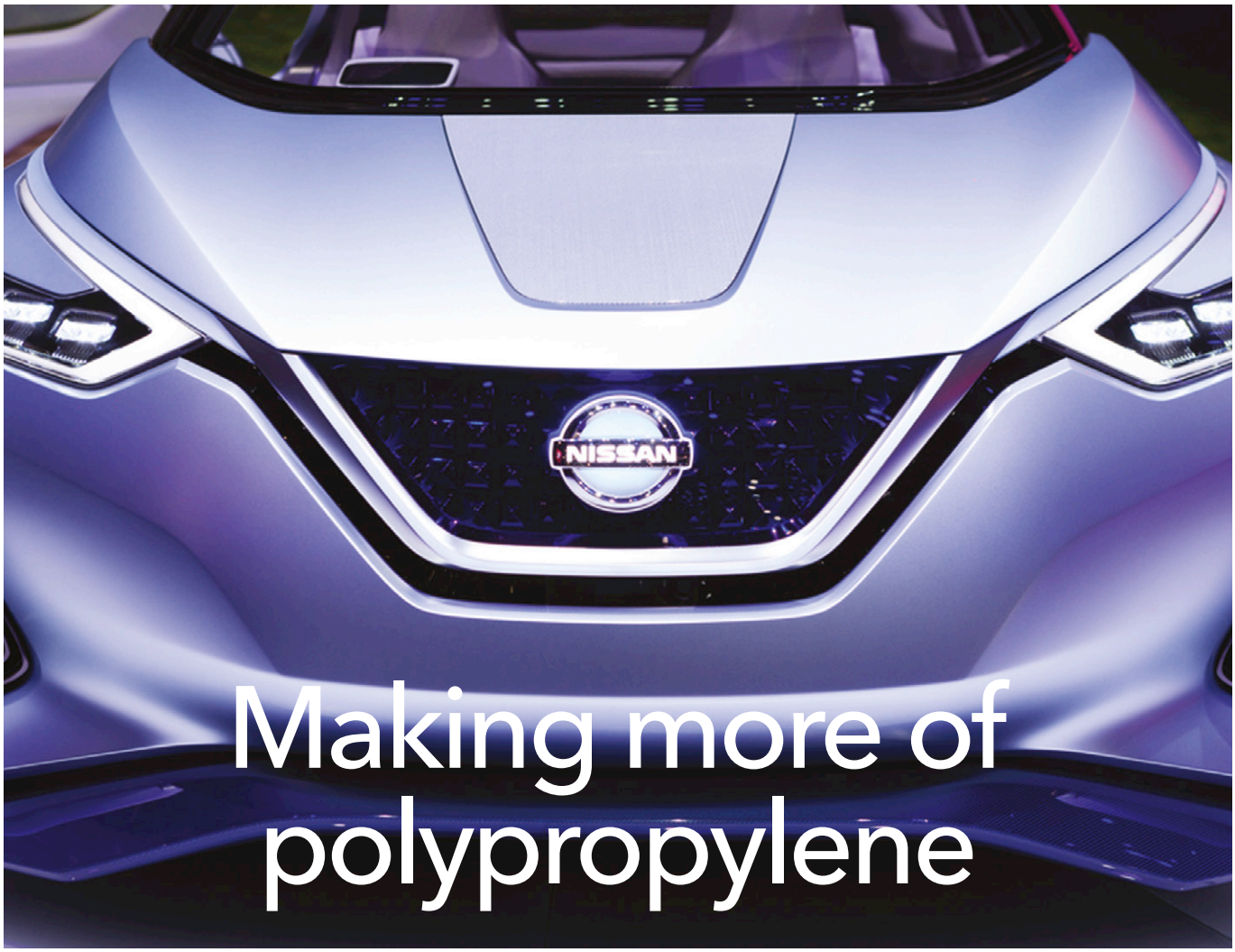


PHOTO: SHUTTERSTOCK

Making more of polypropylene

New additive and filler technologies are further extending the versatility of polypropylene and will come under the spotlight at AMI's first Performance Polypropylene conference in Cologne in April

Few polymers offer the versatility of polypropylene – it is easy to process and displays a good combination of base properties. It also lends itself to modification, allowing its performance to be optimised for a broad and growing range of engineered applications in industries as varied as automotive, appliance and construction. AMI's first Performance Polypropylene conference focuses on the reinforcements, fillers, additives and chemistries that are enabling PP to take on ever more demanding roles.

