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LyondellBasell completes A Schulman acquisition

LyondellBasell has completed the acquisition of compounding giant A Schulman. The move doubles the size of LyondellBasell's compounding business and broadens its reach into markets such as automotive, construction materials, electronic goods and packaging.

The company said the Schulman business will be combined with LyondellBasell's existing PP compounding asset into a newly created single reporting segment called Advanced Polymer Solutions. Its products include the Catalloy brand of thermoplastic resins and Polybutene-1 resins from LyondellBasell, plus the whole of Schulman's range of engineered composites, powders and masterbatches.


PHOTO: SHUTTERSTOCK

Schulman buy doubles size of Lyondell-Basell's compounding business

■ Separately, LyondellBasell has signed a cooperation deal with the Karlsruhe Institute of Technology (KIT) in Germany to develop technology to convert post-consumer plastic waste into monomers for reuse in polymers.

Massimo Covezzi, LyondellBasell Senior Vice-President of R&D, said it is seeking "to create a new and complete plastic waste molecular recycling process. The goal is to develop a high efficiency and clean plastic depolymerisation process, through catalyst innovation, to transform plastic waste back to the chemical building blocks."

The move follows the polymer producer's recent acquisition of a 50% stake in Netherlands-based Quality Circular Polymers (QCP), which mechanically recycles polyolefins from post-consumer waste streams, and is said to complement it by adding chemical recycling to the company's technology portfolio.

› **www.lyondellbasell.com/advancedpolymersolutions**
› **www.kit.edu**

Black Bear raises €11m for tyre-to-carbon black project

Netherlands-based Black Bear has raised a further €11m to continue the development of its carbonisation technology for conversion of scrap tyres to carbon black additives.

The new investment has been made by banking group ING, Netherlands-based investment firms 5square and Social Impact Ventures, and the Thailand-based conglomerate SCG, as well as additional contributions from original funders Chemelot Ventures and DOEN Participaties.

The funding will allow the company to further develop its industrial scale prototype production unit at Nederweert in the Netherlands, which it operates with tyre recycler Kargro. This is already capable of handling 1m tyres annually, producing 5,000 tonnes of carbon black, 3,000 tonnes of steel and 1MWhr of green electricity.


PHOTO: BLACK BEAR CARBON

Black Bear Carbon CEO Martijn Lopes Cardozo with tyre raw material

"This new consortium means much more than just fresh capital", said Black Bear CEO Martijn Lopes Cardozo, "They are strategic partners, who will play a key role in the development of our technology and who will speed up our international roll-out."

› **www.blackbearcarbon.com**

Invista to build China ADN plant

Invista has announced a more than $1bn investment in a 300,000 tonnes/yr "world scale" plant in China to produce butadiene-based adiponitrile (ADN), a key intermediate for PA 6,6. Construction is targeted for 2020 and production should begin in 2023.

The company, which is the world's largest merchant supplier of ADN, said the last world-scale ADN plant was built 35 years ago. It said there is strong Chinese demand for ADN.

Over the past five years, it has invested more than $600m in China.

› **www.invista.com**

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Azoty invests in plasticisers

Polish chemicals group Grupa Azoty will complete a 30% capacity expansion for its non-phthalate Oxoviflex plasticiser by the end of the year and has started work on a 10,000 tonnes/y unit for production of new specialty polyester and polysuccinate plasticisers.

The moves are the company's response to the rapidly changing global regulatory position for plasticisers, which it said is particularly noticeable in Europe and the US but increasingly also in countries such as China. The investments follow the firms' announcement in February this year that its Oxo Segment had ended production of DEHP, DOP (including medical grades)

and DPHP and would cease all supply once it had cleared its inventories.

Grupa Azoty launched production of its Oxoviflex DEHT/DOTP plasticisers in 2015 and claims to be the largest player in the European market. The products are suitable for substitution of many currently used plasticisers and meet the requirements of EU toy and food contact regulations, according to the company.

The new investment in non-ortho-phthalate DEHT/DOTP plasticiser production will lift the company's annual capacity by 15,000 tonnes to 65,000 tonnes and justifies its decision to enter the sector, according to OXO Segment Director Aleksander Grymel. "Growing demand for Oxoviflex proves that we have taken the right decision," he said.

The separate decision to build a new plant for production of polyester and biocompatible polysuccinate plasticisers is part of the company's previously initiated Special Esters Project and underlines the role that specialty plasticisers are expected to play in the Grupa Azoty business in the future.

The company already has a small-scale pilot specialty esters plant in operation, allowing it to supply sample quantities. The new 10,000 tonne/yr capacity unit will support commercial introduction.

› **www.grupaazoty.com**

Brenntag acquires Alphamin

Brenntag has acquired Belgian speciality chemicals distributor Alphamin, including its US subsidiary, from KeBeK Private Equity. Terms were not disclosed.

Alphamin is focused on speciality polymers and waxes, with plastics among the many industries it supplies. It had sales of €44.6 million in the year to 30 June 2018.

Karsten Beckmann, CEO of Brenntag Europe, Middle East and Africa, called Alphamin "an attractive bolt-on".

› **www.brenntag.com**

Versarien in graphene deal

Advanced materials engineering group Versarien has signed an agreement with UK-based independent technical compounder Luxus to develop a supply chain for graphene-enhanced plastics suitable for volume sale to injection moulding companies.

Versarien already has an agreement with Warwick Manufacturing Group (WMG) to incorporate its Nanene graphene nano-platelets into polymers to enhance their mechanical strength and other properties. The deal with Luxus aims to ensure the developed materials are suitable for commercial application.

"We are seeing strong interest from a variety of sectors in utilising the materials we are developing with WMG," said Neill Ricketts, CEO of Versarien. "Being able to produce these graphene-enhanced plastics in commercial volumes will enable them to be more rapidly adopted for use in a wide variety of applications."

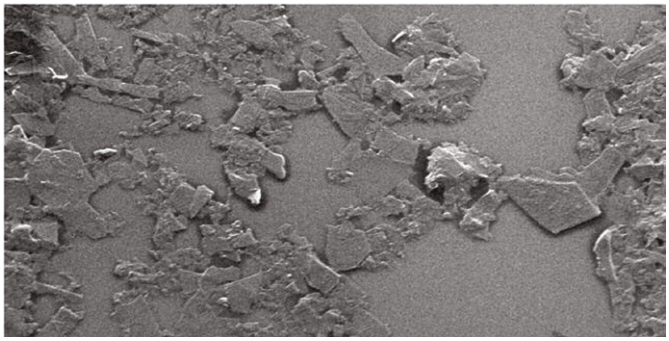

PHOTO: VERSARIEN

Aims to ensure graphene compounds are commercially viable

Applications are envisaged in a number of different markets served by Versarien and its subsidiaries – 2D-Tech, ACC Cyroma, Cambridge Graphene and Total Carbide. These include automotive, construction, utilities and retail industry sectors.

› **www.versarien.com**

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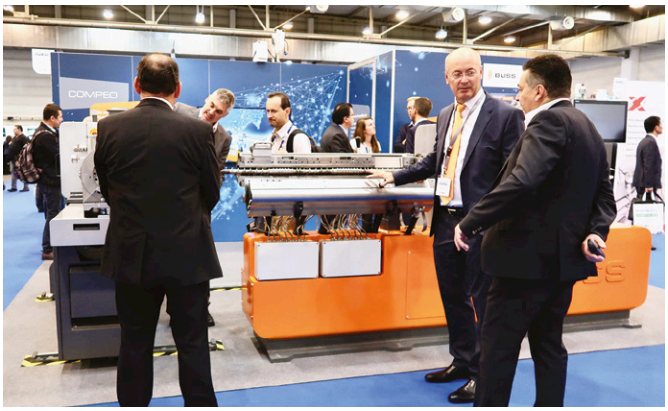
Exhibitors sign up for three new US plastics shows

More than 100 companies have already booked booths at three free-to-attend plastics industry tradeshows that make their US debut next year. Organised by AMI, the Compounding World Expo, Extrusion Expo and Plastics Recycling World Expo will be co-located in the two largest halls at the Huntington Convention Center in Cleveland, Ohio on 8-9 May 2019.



The event builds on the success of earlier shows held in Essen

Building on the successful launch of AMI's compounding and recycling shows in Essen, Germany, in June of this year, the new Cleveland event is shaping up to be the largest plastics industry gathering in the US next year. It will include five free-to-attend conference theatres, plus a networking party for attendees and exhibitors at Cleveland's Rock and Roll Hall of Fame on the evening of 8 May.

"The first Compounding World and Plastics Recycling World Expos in Essen, Germany attracted 184 exhibitors plus 4,024 visitors, and received an extremely positive reaction from the industry," said Rita Andrews, Head of Exhibitions at AMI. "With the addition of the Extrusion Expo, we are confident that we will build on these numbers to make the Cleveland event even bigger and busier."

Companies already signed up for booths at the focused Cleveland expos include Azo, Bausano, Beier, Brabender, Buss, Cabot, Chemours, Coperion, CPM Extrusion, Cumberland, Davis-Standard, Dr Collin, Doteco, Dover Chemicals, Entek, Farrel Pomini, FB-Balzanelli, Ferro, JSW, Leistritz, Luigi Bandera, Macchi, Milliken, Modern Dispersions, NFM, Nordson, Oden Technologies, Omya, Orion, Piovan, Reifenhaüser, Schenck, Struktol, Vertellus, Wacker, and Zeppelin.

"We've been delighted by the very positive industry response to our new tradeshows," said Andy Beevers, Director of Events at AMI. "We selected Cleveland as the ideal location for the US exhibitions because of its easy accessibility for huge numbers of compounders, extruders and recyclers. In addition, the city boasts excellent convention facilities, hotels, restaurants and entertainment options in its revitalised downtown."

For more information on the Extrusion Expo 2019, Plastics Recycling World Expo 2019 and Compounding World Expo 2019, please visit: **https://www.ami.international/exhibitions**

Neste backs feedstock recycling

Finland's Neste has joined UK-based chemical recycling company ReNew ELP and Australian technology developer Licella in a development project to explore the potential of using mixed waste plastic as a raw material for fuels, chemicals and plastics.