Taking place in Cologne in Germany on 11-12 April 2018, Performance Polypropylene 2018 will bring together expert speakers from leading PP resin and additive suppliers, compounders and brand owners to debate the latest innovations in PP formulation and technology and to hear about the changing requirements of key end-user industries such as automotive. It will provide a platform for all in the PP industry to exchange ideas and learn about the latest developments. Here we preview the event, taking a closer look at the international speaker line-up and the topics that will be covered.

Automotive ideas

Performance Polypropylene 2018 will be opened with a presentation by **Paul Burda**, Material Design & Test Engineer at **Nissan** in the UK, who will provide an overview of what lightweighting means for the automotive industry and why it is becoming such an important area of development. He will be followed by **Terry Burton**, Technical Manager at UK

Main image: High performance PP compounds are meeting car maker's requirements for design flexibility, high performance, and reduced weight

Speakers at the first AMI Performance Polyamides conference include (from left) Repsol Chemicals' Senior Automotive Specialist Roberto Lopez, Polykemi Plastic Application & Material Specialist Dr Annette Munch Elmér, Asahi Kasei Business Development Manager James Dutchik, and Sabic Europe Research Engineer Ginger de la Croix

technical compounder **Luxus**, who will examine how new methodologies are making it possible to produce recyclable PP compounds that can meet the highest performance demands in automotive interior applications. Then **Roberto Lopez**, Senior Automotive Specialist at **Repsol Chemicals** in Spain, will detail the company's progress in tailoring PP properties to meet changing automotive interior requirements.

New opportunities

The next session will look at opportunities that PP is presenting in new applications. It will be opened by **Luca Gazzola**, R&D Polyolefins Manager at Italian compounder **Sirmax**, who will detail the company's approach to developing solutions for home appliance and other demanding applications. **Piergiovanni Ercoli Malacari**, Product and Application Development Specialist at Italian talc producer **IMI FABI**, will follow with an explanation of the role of talc in advanced appliance applications. Then **Dr Annette Munch Elmér**, Plastic Application & Material Specialist at **Polykemi** in Sweden, will provide an insight on how the compounder goes about connecting PP innovations with OEM requirements.

The conference will then move on to examine techniques for boosting the strength and toughness of PP. The first presentation will be given by **James Dutchik**, Business Development Manager at **Asahi Kasei** in Germany, who will detail how the company achieves higher strength while simultaneously improving environmental performance in automotive applications. **Derek Bristol**, Research Associate at **Johns Manville** in the US, will explain how chopped-strand glass fibres can maximise performance of PP compounds. And the session will conclude with a presentation by **Prem Patel**, Global Strategy & Business Development Manager Plastic Additives for **Milliken** in Belgium, who will explain how the company's additives are being used to enhance the stiffness, impact and melt flow of PP compounds.

Day one of the conference will be brought to a close with a panel discussion. This will bring together a number of automotive OEM specialists – including **Paul Vickers**, Senior Project Engineer at **Honda R&D Europe** in the UK, and **Markus Franzen**, Research Engineer Advanced Engineering at **Ford Werke** in Germany – to discuss the future requirements of the automotive industry.

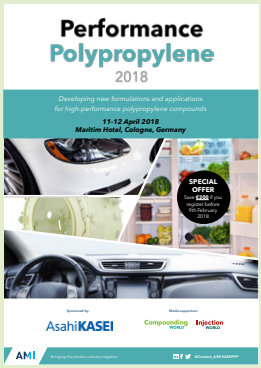
Adapting to change

Day two of *Performance Polypropylene 2018* will be opened with presentations explaining how changing automotive requirements are influencing upstream innovation. **Ginger de la Croix**, Research Engineer at **Sabic Europe** in the Netherlands**,** will detail the company's strategy for meeting these global requirements through development of compounds with low-density, enhanced aesthetics and improved safety. **Dr Abdullah Al Mamun**, Advanced Development for Corporate R&D in Material Development at **Adler Pelzer Group in Germany,** will discuss how the company is optimising properties of mineral-filled PP for complex

About Performance Polypropylene 2018

Taking place in Cologne in Germany on 11-12 April 2018, Performance Polypropylene is a new conference from AMI focused on the development of high performance PP compounds for demanding markets such as automotive, appliances and construction. It will bring together expert speakers from resin producers, additive makers and end-users to hear about the latest market requirements and technology trends.