As part of the project, the partners will study the feasibility and sustainability of liquefied waste plastic as a refinery raw material and will also work for regulatory acceptance of chemical recycling. Neste said it aims to process over 1m tonnes/year of waste plastic by 2030.

ReNew ELP is separately beginning construction of a chemical recycling plant in Teesside, UK, which will use Licella's Cat-HTRTM catalytic hydrothermal liquefaction platform to produce raw materials for multiple petrochemical products from post-consumer plastics. This will be the first plant to use the technology at commercial scale and is co-financed by energy investment firm Armstrong Energy.

Neste is already working with Ikea to develop a bio-based PP. A commercial-scale facility is expected to open this autumn using waste fats and oils as raw materials.

› **http://neste.com**

PHOTO: NESTE

www.kraussmaffeiberstorff.com

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Pictured from left by the new line: BPC's General Manager Mike Krause, Process Manager Reggie Dunn and Operator Austin Castleberry

BPC starts up new toll compounding capacity

BPC Toll Compounding & Blending of Meredosia, Illinois, has commenced production on the Entek 73mm twin-screw extruder compounding line it ordered at the last NPE show.

The company will use the new line mainly to expand its toll compounding business, whose capacity will rise from 10,000 to 27,000 tonnes/year as a result.

This line is BPC's second and features K-Tron Coperion feeders and a Gala underwater pelletiser. "In the past our capacity was limited to one line, now we are able to expand our customer base," said General Manager Mike Krause. "In addition to the extruder, we are adding more blending capacity as well as more trucks and off-loading equipment to handle the increased extrusion capacity."

BPC makes a wide range of compounds based on PP, PE, TPOs, TPEs and engineering polymers, using additives that include talc, mica, calcium carbonate and flame retardants,

Originally located in Houston, BPC moved to Illinois in 2012 and diversified from testing services to toll compounding. The company currently employs 20 people in a 7,400 m² plant.

The facility includes a development lab with a compounding line with a strand pelletiser, lines for five-layer blown film and cast film and tape, and an injection moulding machine.

› **https://bpctoll.com**

Brüggemann invests in additives

L Brüggemann is investing €25m in new production capacity at its polymer additives site at Heilbronn in Germany. The company has provided no further detail on the expansions but said the new capacity is expected to commence production in 2019.

The company produces a wide range of additives, including reducing agents, zinc derivatives, and additives for PA and polyester. These go mainly into the automotive and electronic sectors, plus rubber, textile, cosmetics and construction.

Brüggemann claims to be the global leader in reducing agents for initiation of emulsion polymerisation and environment-friendly binding agents.

The company, which celebrated its 150th anniversary this year, was sold in 2017 to Ronald Ayles. The move ended four generations of ownership by the Brüggemann family. Managing directors Joachim Hofmann and Dr Josef Berghofer remain at the helm.

› **www.brueggemann.com**

NEWS IN BRIEF...

Mitsui Elastomers Singapore (MELS), a subsidiary of Japan's **Mitsui Chemicals**, is to increase capacity for the Tafmer brand of high performance elastomers at its Jurong Island facility from 200,000 to 225,000 tonnes/year by about July 2020. Tafmer is used as an impact modifier for PP and soft moulding material. Applications are found in automotive and packaging materials, engineering plastic modifiers and sports shoe midsoles.
www.mitsuichemicals.com

Addivant's Weston 705 nonylphenol-free stabiliser has been included in the revision to the food contact regulation of the South American Mercosur region. The material is already approved for such uses in more than 180 countries and is the first antioxidant since the 1970s to achieve such widespread food contact approval, according to the company.
www.weston705.com

Turkish TPE producer **Elastron Kimya** has gained certification to NSF/ANSI 61, the US national standard for drinking water system components, for its V 281 series of thermoplastic vulcanisates (TPVs). The products cover a hardness range of 55-90 Shore A and 40 Shore D and are specifically developed for pipes, fittings and accessories.
www.elastron.com

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NEWS IN BRIEF...

Celanese has announced price increases across its range of engineered plastics, with US users facing the biggest hit as a result of the US Trade Representative's implementation of a 25% tariff on PBT and PET products imported into the country from China. Prices of PBT and PET rise by €0.13/kg in Europe and $0.15/kg in Asia (outside of China) but will see a 25% increase in the US.
www.celanese.com

German distributor **Krahn Chemie** has expanded its cooperation with **Valtris Speciality Chemicals** with an agreement to distribute the Santiciser plasticiser for flexible PVC, rubber, coatings, adhesives and sealants in France. It already distributes Valtris's stabiliser portfolio there and Santiciser across most of Europe.
www.krahn.eu
www.valtris.com

Polydist UK is adding several more products from **SABIC** Specialties to its portfolio of polymer resins, including Noryl and Ultem resins, LNP compounds, copolymer polycarbonate grades and flame retardant grades of Lexan, Cycoloy and Valox resins. The two firms have been working together since 2015, when they signed a distribution agreement for SABIC's LDPE and LLDPE materials from sites in the UK and Germany.
www.polydistuk.com
www.sabic.com

VTT lifts 3Dprint speeds

Finnish research institute VTT and nanotechnology firm Carbodeon have developed a new PLA-based compound containing carbon nanodiamonds for 3Dprint applications that is claimed to offer improved mechanical and thermal properties and process faster.

According to VTT, the spherical-shaped nanodiamonds increase modulus of 3Dprinted test samples by up to 200% compared to current PLA grades used in this market. They also increase thermal conductivity and act as a lubricant, which is said to reduce the risk of nozzle blocking and increases throughput.

VTT's researchers developed a way of dispersing the nanoparticles to allow them to be melt processed and has already produced a 600kg batch on its pilot plant.

"This is the first product of a family that will be sold as a finished 3D filament and in a granular format, as well. VTT has been a long-term, reliable partner in this development, and has reacted to our needs quickly," said Carbodeon CEO Vesa Myllymäki.


PHOTO: VTT

Researchers in the VTT pilot plant with the new nanodiamond compound

› **www.carbodeon.com**
› **www.vtt.fi**

RMCC trebles $Mg(OH)_2$ capacity

Russian Mining Chemical Company (RMCC) is opening a third plant for production of natural magnesium hydroxide at Vyazma in the Smolensk region, increasing capacity from 50,000 to 150,000 tonnes/yr.

RMCC products are distributed by Netherlands-based Europiren. They include Ecopiren flame retardants for polymers, mainly PP and PP, which are used in wire and cable, roofing membranes and aluminium composite panels.

As well as being halogen-free and non-toxic, Ecopiren is claimed to suppress and reduce the acidity of smoke more effectively than aluminium trihydrate alternatives while forming a more stable char.

In October, RMCC will also begin production of its MagPro high active magnesium oxide, which is said to be suitable for application as a scorch retarder and vulcanisation agent in chlorinated rubber.


PHOTO: RUSSIAN MINING CHEMICAL

VIPs in RMCC's new Ecopiren magnesium hydroxide plant in Russia

› **www.europiren.com**

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Colour merger creates Chroma Color Corp

Following Carolina Color's acquisition of Chroma Color earlier this year, the US-based company has announced it is to bring the two operations together with its previous Breen and Hudson Color acquisitions under the Chroma Color Corporation name.

Chroma Color Corporation Chairman, George Abd said: "This is an exciting time for the company as it grows organically, leveraging its patented products, expert technological resources and considerable manufacturing capacity and through future strategic acquisitions. We look forward to great success for Chroma Color Corporation."

The new business is headquartered in McHenry in Illinois. Former Chroma Corp President and CEO Tom Bolger takes on the role of CEO and Carolina Color Chairman and CEO Matt Barr becomes Vice Chairman.

The new combined business produces high quality colour concentrates on short lead times for markets such as wire & cable, packaging, building & construction, consumer, medical, healthcare, and transportation. It generates sales of more than $150m.

Private equity group Arsenal Capital became a strategic investor in the Carolina Color and Breen businesses in 2017.

› **https://chromacolors.com**

IMCD agrees to buy Velox

IMCD, the fourth largest chemical distributor in the world with annual sales of more than €1.9 bn, has agreed to acquire Hamburg, Germany-based distributor Velox. The deal is subject to regulatory confirmation.

Founded in 1993, Velox is focused on specialities for the plastics, composites, additives, rubber, paints and coatings industries. It had sales of €155m in 2017 and employs 225 people.

"This acquisition enables IMCD to further strengthen its position as distributor of speciality plastics and additives. Our portfolios very well complement each other, and we expect to be able to create more value for our suppliers and customers," said Piet van der Slikke, CEO of Netherlands-based IMCD.

› **www.imcdgroup.com**

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PHOTO: FERRO CORP

*Raw material shortages are pushing up some pigment prices while mergers and acquisitions are on the rise. **Peter Mapleston** explores the latest pigment industry developments*

Concentrating on colour

Today is proving a turbulent time for plastics coloration and a lot of that has to do with the word of the decade - sustainability. Tougher environmental rules in China and India have created severe shortages of some key raw materials used to produce organic pigments, with the inevitable consequence of price rises. The situation for polymer-soluble dyes is not dissimilar, according to at least one un-named supplier of these colourants (used mostly for colouring engineering plastics), and that may go some way to explain the recent uptick in M&A activity among suppliers.

This April, for example, **Dominion Colour Corporation** (DCC), which makes high performance pigments, dispersions, and preparations for plastics as well as coatings and specialty inks, and **Lansco Colors**, a major supplier of a wide-range of quality pigments sold to similar industries, said they would merge to form DCC Lansco. Dominion has manufacturing facilities in Canada, the Netherlands, and the UK, as well as technical sales offices throughout the Americas, Europe, and Asia. Lansco serves around 600 US customers in the coatings, ink and plastics markets as well as in selected international markets.

"Together, we bring a broad product portfolio to the market with a unique value proposition," says Dr Mark Vincent, CEO of Dominion Colour Corporation. Donald Greenwald, CEO and President of Lansco Colors, adds that, "as a combined entity, we will be able to offer customers significant synergies and benefits of scale. Each of us brings our own complementary strengths. By combining to create a broader global pigment provider, we will offer a range of organic and inorganic pigments, dispersions, and preparations that will be unmatched in the industry."