Aside from the formal conference sessions, Performance Polypropylene 2018 will also offer extensive networking opportunities during the break-out and refreshment sessions as well as the informal cocktail reception at the end of the first day. To find out more about attending, sponsoring or exhibiting at Performance Polypropylene 2018, contact Conference Organiser Jasmine Coles. Tel: +44 (0) 117 314 8111; Email: **jasmine.coles@ami.international**. Or visit the **conference website**.



automobile parts. And **Morteza Zare**, Senior Polymer Researcher of the Compounding Section at **Marun Petrochemical** in Iran, will talk the audience through the many opportunities for PP in automotive under-the-hood applications.

The next session will focus on the versatility of performance PP compounds. **Sascha Norden**, Vistamaxx Market Developer for **ExxonMobil** in Belgium, will detail how the company's performance polymers are being used to extend the limits of performance and processing of PP. **Dr Rudolf Pfaendner**, Division Director of Plastics at **Fraunhofer LBF** in Germany, will discuss the latest developments in highly efficient flame retarded PP formulations based on radical generators. And the session will be closed by **Peter Sebo**, Head of Marketing and Market Development at **Quarzwerke** in Germany, who will outline how functional fillers for can be exploited to take PP into new market sectors.

Seeking stability

The final session of the conference will cover stability of PP within high performance applications. It begins with a presentation by **Ivan Vulic**, Senior Application and Sales Manager at **Solvay** in the Netherlands, who will highlight the latest advances in polypropylene stabilisation technologies for use in the automotive and construction markets.

The Performance Polypropylene 2018 conference will be brought to a close by **Catherine Malchaire**, Technical Sales Manager Europe at **Songwon** in Switzerland, who will explore advances in low-VOC stabilisation systems for both PP and PP blend-based automotive applications.

PHOTO: SHUTTERSTOCK

Above: Appliances are a growing application area for PP compounds, replacing metals and other polymers in interior and exterior parts

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Reaping the benefits of lasers

Additives, masterbatches and compounds formulated with laser decoration in mind are growing in number. Peter Mapleston finds the choice of materials for laser welding is broadening, too

Main image: The QR code on this water bottle was created by laser marking using Budenheim's Budit L additive

Laser marking of plastics offers numerous advantages compared to other decoration methods – it is resistant to abrasion, chemicals and weathering and can be applied to all sorts of surfaces, whether they be soft, hard, smooth, coarse, flat, stepped or curved. Laser technology also excels with its high adaptability, making it perfect for small batch sizes and rapidly changing layouts. As a consequence, many polymer and compound producers now include laser-markable – and also laser-weldable grades – in their line-ups. As far as the additives they employ to produce the desired effect are concerned, the technology now appears to quite mature. Applications, however, continue to increase and broaden.

Evonik is among the leaders in this field, offering laser-processable plastics (for decoration and for welding) as well as additive systems. The company points out that unmodified plastics do not absorb laser radiation in the region extending from the near ultraviolet to the near infrared. Conversion of laser energy into heat is therefore possible only if the polymer has been appropriately "laser sensitised" with a special additive.

In the absence of laser additives, polymers can be processed only using far ultraviolet light, for example, with excimer lasers, and in far infrared light, for example, with CO_2 lasers. Because the Nd:YAG laser, which has a wavelength of 1064nm, is the most commonly used in practice, most moulding compounds for laser-marking are now formulated for the wavelength of this laser.

Evonik's High Performance Polymers Business Line has developed additives for laser marking that provide very high contrast: dark markings on light-coloured formulations and light markings on dark coloured and black products. Near-infrared absorbing additives designed especially for transparent plastics have also been developed by the company's Inorganic Materials Business Unit.

Evonik says that the transparent plastics that it produces itself (Plexiglas PMMA and Trogamid polyamide) containing laser additives are distinguished by their absolute colourlessness and very low haze. It attributes this to its nanoscale metal oxide additive technology, which, on account of the small particle size, does not scatter visible light. "The skill in the incorporation of the metal oxides lies in controlling their tendency to agglomeration and dispersing them as homogeneously as

PHOTO: GABRIEL-CHEMIE

Right: An animal tag indelibly marked using Gabriel-Chemie's Maxithen laser marking additive

possible in the polymer matrix," Evonik says.

When irradiated by a laser, the metal oxides absorb the energy and heat their immediate environment, which results in foaming or carbonisation. In both cases, there is a locally confined change of refractive index, rendering the marking visible in a shade of grey that depends on the polymer and the laser parameters.

Marking categories

Italian compounder **Lati** says that thermoplastics can be divided into three general categories according to their ability to be marked: polymers such as polysulphone (PSU) and polyethersulphone (PES) that adequately absorb laser energy and consequently carbonise to produce a noticeable darkening of the area where the laser hits; thermoplastics such as styrenics and polyesters that absorb laser energy erratically and so also carbonise in an irregular way; and thermoplastics with low or negligible absorption such as polyamides, polyolefins, acetals, and polyphenylene sulphide. In the case of the latter two groups it is necessary to use special pigments or additives to achieve good results.

"Laser marking may be strongly influenced by the addition of fillers, reinforcers, special additives, self-extinguishing additives and other additives," Lati says. "Contrary to what one might think, the presence of fibreglass reduces the ability to be marked only slightly. Due to their intrinsic colour, some types of fillers or self-extinguishing additives may reduce the ability to be marked by laser. On the other hand, the additives in certain self-extinguishing systems may improve the contrast of laser marking."

Budenheim has developed a range of laser-sensitive ingredients that enables advanced high-contrast laser marking and laser welding in a wide range of thermoplastics. It says the Budit L Series is both easy to add and to process. The additives also absorb NIR radiation and provide high transparency in the visible range. Depending on the energy level, different visual marks from bright to dark can be generated on the polymer surface. "Using a typical concentration of 0.1%-5.0%, the energy of the laser beam creates marks within 10 microns underneath the plastic surface," Budenheim says.

Budenheim marketing manager Henrike Scheel says the company has a number of promising new development projects for the product involving medical devices, food packaging and automotive back lights.

Eckart says its Lasersafe 040 laser marking additives (which like most other offerings use heavy metal-free pigments) enable "exceptional" contrasts and high quality at high speeds. The additives work with all standard laser technologies. "Lasersafe 040 is designed for plastics which are inherently poor for laser marking such as polyolefins as well as engineering plastics," the company says. "Due to its excellent laser marking efficiency, even at low dosage levels, Lasersafe 040 offers good colour stability of the final formulation." The additives are supplied in pellet form so they can be handled and processed like regular colour masterbatches. The carrier material is based on a thermoplastic polyolefin.

Contrasting results

Gabriel-Chemie offers laser additives under its Maxithen brand and says material optimisation through the addition of 2-3% of laser additives is usually enough to achieve the desired marking contrast. The company claims to have been involved with the technology since laser marking on plastics was first introduced. As a result, its product portfolio now consists of additives and combination masterbatches (additives plus pigment) suitable for all thermoplastics. The company can also provide customers with access to infrared lasers for trials and tests. It works with a network of partners who supply laser equipment or offer contract laser marking services.

Typical laser marking applications, according to Gabriel-Chemie, span promotion codes in beverage caps and bottles, barcodes and QR codes, food and cosmetics packaging with logos and decorative designs, product information and expiry dates, animal ear tags, safety seals, security tags and anti-counterfeit measures, keyboards, automotive interior and exterior components, cables and

PHOTO: GABRIEL-CHEMIE

Right: These cosmetic bottles are decorated using laser marking additives from Gabriel-Chemie