The pigments industry has seen some drastic changes in 2018, according to Lansco Global Product & Marketing Manager Dr Bruce Howie. "We are seeing increased regulatory requirements and environmental restrictions across the world, as well as increasing raw material costs that are affecting pigment prices and therefore downstream industries. This is affecting businesses including our own, and we're adapting to remain competitive whilst continuing to create sustainable solutions for our customers," he says.

"The next step in this merger is to align our global sales and customer service teams. In the

Main image: The pigments industry is seeing considerable activity. Ferro Corporation, for example, has expanded its position with acquisitions and capacity investments

Right: Ferro is growing its leading position in ultramarines with capacity expansions in Colombia

PHOTO: FERRO CORP

coming months the customer experience will be enhanced by having local inventory of DCC manufactured goods stocked in the Lansco USA warehouses and Lansco products in European and global distribution warehouses."

Howie says DCC completed EU REACH registration for most of its products this year. "We will continue to invest in REACH annually to ensure ongoing supply to our customers in the European Union," he says. "Furthermore, we are committed to the continual improvement of our environmental performance and compliance. "

The company has also been working on improving production efficiencies, initiating what Vincent says are innovative environmental actions at its site in Maastricht in the Netherlands, where it produces bismuth vanadate pigments. These include recovery and reuse of vanadium and molybdenum from wastewater, using recycled bismuth in production, and reducing fuel requirements in its ovens by switching from electricity to gas.

DCC recently launched several grades of organic and bismuth vanadate (PY.184) pigments, which Vincent says have allowed it to expand market share in coatings and plastics markets.

The DCC and Lansco merger is the latest in a string of M&A moves in the colour arena. Several months ago, **Ferro Corp** completed its acquisition of Belgium-based **Cappelle Pigments**, a supplier of specialty, high-performance inorganic and organic pigments – it too with a strong reputation in bismuth vanadates that provide alternatives to lead chromates in yellow, orange and red shades in high-performance applications, as well as organic pigments with high heat, light and environmental wear resistance. The acquisition came around 18 months after Ferro bought Nubiola, a producer of specialty inorganic pigments and the world's largest producer of Ultramarine Blue.

Last year, **Milliken** acquired **Keystone Aniline Corporation**, a producer of dyes, pigments, pigment dispersions and polymers headquartered in Chicago in the US. Milliken said at the time that while it and Keystone both provided colorant technologies to the agricultural, plastics, coatings, inks and household institutional and industrial markets, customers rarely overlapped because the two companies had specialised in different product areas. Milliken's Performance Colorants & Ingredients business was focused on polymeric colorants, "while Keystone brings exceptional formulation skills and application development technology to the table," the company said.

Meanwhile, Ferro is increasing its colour capability through internal growth as well as acquisition. In July, it said it was expanding its production facility in Girardota in Colombia to meet increasing global demand for its ultramarine blue and micronised iron oxide pigments. "We plan to be producing significantly higher volumes by early 2019," says Matthias P Bell, Vice President, Americas and Color Solutions. Ferro is already the world's largest producer of ultramarine blues, violets and pinks.

Below: Milliken has extended its Keyplast Resist colorant line for high-performance engineering polymers

PHOTO: SHUTTERSTOCK

Aiming for ETPs

Discussing its latest developments in colour, Dayne Shaw, Account Manager – Keyplast EMEA at Milliken Chemical, says: "It's not easy to colour high-performance engineering polymers with bright and vibrant hues. Not only are such materials subject to high-temperature processing, they also require steady, reliable performance properties when used, as is often the case, in demanding outdoor applications. Colours and additives cannot be allowed to negatively impact any of those properties."

Milliken is now launching a range of Keyplast Resist products for colouring engineering polymers such as polyamides, polysulphones, PEEK, PPO and other high-heat resins and alloys. Polyamides in particular have tended to provide significant colouring challenges in the past due to their chemical composition. Additives historically used to colour many other resins did not prove effective

PHOTO: SHUTTERSTOCK

Above: Consumer durables such as power tools are a key target market for the latest Keyplast colorants

in these resins. "At first, many thought this problem to be related to the high heat processing requirements for nylons," says Shaw. "But subsequent research revealed that normal colorants, both pigments and dyes, react with the amide system and [discoloration occurs] due to the loss of conjugation in the colorant molecule."

Polyamides are often used in consumer durables that require precisely controlled coloration. "Through continued research and development, Milliken has now developed Keyplast Resist to allow it to be used effectively with all grades of polyamide, including PA 6, 66, 46, 11 and 12," says Shaw. The new high-purity materials are claimed to offer improved weather resistance and light fastness, and perform well in the high-temperature and chemically-reductive conditions typically associated with high-performance polymers.

Adding his thoughts on recent supply difficulties, Shaw says: "Users of such colorants are all too aware of the severe product shortages currently impacting the market. Stricter enforcement in Asia of environmental regulations and manufacturing effluent limits has led to short supply primarily of key colorant intermediates, and even prompted plant closures or drastic cutbacks in production. As a result, for the past few quarters, the colorants market globally has seen unprecedented cost increases, which are impacting all levels of the supply chain.

"Milliken, of course, is not immune to these market pressures, but is working to take a proactive approach regarding customer's needs," he adds.

Philippe Lazerme, Head of Strategic Marketing Plastics in **Clariant**'s Pigments Business Unit, says his company, too, is renewing its efforts related to sustainability and the circular economy. "Clariant is quite active in this field and the BU Pigments has developed some products to help the plastics industry achieve the targets," he says.

Clariant recently launched PV Fast Yellow H4G, a brilliant greenish yellow pigment containing no halogen in the molecular structure. "It is FDA approved, compliant with EU Regulation 10/2011 on plastics in contact with food, and listed on the Chinese GB 9685-2016 National Food Safety Standard," Lazerme says. "It displays a very good light and weather fastness. It can be used for the packaging sector but also for outdoor applications and a variety of consumer goods. Its specific characteristics – no halogen in the molecular structure and high light and weather-fastness – fully meets the Circular Economy trend of longer lifetime and recyclability of plastics."

Lazerme also points to Telasperse PVC, the company's new range of colourants for PVC, which he says provides another contribution to sustainability. "Telasperse PVC offers significant advantages, especially for the PVC compounding industry," he says.

"It is a solid pigment preparation in which the pigment is fully dispersed, and it is low dusting. PVC compounders are still dispersing the pigments in-house and very often face dispersion issues and dust development. With Telasperse PVC they will see a significant improvement in their working environment and develop the full colour strength of the colorants, while reducing energy consumption."

Lazerme also points to work his BU is carrying out on developing new high-performance pigments using raw materials from renewable sources. The first pigment of this series is PV Fast Pink E, which he says has received positive feedback from the market.

Red alert

BASF meanwhile is extending its red pallette. Speaking at Compounding World publisher AMI's Masterbatch 2018 conference in Madrid at the

PHOTO: CLARIANT

Rght: PV Fast Pink E is the first in a range of high-performance pigments from Clariant that will use renewable raw materials

“ ENTEK Twin-Screw Extruders Have Been an Integral Part of Our Growth, and Their Technical Support Sets Them Apart”

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Wayne Miller, Vice President Manufacturing, Penn Color, Inc.

Jeff Zaskoda, Penn Color Plant Manager (left) and ENTEK's Bill Petrozelli at Penn Color's Milton, WI Facility

“Business has grown strongly and consistently for Penn Color, both for our thermoplastic and liquid dispersants businesses. We've added several new facilities and added capacity at legacy facilities, all in the support of growth related to our thermoplastic color and additive businesses.

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PHOTO: LANXESS

Right: Lanxess is increasing production capacity for Macrolex soluble organic dyes

beginning of September, Dr Christof Kujat, New Business Development – Global Industry Management Plastics, introduced no fewer than three new developments in this area: an inorganic red, a heat-stable red for polyamide, and two DPP reds that fulfil purity demands in applications such as mineral water bottle closures.

Highly durable inorganic red pigments are either rather orange in colour, low in chroma or suffer from a bad toxology profile, he said. An experimental BASF pigment, PR 290, based on a new chemistry, is more chromatic than iron oxides and more red than Sn/Zn/Ti oxide (PO 82). It is also stable at temperatures over 350°C.

A new heat-stable red for polyamides, Cinquasia Rubine K 4370 FK, expands the colour space into the medium red area and has high hiding power (Figure 1). It has very good dispersibility and very good lightfastness, and is also FDA compliant. Finally, Irgazin Red K 3840 UP and a low-warp version 3840 LW are described as control refined products, with strict specifications to NIAS (non-intentionally added substances) for off-flavour sensitive applications.

More colour capacity

Lanxess, also a major colour supplier, said in February that it would increase capacity for Macrolex dyes by 25% at its Leverkusen site in Germany. The extra capacity is intended to be available from the end of this year. Philipp Junge, Head of Lanxess's Rhein Chemie business unit, says the company sees a significant increase in demand for high quality dyes for plastics, especially in Asia.

Macrolex soluble organic dyes are primarily used for the coloration of products such as beverage bottles, electronic devices, car taillights and children's toys. They are used for colouring styrenics, polycarbonate, PET, and acrylic (PMMA). Dominik Risse, who is responsible for Lanxess's Colorant Additives Business, says that because regulatory requirements are becoming stricter, especially in sensitive application areas, demand is growing for products with high purity, "for which Lanxess is the market leader."

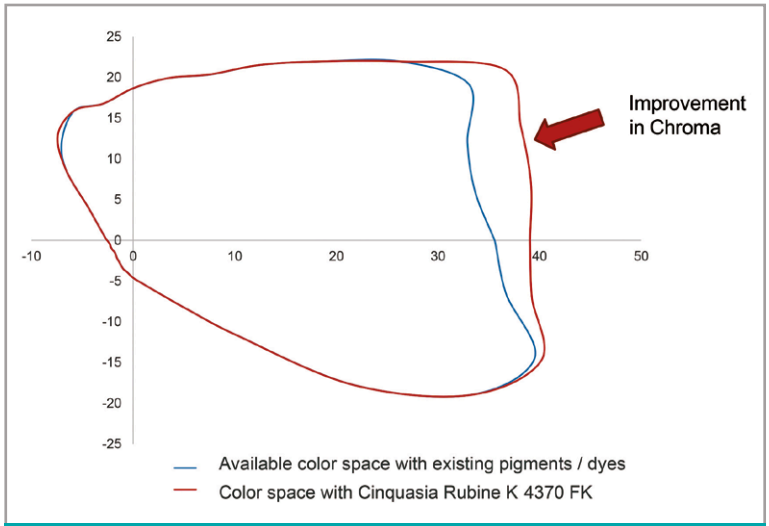

Figure 1: BASF's Cinquasia Rubine K 4370 FK expands the colour space for polyamide (calculated for L* = 40 -)
Source: BASF

Liquid colours

Companies introducing new liquid colourants include Toyocolor and Riverdale. **Toyocolor**, a Toyo Ink Group company, is launching liquid colour masterbatches into its Lioplax family of colorant solutions this autumn. It says a full range of colour and effect masterbatches are available for PET/PC applications. They include grades blended with organic and inorganic pigments and dyes, and special effect formulations incorporating pearl pigments and additives that enhance surface appearance. They are said to be easily incorporated into transparent or translucent polymers, with typical target applications in beverage, cosmetics, beauty care and household goods.

The new line-up is formulated using Toyo's nano-scale liquid and solid dispersion technologies, which enable them to maintain a high level of reflectivity in pearl pigments. "Moreover," says a representative, "Toyocolor researchers succeeded in dispersing functional nanofillers in the polymer matrix – a feat that is difficult to accomplish with conventional pellet concentrates. Excellent performance can be achieved even at low let-down rates." The new Lioplax line-up contains special-effect masterbatches in both liquid and solid forms that give adjustable frosted finish and a grainy textures to PET bottles.

Riverdale Global has commissioned its first fully

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automated plant for manufacturing liquid colorants and additives for plastics. Housed in an 18,580m² facility at High Point, in North Carolina in the US, the new facility incorporates automated production of pigments and their dispersion in liquid carriers.

"While the standard industry practice is to use the same equipment and containers for multiple colours, Riverdale Global is building dedicated hoppers, augers, and containers for each pigment, eliminating the need for cleaning when switching from one pigment to another," says Riverdale Global President Paul Maguire. The containers all have built-in pigment mills and dispersion blades and remain closed and sealed to prevent cross-contamination and material waste.

The containers allow the combination of any of 100 pigments with various types of liquid carrier to produce single-pigment dispersions (SPDs). Riverdale Global has hundreds of SPD formulations in its database. The SPDs are shipped to satellite plants where they are custom-blended for local customers. Maguire says the new operation makes possible real-time inventory control that will reduce order lead times and allow for automatic traceability with raw material lot numbers.

The company also offers a no-cost colour-tracking capability that uses data from liquid-colour metering devices to automate many of its customer's purchasing, production management, and compliance functions. The GlobalTracker system also makes remote troubleshooting possible.

The system uses transmission boxes at the customer's plant that receive data from the controllers on liquid colour metering devices and transmit it to Riverdale Global via the internet or a cellular network. Software on the company's server tracks the customer's material usage and records job-specific data such as operator ID, work order, lot number, and colour ID. Customers can also obtain information on open, invoiced, and paid orders, search their order history by order or production job, see their current colour match status, submit new colour matches, and document production runs for compliance with job specifications or regulatory requirements.

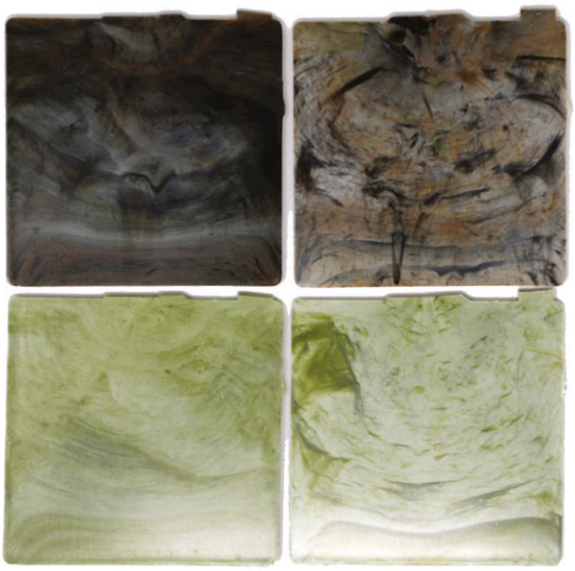

PHOTO: TEKNOR APEX

Right: CamoTek concentrates enable variegated colours to be produced even on processing equipment with optimal mixing performance

Variegated effects

New concentrates for polyolefins from **Teknor Apex** enable injection and blow moulders to create variegated colours for aesthetic and functional effects in products used both indoors and outdoors. The concentrates, which were introduced at the NPE show earlier this year, contain proprietary formulations that yield mottled, swirled, streaked, or other variegated effects in products moulded on standard equipment. They can be used to impart decorative patterns and camouflage effects.

"In the past, variegated effects were easy to achieve, but this is no longer possible with today's modern processing equipment," says technical manager John Wood. "Improvements in screw design and mixing have defeated the old methods. CamoTek concentrates, combined with appropriate changes to process parameters, make such colours possible again."

PHOTO: TOYOCOLOR

Right: Lioplax special-effect masterbatches (available in liquid and solid forms) yield an adjustable frosted finish to PET bottles

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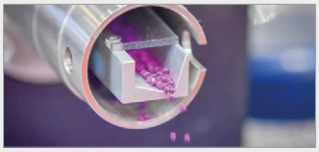

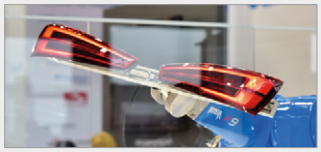

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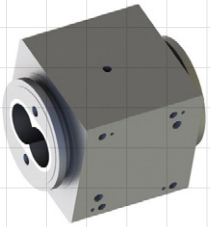

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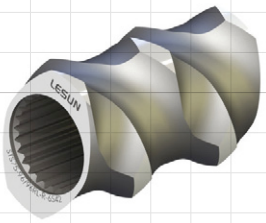

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Reacting to change

*Reactive compounding offers performance modifying opportunities not available using blend processing. **Mark Holmes** finds out more about the latest developments*

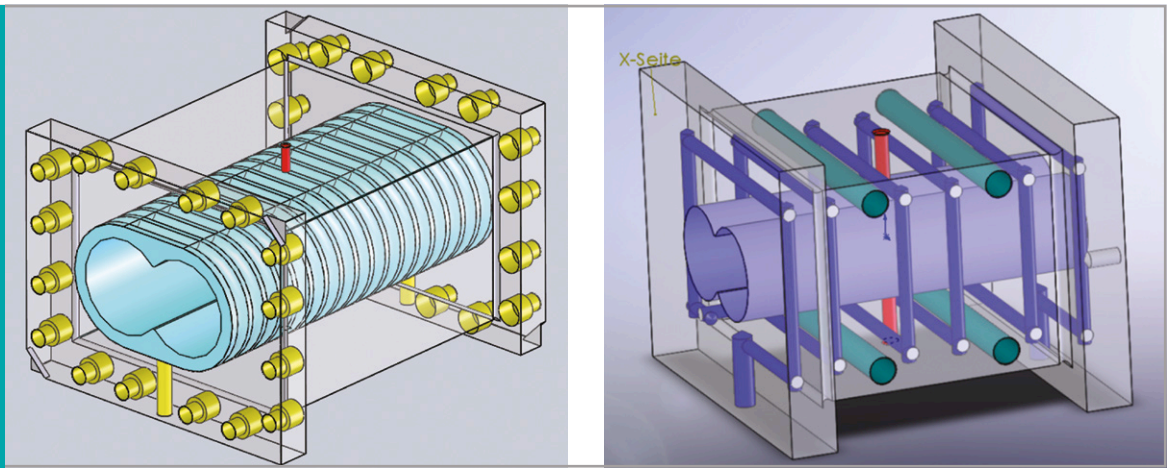
Reactive compounding techniques offer the opportunity to modify polymers and filler interactions to achieve levels of performance not possible through conventional mechanical blending and melt mixing. Interest is being fueled by more demanding end-user requirements and growing interest in compounds such as TPEs, as well as the growing need to handle and enhance complex waste plastic streams. And there's a clear trend away from traditional batch to continuous reactive processing, with compounding extruders adapting their equipment to suit.

Markus Fiedler, Senior Process Engineer with **Coperion**, confirms the continuous processing trend. "Our customers are changing over from batch processes to continuous production for a variety of reasons, such as cost-effectiveness, easier cleaning and more precise process control," he says. "Typically, Coperion supports the changeover from batch to continuous in a two-step process. Firstly, we create a detailed analysis of the existing batch process together with the customer and transfer it to twin screw extrusion. In a second step, a feasibility trial will be done in the Coperion test laboratory in Stuttgart, typically on a small ZSK extruder."

Fiedler says that the modular design of the ZSK extruder process section and the variety of individual twin screw elements allows the company's engineers to adjust the extruder setup exactly to the requirements of the reaction process. Particular attention is paid to residence time and process cooling, which is eased by the ability to configure extruder process sections with L/D rations of up to 80.

The Coperion test laboratory in Stuttgart is well equipped with extruders from the smallest sized ZSK 18 MEGAlab up to the ZSK 70. In addition, it can utilise more than 100 gravimetric feeders for different kind of materials as well as more than 60 gravimetric liquid feeding systems. Liquid feeders are available for a broad range of viscosities and options include heated liquid feeding systems and piping to the extruder for test setups. A dedicated aspiration system and special personal safety equipment also allows trials with hazardous materials, such as isocyanates, amines or even selected CMR (carcinogenic, mutagenic and reproduction toxic) categorised materials after individual examination under safe conditions.