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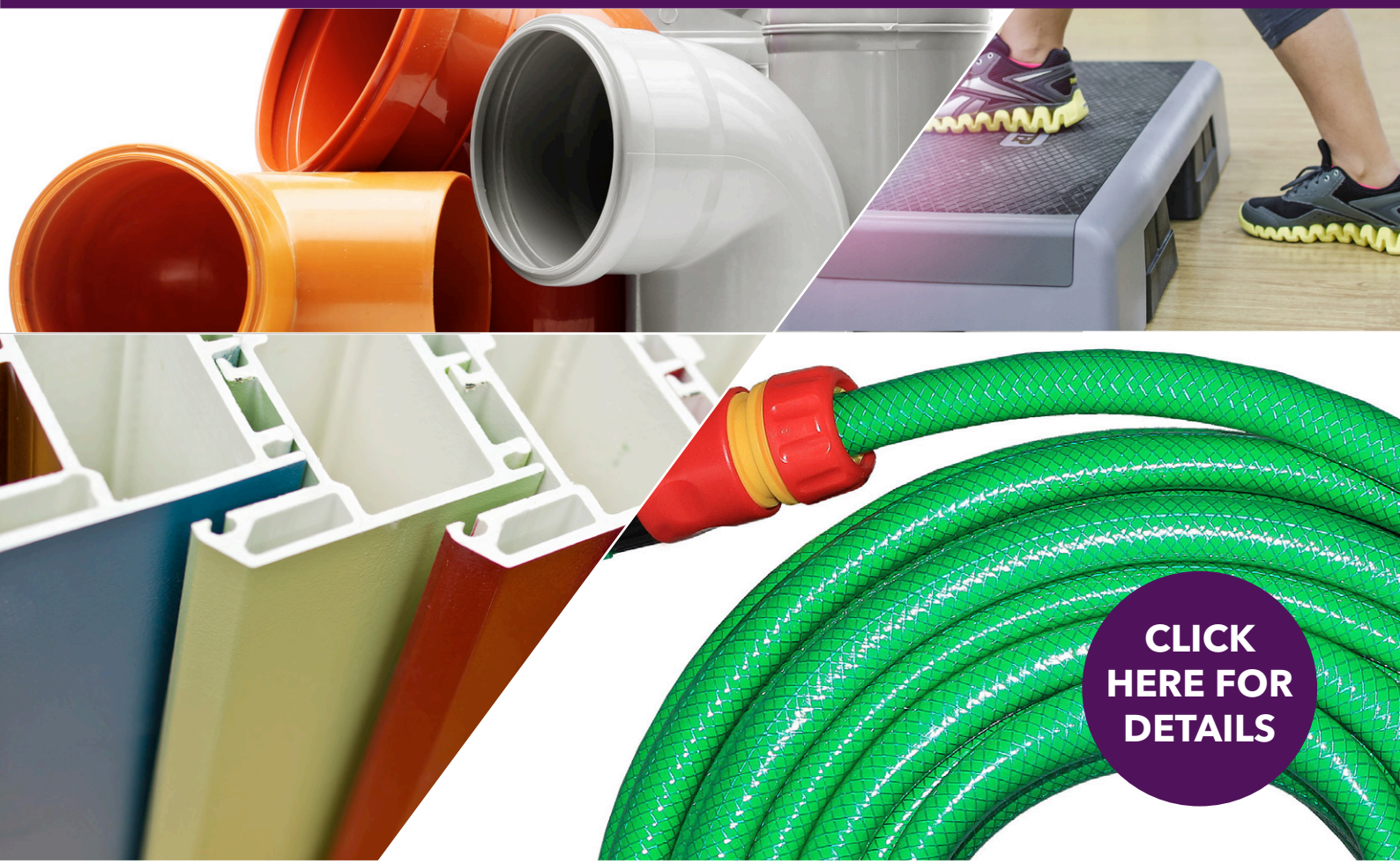

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Above: Silvet LR laser receptive aluminium pigments from Silberline can be laser marked

pipes, electronic components, medical products and laboratory equipment, and more.

Gabriel-Chemie says its Maxithen laser marking masterbatch is suitable for processing in injection moulding and extrusion of thick-walled products. It can also provide masterbatches for film extrusion upon request. Three kinds of marking colour are possible: dark marking (carbonisation); light marking (foaming), and coloured marking (on black). The company has also developed a completely transparent laser additive for use in clear plastics. "It enables dark depth marking that is gentle on surfaces and has an extremely good contrast," it says.

The company's laser competence centre in Germany has also developed a number of formulations using special pigments. The visual properties of these pigments can be modified by the laser, achieving effects ranging from complete opacity to a desired degree of translucency. Applications range from back-lit switches to cosmetics packaging and elements for decorative applications.

Special effects

Special-effect additives can also be used with laser decoration. **Merck**, for example, offers its Iriotec 8000 series pigments, comprising eight grades using various chemical formulations. These can be used for laser marking as well as Laser Direct Structuring applications. **Silberline** offers Silvet LR (Laser Receptive) aluminium pigments that allow precise definition when using CO_2 or Nd:YAG lasers. The company says that in uncoloured compounds, the additive gives very bright silver metallic effects while in coloured compounds it provides a "cost effective superior performance" alternative to pearlescents.