Main image: TPU production is among a growing number of opportunities for reactive compounding technology



Coperion's wet bushing technology (left) provides more intensive barrel cooling than conventional cooling channels (right)

Source: Coperion

Fiedler emphasises that there is more to achieving a successful reactive extrusion process than just residence time. Cooling, particularly where exothermic reactions are taking place, is also a major issue. "Coperion has developed a barrel in a new cooling design with 'wet bushing'," he says. "Barrels equipped with 'wet bushing' allow intensive cooling of the product inside the extruder at a temperature range of below 100°C. Compared to a barrel with normal cooling channels that circle around the eight-bore of the extruder, the barrel with the wet bushing allows more intensive cooling as the liner is directly cooled with water."

Economic concerns

The engineering team at **Leistritz** agrees that, for economic reasons, reactive compounding processes are being moved from non-continuous production systems to continuous processes. The company says that the long residence time that can be achieved in conventional batch systems, such as an agitated vessel, can be compensated for in a twin screw extruder through smart process control, tight temperature control or by generating additional surface area through the mixing characteristics of the screw profile.

New application areas emerging for reactive compounding include polymerisation reactions, degassing and crosslinking. In order to meet these requirements, Leistritz says that it has extended the length of the processing unit of its twin screw extruders. The company has recently supplied extruders in lengths up to 72 L/D and a model up to 84 L/D is in development.

One recent reactive compounding project deliverd by Leistritz involved TPU polymerisation and the production of special TPV compounds. In this example, compounding of all the ingredients and the necessary crosslinking reaction was all achieved in one process step. Due to the extended processing length for the extruder used, Leistritz says it was able to design the system to optimally compound the several components and then carry out chemical crosslinking of the EPDM component in the final step.

Leistritz adds that reactive compounding is also a potential application area for its recently developed Elongational Rheometer, which facilitates much improved inline process monitoring. It says strategies are under development to use data from the unit within an integrated control loop.

The move from reactive compounding to continuous processing is also identified as a key industry trend at **JSW**, where engineers also confirm that control of polymer temperature and residence time are the prime considerations in maintaining stable reaction processing. One current trend it sees for reactive extrusion, particularly in Europe, is in chemical recycling of waste polymer.

JSW says that a high torque extruder can control polymer temperature while optimised mixing screw elements are needed to obtain enough residence time. The company says its TEX-αIII extruder can deliver the torque required while its TEX-FAN simulation software can analyse polymer behaviour, predicting temperature and residence time inside the extruder.

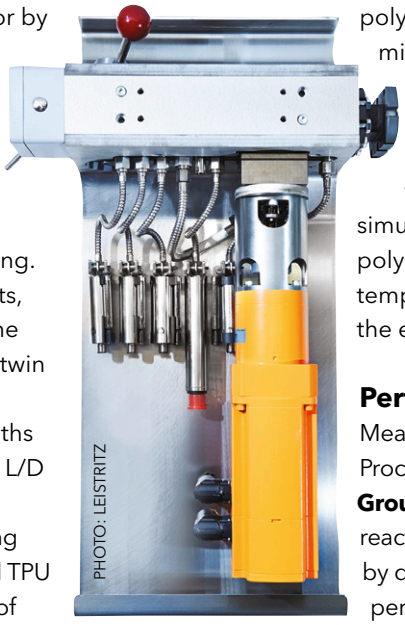


PHOTO: LEISTRITZ

Right: Leistritz expects its recently introduced elongational rheometer to find application in reaction process control

Performance demands

Meanwhile, Adam Dreiblatt, Director Process Technology at **CPM Extrusion Group**, says new developments in reactive compounding are being driven by demand from the market for high performance materials that cannot be

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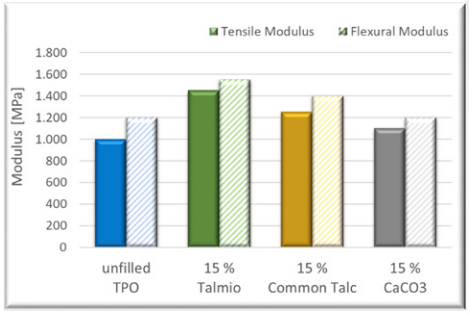
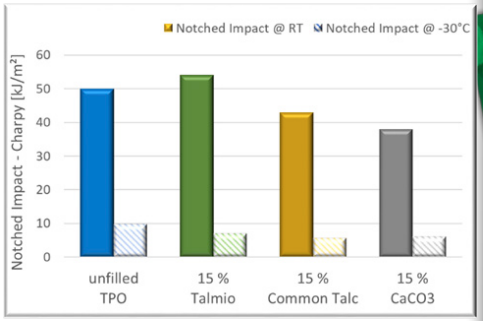
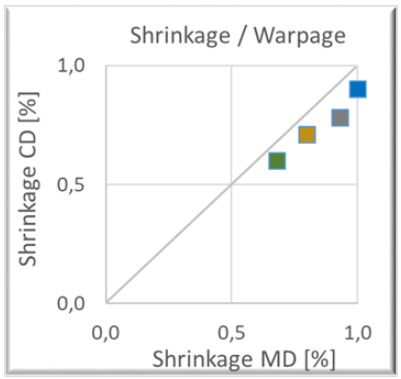


Reinforcement with 2 microns Talc in TPO



Impact strength with 2 microns Talc in TPO



Example: anisotropic shrinkage in TPO

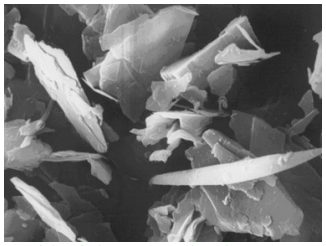

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PHOTO: SHUTTERSTOCK

Right: TPVs, which are increasingly being used in automotive sealing applications, lend themselves to reactive compounding

produced using simple mechanical blending. "The ability to tailor residence time distribution (RTD) and the degree of mixing combined with self-wiping characteristics makes intermeshing and co-rotating twin screw extruders the perfect reactor for polymerisation, polymer modification and compatibilisation of blends," he says.

"The limitations for reactive processing on twin screw extruders are mostly economic and not technical; the extruder can produce the desired functionality, however, the capital equipment cost may be prohibitive at the capacity required to obtain the desired properties," according to Dreiblatt.

"The relatively small volume of twin screw extruders becomes a limitation for reactions requiring average residence time more than a few minutes. The majority of current materials produced via reactive compounding can operate within this range of residence times. The new polymer chemistries - yet to be developed - may require much longer residence time," he says.

Dreiblatt says there are only two options for increasing residence time beyond a few minutes and both dramatically impact on the production cost of such materials. The first is to increase free volume and this means either using a larger diameter extruder for a given throughput or to accept significantly reduced capacity. He says that for a given screw diameter, the extruder length (L/D) can be extended in some cases up to 100D or more to provide increased free volume along with increased diameter ratio.

The second option is to arrange two extruders in series. "With the two-machine approach, the reaction can be completed in the first machine which feeds directly into a second machine for devolatilisation of reaction by-products and/or residual monomer. This option provides the flexibility to run each machine at different speeds - each machine can be a different diameter - to optimise the reaction separately from the devolatilisation, but requires more floor space and significantly more capital," he says.

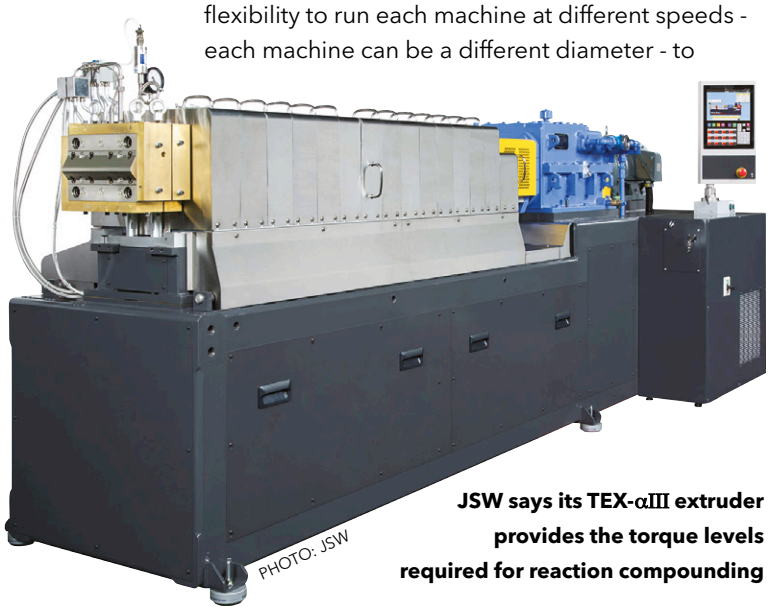

PHOTO: JSW

JSW says its TEX-αIII extruder provides the torque levels required for reaction compounding

Dreiblatt says there are many patents describing reactive compounding using multiple extruders in series, as the concept is not new. However, he adds that specially equipped test facilities to trial new reactive extrusion chemistries using the two-machine approach for increased residence time will be needed. "Such facilities must be capable of feeding solids and liquids at multiple points along the extruders, deep vacuum pressure with multiple vents and handling potentially flammable solvents," he says. "The US company **Orrex**, for example, has pioneered the development and production of new products via reactive compounding using two machines in series."

Within the ring

Dreiblatt adds that CPM's RingExtruder (developed within the German company Extricom that was acquired by CPM in 2017) offers the same desirable characteristics of twin screw extruders for reactive processing – including self-wiping, narrow RTD and flexible screw configuration for optimised mixing – but with significantly higher free volume for reactive systems requiring much longer residence time.

The high free volume is achieved in the RingExtruder design using twelve co-rotating and intermeshing screws arranged around a stationary central core. This geometry provides the equivalent residence time of two twin screw extruders in series with much less floor space and with a lower cost for an equivalent throughput. The geometry of the RingExtruder also provides the increased surface/volume (compared to twin-screw extruders) required for the high levelvs of heat transfer necessary for exothermic reactions. The higher surface/volume of the RingExtruder also provides increased venting efficiency.

"There are many polymers and materials that are manufactured using multiple-step batch processes simply because the residence times required are much longer than can be achieved in twin screw extruders. These reactions may be possible within the RingExtruder with extended L/D," says Dreiblatt.