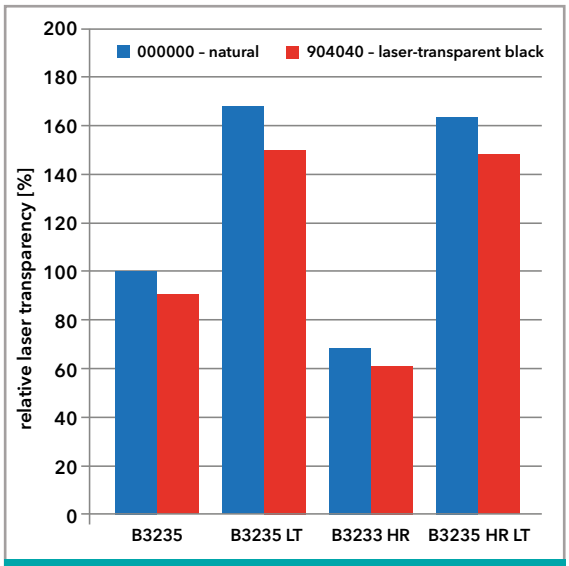
Foiling counterfeiters

A more recent use for laser-sensitive additives is in combating counterfeiters. In this case, shining a laser on the part causes the additive to fluoresce; once the radiation is removed, the fluorescence stops. Several suppliers of additives and compounds are working in this area (see CW January 2018), including **PolyOne**. The company cites a recent project example for a major manufacturer of water storage, purification, and treatment equipment that was suffering from counterfeiters. "They not only ate into revenue but also raised the cost of sales and the potential for unjustified product responsibility issues," PolyOne says.

The unnamed manufacturer was having to defend product failure lawsuits brought by construction companies who thought they had purchased genuine equipment. "Legal costs became a significant and completely unforeseen drain on finances. What's worse, the equipment manufacturer's reputation for quality products was beginning to take a beating," says PolyOne.

The customer had been marking its articles using hot foil stamping and ink printing. "These marking methods required consumables, frequent tool changes and adjustments, regular quality control checks, and storage of the consumables," PolyOne says. It proposed a multi-functional solution, including a laser-marking additive, an authentication additive and a colorant, bundled into a single Smartbatch masterbatch.

"OnCap laser-marking additive technology made laser marks more visible and indelible to create an overt signal that more easily identified the manufacturer's genuine products in a difficult-to-simulate fashion. It also meant the end of hassles with hot stamp foil and ink," PolyOne claims. "Percept anti-counterfeiting technology created an authentication method, not visible to the human eye, to help lower the financial result of fighting court cases, once the covert authentication was revealed. The concentrate also included the



Laser transparency of the Pocan LT grades is much better than standard Pocan PBTs
Source: Lanxess

The Cable Industry in Europe 2017

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PHOTO: AKRO-PLASTIC

Above: A moulded plaque in an Akro-Plastic laser-transparent compound photographed with a normal camera (left) and with an infrared camera (right)

required colour for the manufacturer's branding and an additive for UV protection."

At another major compounder, **RTP Company**, Strategic Account Manager Joe Hennessey says use of laser marking is growing among producers of medical devices such as injection pens, partly because of FDA requirements. It offers three laser marking masterbatches in LLDPE and PP carrier resins suitable for placing dark marks on a range of polymers including polyolefins, TPEs, TPUs and POM.

Laser transmission welding

Lasers are not only used to mark and decorate plastics parts – they are also increasingly used to join them. The choice of masterbatches and compounds for laser welding is now quite broad, particularly from suppliers of engineering plastics, but continues to broaden – and properties continue to improve. Several months ago, for example, **Lanxess** added to its laser-weldable Pocan PBTs and Durethan PA6 grades, claiming for its Pocan B3235 LT and a hydrolysis-resistant variant Pocan B3235 HR LT that "virtually no comparable products with the same high level of laser transmission and the same high level of properties are sold on the market."

It is also an area of high interest back at Gabriel-Chemie. "Laser transmission welding has become increasingly important over the last few years, so we are dedicated intensively to the development of this product line. The company offers optimised laser welding masterbatches for all types of process variants," a spokesperson says.

Unlike other welding processes, laser welding generally requires the use of parts made in two different materials or one material incorporating two different additive systems: one that transmits laser radiation (so the radiation can pass through it on the way to the joint) and one that absorbs it (and so heats up and melts the plastic). Laser wavelengths of 808nm, 940nm, 980nm and 1064nm are used.

A typical example is the housing of a waste gate actuator for automobile turbo chargers by Hella, which is laser-welded from two parts based on two different grades of Evonik's Vestamid HTplus polyphthalamide (PPA). The cover is made from a specially developed laser-transparent Vestamid HTplus M1034 grade, while the body is made from the laser-absorbing Vestamid HTplus M1634; both grades contain 40% glass fibre.

"Laser welding has several advantages over the more commonly used ultrasonic welding," says Evonik. "No damage to internal electronic components, homogeneity, narrow heating zone, high welding seam strength, and no welding spatter in the housing."

Other products taking advantage of the technology include window frames with integrated panes, vehicle lights and bumpers, and microflow reactors for gases and liquids.

Technical compounder **Akro-Plastic** offers various masterbatches and compounds suitable for the laser welding process. "With increasing use of plastics in automotive, electrical, medical and industrial markets, precise, fast, flexible and clean joining technique of the highest quality standard is required," the company says.