He also sees potential for the technology in the TPU sector. "Reactive polymerisation of TPU has

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PHOTO: CPM EXTRUSION GROUP

Right: Ring extruders are a good solution where high free volume and residence time is required, accoridng to CPM

been in commercial production using twin screw extruders for more than 20 years and is experiencing tremendous growth with new applications for TPU. The process requires intimate mixing of monomers with catalyst, long residence time, excellent heat transfer and self-wiping screws – all of which are achieved using twin screw extruders. The scale-up to larger diameter twin screw extruders of more than 100 mm, however, is limited by the decrease in heat transfer. This is just one example of an application that would be an excellent candidate for the RingExtruder, due to the higher surface/volume as compared to a twin screw extruder," says Dreiblatt.

Combined processing

One of the organisations at the forefront of reactive extrusion research is **Fraunhofer ICT** in Germany and Dr Björn Bergmann, who is Team Leader of the Compounding and Extrusion Research Group, highlights a number of current trends. "Firstly, there is considerable potential to combine processes to save energy and shear force introduced into the material. In addition, there is the possibility to utilise polymeric secondary waste streams, which are only able to be processed using solvent intensive processes or using extruders," he says.

"For reactive compounding, both a knowledge from polymer processing/compounding and from chemistry is needed – a combination not always present in companies. Other issues arise in reactive compounding, such as questions involving the handling of hazardous goods in compounding surroundings, which processors usually try to avoid. Finally, particularly when significantly influencing the viscosity of material during reactive compounding – which often happens – new phenomena can arise during extrusion that have to be considered and the literature may not be of assistance. This has to be answered by alternative process setups and screw configurations," Bergmann says.

Bergmann also sees new application areas emerging for reactive compounding. "In my opinion, material optimisation such as upcycling and utilisation of secondary raw materials, as well as efficient polymer modifications – even polymerisation in some cases – are all questions that can be answered using reactive compounding," he says. "For example, recently we developed reactive compounding-based recycling processes for EPDM and the production of polyurethanes and polyglycolic acid through an addition polymerisation and polycondensation reactions. Future developments at Fraunhofer ICT currently involve feasability investigations into other polymerisation reactions to be achieved in reactive extrusion. The question of advanced recycling strategies, including VOC and/or odour removal for primary and secondary raw materials, by advanced compounding technology is our main focus."

The EPDM project at Fraunhofer ICT involved the devulcanisation or decrosslinking of post production waste EPDM rubber. Part of the REUSE project, which was funded by the German Federal

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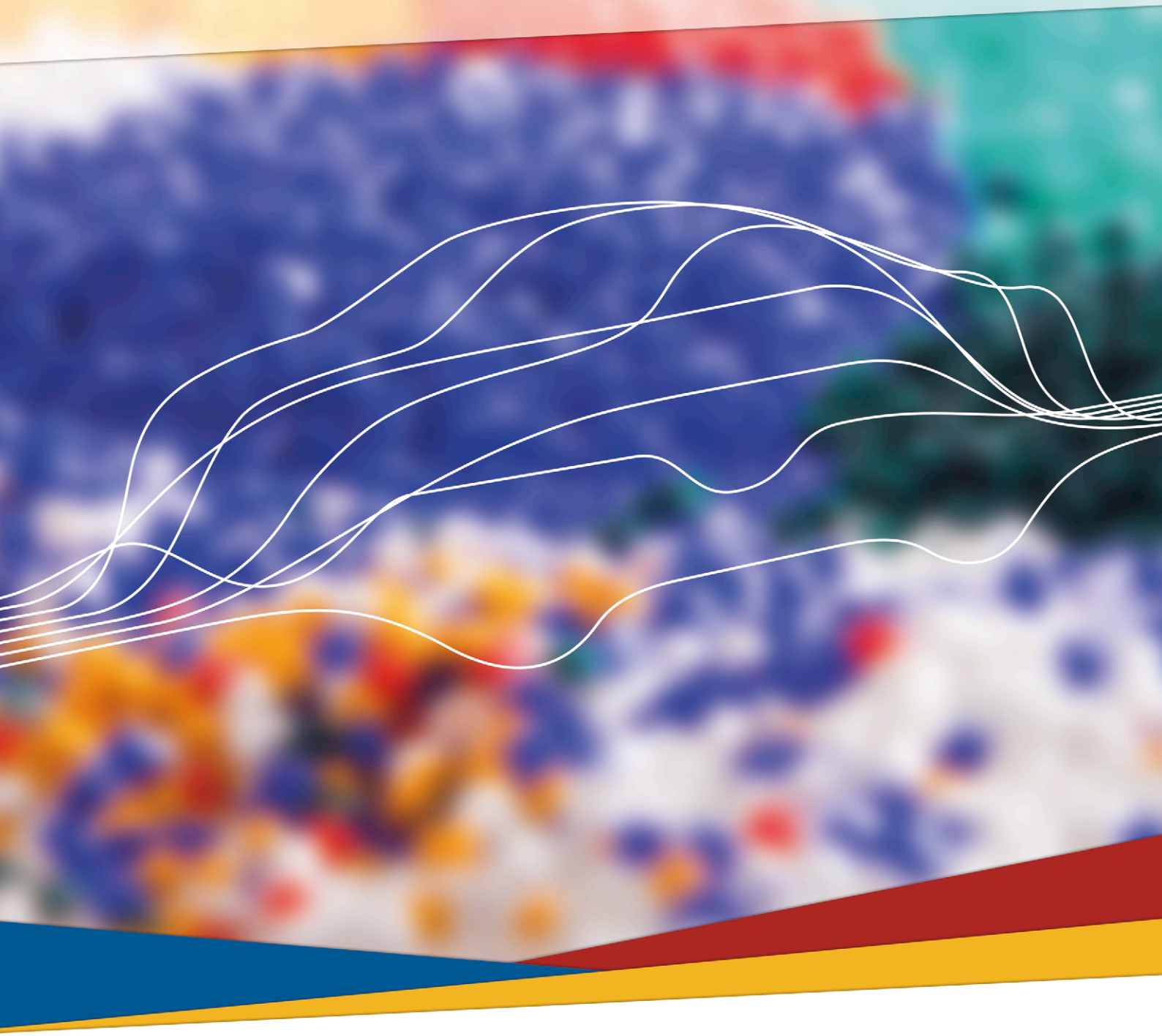

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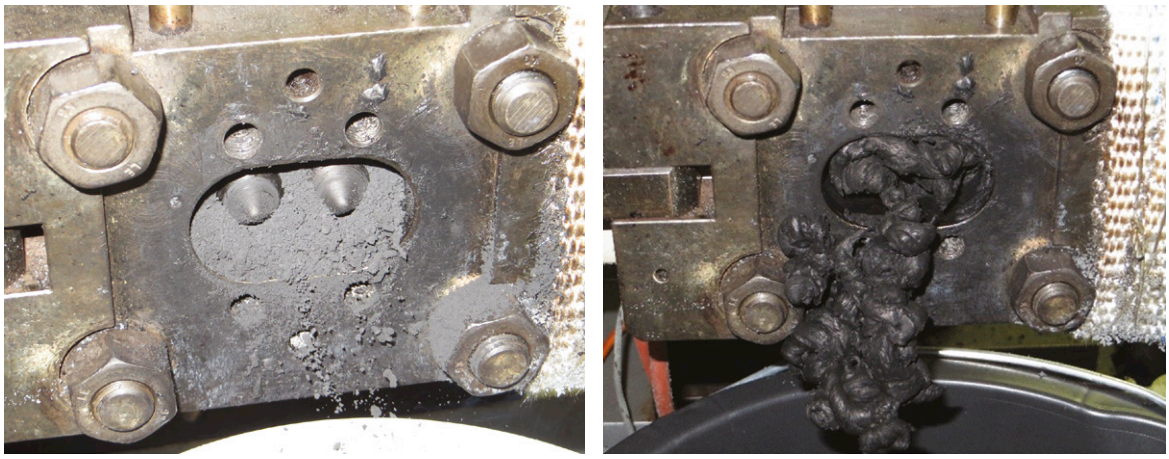

PHOTO: FRAUNHOFER ICT

Fraunhofer ICT's ReUse project uses reaction processing to devulcanise EPDM. Images show the vulcanised material at the extruder exit (left) and final raw polymer (right)

Ministry of Education and Research (BMBF) under agreement number 01DL17004A, the consortium works with EPDM concerns from different application areas. Using twin screw extruders, the fully vulcanised rubber was devulcanised. This involved a proportion of the bonds creating the rubber network being cleaved to leave a secondary raw material suitable for reuse.

In order to increase reaction efficiency, the extruder was equipped with an additional ultrasound energy input. The additional ultrasound shear forces acting on the material results in improved devulcanisation rates, providing an additional tool in the complex field of reactive extrusion process parameters. To enhance the reaction further, carbon dioxide was also dosed into the extruder. Depending on the chosen screw configuration, the carbon dioxide can be introduced in liquid form or in a supercritical state. This additional ingredient in the extrusion process allows the viscosity to be varied significantly - enhancing the ultrasound energy input.

"It is a highly complex field of dependent interactions," says Bergmann. "However, after a couple of days we understood the characteristics of the materials provided to us and managed to supply very promising materials to the project partners."

The changes in the material characteristics and the behaviour observed during the extrusion process can be seen in the images above. Although the project is only half way through, Bergmann says the project partners are delighted with the results obtained so far and Fraunhofer ICT will show a number of the resulting materials at its booth at Fakuma in October this year.

Demanding reactions

In another funded project at Fraunhofer ICT, the demanding process of polycondensation has been addressed. Due to the reaction kinetics and the water produced during polycondensation polymerisation, which has to be removed constantly, it poses specific problems in reactive extrusion. Fraunhofer ICT opted to use a cascade setup for the project.

Starting from glycolic acid in aqueous solution, a pre-polymerisation step and subsequent polymerisation are performed in a continuous setup. While the initial steps are performed in vessels dedicated to low viscosity materials, twin screw extruders take over the material showing thermoplastic behaviour. This combination ensures that the material is always processed by machinery optimised for the required characteristics. It means each item of machinery is able to work in optimal processing windows, allowing good material properties with minimum stress.