Akro-Plastic offers a range of compounds based on various polyamides, unreinforced and reinforced, impact modified, black or coloured, that are transparent to laser. The company measures the laser transparency with a laser having a 980nm wavelength at regular intervals during production of its laser transparent compounds using an LPKF TMG 3 measuring device and states the laser transparency value on the certificate of analysis (COA).

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- **www.lati.com**
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Published by AMI Consulting

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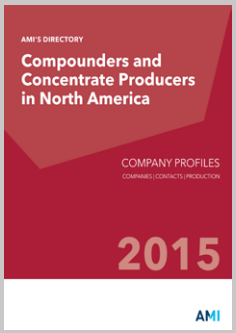

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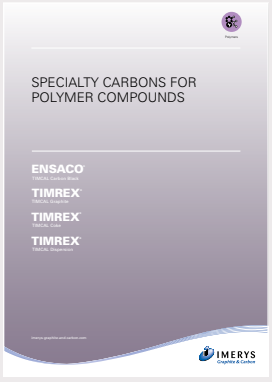

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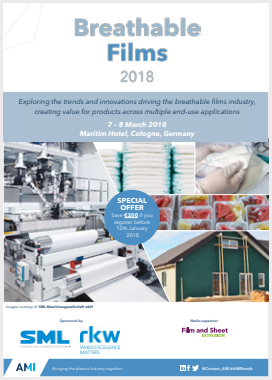

Taking place in Cologne, Germany, on 7-8 March 2018, Breathable Films is a new conference from AMI focused on the developing area of micro-porous films. It will address emerging application areas as well as new material and processing developments.

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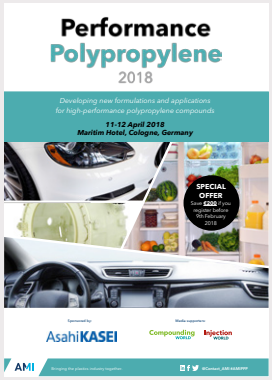

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Silon s.r.o.

Head office location:	Plana nad Luznici, Czech Republic
Date founded:	1950
Managing Director	Bernhard Rustige
Ownership:	Limited Liability Company
No. of employees:	550
Sales 2016:	€140m
Production 2016	58,000 tonnes
Plant locations:	Plana nad Luznici, Czech Republic
Profile:	Established as a polyamide filament yarn producer in 1950, Silon spent the following 50 years expanding its product portfolio into a variety of other areas, including PET staple fibre and non-wovens, injection moulding and compounding. In 2001, the company's management decided to concentrate its future efforts in polymer compounding and PET fibre production, selling off its other activities.
Product line:	Silon's compounding activities are focused on high performance polyethylene and polypropylene compounds for high performance and technical applications. It has three principal product lines: Taborex cross linkable polyethylenes (including PEX and XLPE types), Tabond maleic anhydride grafted polymers, and Taboren filled and modified polyolefins. Applications include building, infrastructure, automotive and personal care industries.
Product strengths:	The company focuses on technical compounds designed to meet individual and demanding customer specifications. Its competence centre includes compounding and cable lines, plus autoclave capability.

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

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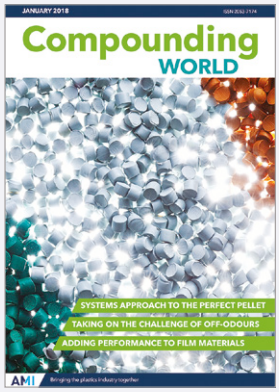

Compounding World January 2018
The January 2018 edition of Compounding World takes a look at the latest innovations in pelletising technology. This issue also explores developments in odour and emissions control, additives for films and polymer foaming.

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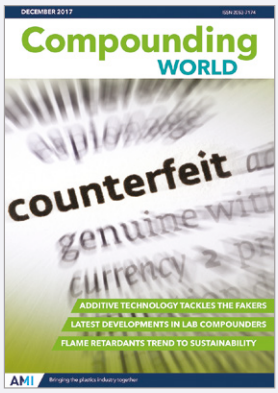

Compounding World December 2017
The December edition of Compounding World takes a look at the use of taggant additives in fighting counterfeiters. It also looks at the latest developments in lab compounders and explores the challenges of accelerated weather testing.

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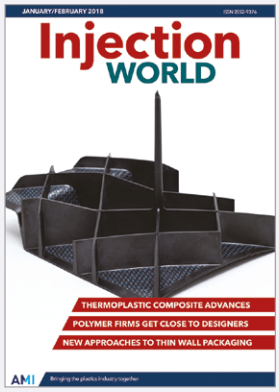

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The January-February issue of Injection World examines the advances being made with overmoulding thermoplastic composites. It also looks at how polymer firms are collaborating with product designers, and the latest in thin wall packaging.

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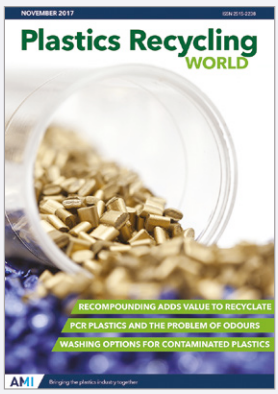

Plastics Recycling World November 2017
The November issue of AMI's new magazine Plastics Recycling World looks at how recompounding technology allows plastics recyclers to add value to recyclate. The edition features other technology developments in washing plant, odour reduction and process monitoring.

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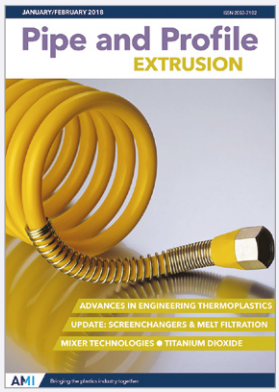

Pipe and Profile January/February 2018
The January/February 2018 edition of Pipe and Profile Extrusion considers how engineering plastics and composites are being utilised in extruded applications. Other features cover titanium dioxide and technology advances in melt filtration and mixers.

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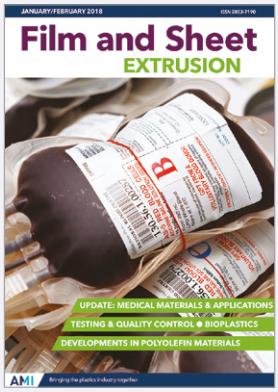

Film and Sheet January/February 2018
The January/February edition of Film and Sheet Extrusion looks at some of the latest medical materials and applications. It also highlights developments in polyolefin resins and materials testing, as well as reviewing progress in bio-based polymer sourcing.

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Injection WORLD
Plastics Recycling WORLD

GLOBAL EXHIBITION GUIDE

2018	**6-8 March**	JEC World, Paris, France	www.jeccomposites.com
	20-22 March	Plastics & Rubber Vietnam, Ho Chi Minh	http://plasticsvietnam.com
	22-24 March	MECCSPE, Parma, Italy	www.mecspe.com
	27-29 March	Plastprintpak Nigeria, Lagos, Nigeria	www.ppp-nigeria.com
	24-27 April	Chinaplas, Shanghai, China	www.chinaplasonline.com
	7-11 May	NPE, Orlando, USA	www.npe.org
	9-11 May	Plastic Japan, Osaka, Japan	www.plas.jp
	15-18 May	Elmia Polymer, Jönköping, Sweden	www.elmia.se
	22-25 May	Plastpol, Kielce, Poland	www.targikielce.pl
	29 May-1 June	Plast, Milan, Italy	www.plastonline.org
	29-31 May	UTech Europe, Maastricht, Netherlands	www.utecheurope.eu
	11-14 June	Argenplas, Buenos Aires, Argentina	www.argenplas.com.ar
	19-20 June	Plastics Design & Moulding, Telford, UK	www.pdmevent.com
	20-23 June	Interplas Thailand, Bangkok	www.interplasthailand.com
	27-28 June	Compounding World Expo, Essen, Germany	www.compoundingworldexpo.com
	27-28 June	Plastics Recycling World Expo, Essen, Germany	www.plasticsrecyclingworldexpo.com
	2-4 August	Plasti & Pack, Lahore, Pakistan	www.plastipacpakistan.com
	16-20 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
2019	**8-9 May**	Compounding World Expo, Cleveland, USA	www.compoundingworldexpo.com/na
	16-23 October	K 2019, Dusseldorf, Germany	www.k-online.com

AMI CONFERENCES

27-28 February 2018	PVC Formulation, Pittsburgh, PA, USA
6-8 March 2018	Cables 2018, Cologne, Germany
8-9 March 2018	Masterbatch Asia, Bangkok, Thailand
14-15 March 2018	Plastics Regulations, Cologne, Germany
20-21 March 2018	Conductive Plastics, Pittsburgh, PA, USA
10-11 April 2018	Fire Retardants in Plastics USA 2018, Pittsburgh, PA, USA

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