TPU reality

The production of TPU through reactive extrusion is even closer to industrial realisation, according to Fraunhofer ICT. Unlike the polycondensation process, this reaction is fast and a cascade setup is not required. In fact, the reaction is so fast that extruder considerations, such as dosing systems, order of dosing and homogenisation of all components, play a major role in the resulting material properties. To solve these problems, Fraunhofer ICT says it employed its chemical laboratory and expertise in small-scale batch reactions in combination with its highly flexible reactive extrusion laboratory. Using its 18 and 27 mm extruders, with processing lengths of 60 and 30 L/D, combined with options for material addition, degassing and analytics, it says it was able to build a customised line.

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Whether for a few days or a few decades, ensuring plastics maintain their performance throughout their intended lifetime means using effective antioxidant systems. ***Peter Mapleston*** *reviews the latest developments*

Bringing stability to plastics

PHOTO: SHUTTERSTOCK

Plastics have earned a reputation for durability but that is not by chance. Whether for long-life applications such as automotive parts, products intended for just a few years in the field – literally – such as agricultural films, or single-use packaging that is destined – hopefully – for near immediate recycling, plastics need chemical additives to provide sufficient stability to survive processing and intended use. Polyolefins are key beneficiaries of such additives: antioxidants, UV absorbers, and hindered amine light (HALS), and heat stabilisers. Additive suppliers continue to make progress in developing products for this sector that are better performing, more cost-effective, and safer.

Plastics deteriorate over time as a result of the polymer chains reacting with oxygen via autocatalytic reactions. Antioxidants, added at a sufficient concentration, slow down these oxidation reactions. "With an increased focus on recycling polymers it has become important to reconsider what constitutes 'sufficient stabilisation' for even single-use short service-life applications," says Dr Niall Marshall, Technical Manager with Everspring Middle East (part of Taiwanese producer **Everspring Chemical**).

"As the volume of polymer to be recycled increases –the European Commission's Strategy for Plastics in a Circular Economy envisages that all plastic packaging will be recyclable by 2030 – the quality of the recyclate will become more important as it finds uses in more demanding applications. The stabilisation system will be required to protect the polymer during processing, use and reprocessing."

Marshall notes that in applications with short service lives such as packaging, the stabilisation requirements for processing are more demanding than those for the service life. For such cases, Everspring offers customised combinations of well-proven stabilisers such as its Evernox range of hindered phenolic antioxidants and Everfos phosphites, together with what he says are highly effective boosters such as Everstab FS042, a dialkyl hydroxylamine which acts as a catalytic chain-breaking radical scavenger.

Recent work carried out by Everspring as part of a study with a plastics recycler has shown that while the same families of stabilisers, with their proven performance and broad regulatory approvals, are able to meet future requirements of stabilising the polymer sufficiently to allow for successful post-use recycling, there are some additional factors which need to be taken into account.

"Even virgin polymer which appears to have the same levels of stabiliser performance after five extrusions is found to have a significantly different

Main image: Surface crazing is one of the most immediately visible signs of inadequate polymer stabilisation

Right: Ampacet's Agristab 372 UV stabilising masterbatch offers better greenhouse film performance where sulphur fumigation is used

PHOTO: AMPACET

MFI after even a single extrusion following oven ageing," Marshall says. "Adding additional antioxidant during recycling (following the oven ageing) does help retard further increases in MFI during subsequent multiple extrusion, but it does not eliminate the differences observed in the first post-ageing extrusion, nor does it undo any damage already done to the polymer." This is shown in Figures 1a and 1b.

Everspring's work has demonstrated that the presence of sufficient levels of active hydroperoxide decomposers (its Everfos 626 and 9228 for example) in the polymer as it is being melted for recycling is important to maintain the polymer's properties. "This is because hydroperoxides, which form during the service life of the polymer in air, are relatively stable at ambient temperatures but rapidly decompose causing a surge in oxidation reactions while the polymer is being heated for reprocessing but before any additional antioxidant can be blended in to the polymer melt," Marshall says.

Agricultural options

Moving to products with lifetimes measured in years rather than weeks and months, **Ampacet** has introduced Agristab 372, which it describes as a highly effective UV-stabilising masterbatch that outperforms conventional HALS and NOR HALS stabilisers typically used in greenhouse film when pesticides are heavily used.

"Typical greenhouse film containing conventional NOR HALS stabilisers is designed for maximum 3,000 ppm sulphur content and three years, or four seasons, of effectiveness, while the market tends to require greenhouses with longer life-spans and higher pesticide usage, to withstand up to 5,000 ppm sulphur for a duration of more than three years," the company says.

Sulphur evaporators are one of the most commonly-used methods to fumigate greenhouses. But the use of sulphur fumigation leads to a loss of UV stabilising properties of the greenhouse film as photo-oxidation of sulphur deposited on the greenhouse film surface can yield acidic species, deactivating HALS stabilisers. Ampacet says Agristab 372 provides greenhouse film with outstanding resistance to pesticides, allowing usage of up to 5,000 ppm sulphur for a greenhouse that can last for more than three years. It does not affect the colour of the film and offers very high light transmission.

Solvay has introduced Cyasorb Cynergy Solutions M528 light stabiliser, specifically developed for masterbatch producers. "Its value lies in the additional formulation flexibility and increased production efficiency that it imparts by enabling the masterbatch producers to produce either super-concentrates or combi-batches, resulting in lower let-down and higher profits," says Andrea Landuzzi, Global Marketing Director, Technology Solutions – Polymer Additives, at Solvay Technology Solutions.

This new UV stabiliser is part of Solvay's M Series, which the company says ensure good long-term quality protection for general PE durable injection and blow moulded articles – crates, boxes,

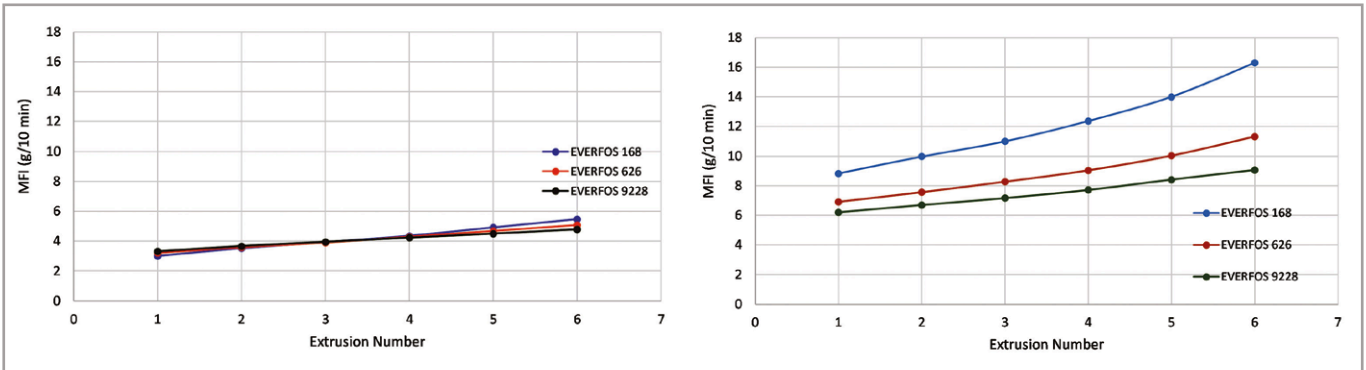

Figure 1a and 1b: Recycling presents greater challenges for polymer stabilisation. A system that works well to protect virgin PP through multiple reprocessing steps (Figure 1a) can be far less effective when the material has a previous service exposure history (simulated in Figure 1b by oven ageing). ***Source: Everspring Chemical***

drums, storage and industrial containers, water tanks, trash and roll-out carts, toys and the like – at reduced loading levels

"The high efficiency of this 100% active product enables its users to reach similar performance as traditional HALS at half the loading required and to add other functional additives into the masterbatch," Landuzzi says. Used at similar concentration as traditional HALS, the new stabiliser will provide additional stabilisation up to 16,000 hours ASTM G155 weathering (Figure 2).

Targeting automotive

Another new stabiliser, Cyasorb Cyxtra V9900 for polypropylene-based materials used in automotive interior and exterior applications, meets global UV weathering standards at lower "cost-to-stabilise," Solvay says. The additive, introduced late last year, is claimed to deliver "next generation UV stabilisation technology" in unreinforced, reinforced and elastomer-modified compounds (TPEs and TPOs).

Cyasorb Cyvxtra V9000t is said to meet all worldwide automotive UV weathering specifications (Figure 3a and 3b) and surpasses key automotive requirements such as low VOC emission, low fogging, low odour and no interference with paint adhesion. It comes in the form of non-dusting off-white to light yellow pellets that do not agglomerate and offers colour and gloss stabilisation. It does not migrate or bloom. Cost savings compared to other commercial UV stabilisers are said to be "significant."

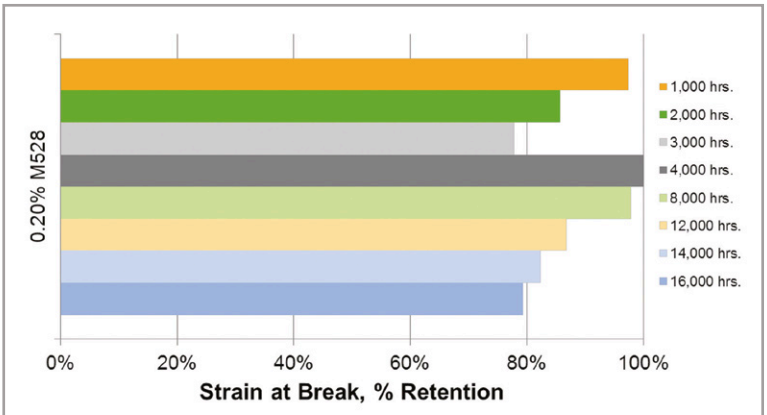

Figure 2: Performance of Cyasorb Cynergy Solutions M528 light stabiliser after ASTM G155 weathering *Source: Solvay*

Commenting on the migration behaviour of Cyasorb Cyxtra V9900, Landuzzi emphasises the importance of adhesion between automotive paint coatings and plastics substrates. "Migrating additives can change the TPO surface wetting behaviour and negatively affect the adhesion," he says. "Cyasorb Cyxtra V9900 has demonstrated little to no migration in TPO, resulting in excellent paint adhesion properties."

At **Songwon**, Thomas Schmutz, Director of Global Technical Services & Application Development, says that emissions from polypropylene are one of the biggest challenges faced by car manufacturers today. "In automotive interior applications in particular, emissions depend on the purity and degradation of the polyolefin, and the solubility and inertness of the additives used," he says. "Resin producers have introduced low-VOC products [but] these grades are more expensive than standard products and do not always meet profitability requirements."

One way to reduce VOC emissions is to slow down the pelletising step after the polymerisation of the PP, but this increases the cost of the resin, Schmutz says. Songwon's XP2085 experimental processing stabiliser for PP "combines cost efficiency with reduced VOC, allowing the resin producer to run the pelletisation step faster."

New stabiliser packages can reduce emission

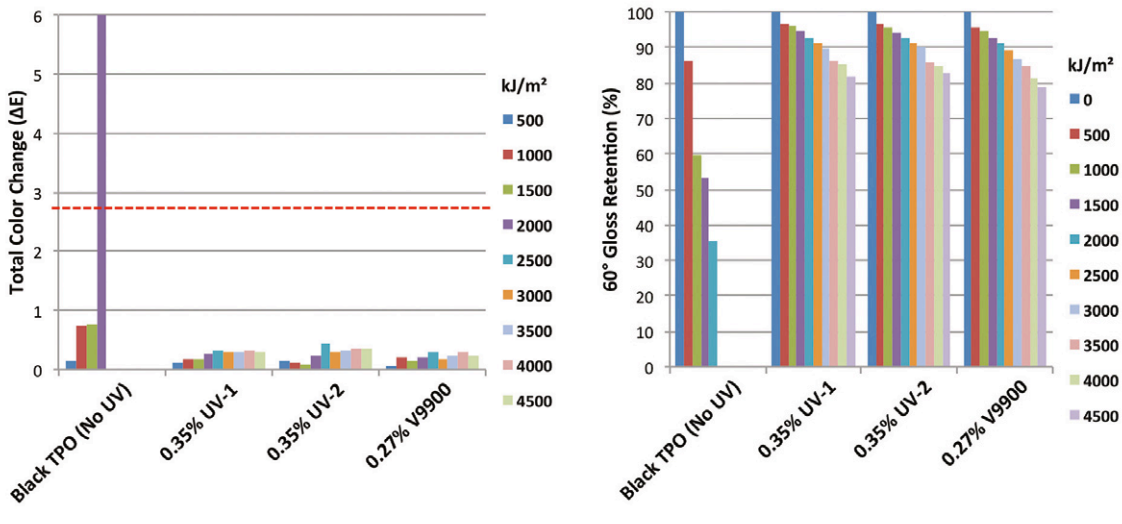

Figure 3a and 3b: Effect of Cyasorb Cyxtra V9900 on colour (Figure 3a) and gloss retention (Figure 3b) in a black automotive TPO compound, tested according to SAE standard J2527 for automotive exterior materials

Source: Solvay

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Right: Songwon's XP2085 experimental processing stabiliser for PP can help polymer producers meet more demanding VOC requirements in automotive

levels in interior TPO automotive applications, Schmutz says. "For example: Songxtend 2124 for under the hood and Songxtend 2123 for car interiors."


PHOTO: SONGWON

Technical solutions

OKA-Tec specialises in stabilisers for technical plastic applications that require improved long-term heat stabilisation and chemical resistance. Managing Director Peter Jan Peters highlights Okabest P808, which he says is an excellent thermal stabilisation booster for antioxidant systems used in polyolefins and other thermoplastics such as PC/ABS and POM (acetal). "It provides great synergistic effects with primary antioxidants like Irganox 1010 and secondary antioxidants like HALS or DSTDP," he says.

Okabest P808 is also a very efficient scavenger of VOCs "and particularly appropriate for compounds used in automotive parts which have to fulfil new emissions requirements in automotive industry like the Chinese GBIT 27630-2011," Peters says. He also points to Okaflex EM, an organic long-term heat stabiliser for all types of polyamides where application temperatures can extend up to 200°C. It also improves long-term resistance to typical automotive fluids such as lubricants, hot oils, glycols, coolants, electrolytes and cleaning agents.

"Okaflex EM shows permanently advantageous electrical properties, such as a high CTI tracking resistance of at least 600 V (according to IEC 112) and very good contact corrosion resistance, so is therefore also ideally suited for future applications in vehicle construction as well as in electrical engineering and electronics (E+E)," says Peters.

Adeka Polymer Additives Europe (APAE) reports that it has finished registering its polymer additives range under the EU REACH program. The range includes ADK STAB PEP-36, which the company says is the only organophosphite processing stabiliser with a proven contribution to long term thermal stability, as well as a portfolio of hindered amine light stabilisers (HALS), including low interacting types. A spokesperson for the company says that ADK STAB LA-502XP, a synergistic HALS blend based on ADK STAB LA-52SC, not only contributes to outstanding weathering stability, but also delivers extra performance in PP formulations that are subject to heat exposure, such as in automotive applications (Figure 4a and 4b).

Phosphite alternatives

At the NPE 2018 show in Orlando earlier this year, Baerlocher USA, part of **Baerlocher Group**, introduced a new generation of its Baeropol RST resin stabilisation technology. It says Baeropol DRS 6812 is a key component of its expanding Baeropol RST global technology platform. "The new additive delivers improvements in melt stability, polymer colour and antioxidant solubility and can be used as a replacement for most secondary phosphite antioxidants," the company claims.

"The rapidly growing polyolefin market, including the circular recycling economy, requires new stabilisation technologies that can solve the challenges facing traditional phosphite additives, such as limited solubility that can lead to process-

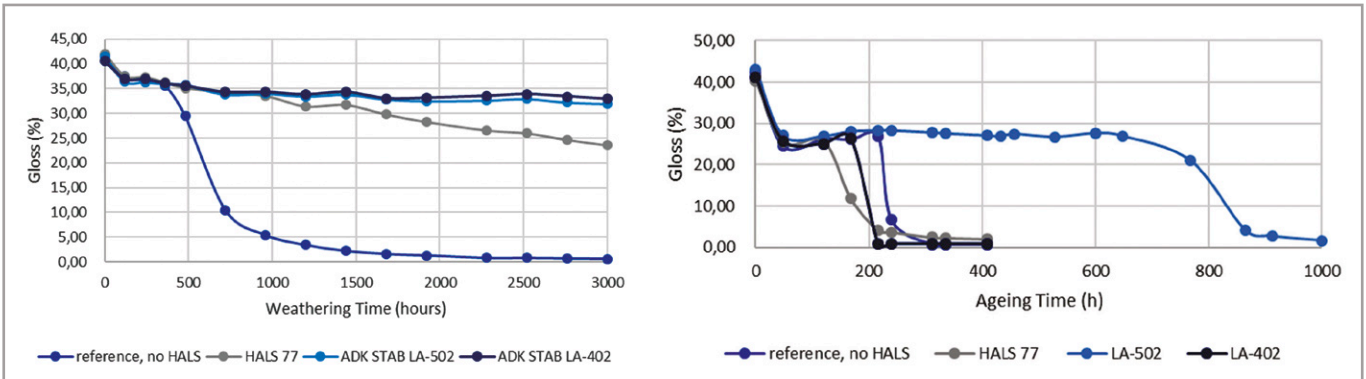

Figure 4a and 4b: Data showing gloss retention of a black PP-GF40 formulation after xenon weathering (Figure 4a) and thermal ageing at 150°C (Figure 4b). ADK STAB LA-402, a synergistic HALS blend based on low molecular weight HALS, shows equivalent surface protection to ADK STAB LA-502 but the latter displays much better gloss retention after oven ageing

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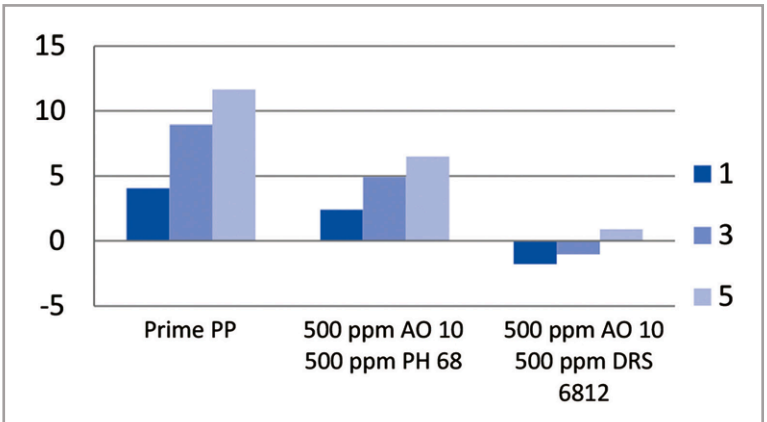

Figure 5: Comparison of the effect of different AO packages on yellowing in polypropylene after one, three, and five extrusion passes
Source: Baerlocher

ing issues," says Robert L Sherman, technical director for Baerlocher USA's Special Additives division. "Innovative solutions are particularly critical for stabilising recycled polyolefin content, meeting regulatory requirements for safety in food packaging, and delivering improved colour and polymer stability." This effect is shown in Figure 5.

Baerlocher says that even though they have been used for years as secondary antioxidants for polyolefins, particularly for melt phase stabilisation, phosphite additives can present solubility issues. "They can come out of solution and cause plate-out on extrusion equipment and polymer parts," it says. "New Baeropol DRS 6812 additive delivers excellent solubility and optimises hydrolytic stability for consistent performance." The new antioxidant is also claimed to offer "exceptional" compounding flexibility. It can directly replace phosphites as a 1:1 drop-in substitute, or act as a synergist to reduce the loading of phosphites. It is even said to allow the use of lower-cost phosphites while maintaining desired performance.

Baeropol DRS 6812 contains synergistic polymer stabilisation additives that improve melt stability in polyolefin resins and compounds, as well as polymer colour and processing consistency, compared to standard phosphites. Baerlocher adds that it also extends useful polymer life. Baeropol RST chemistry can be suitable for generally recognised as safe (GRAS) applications, making it applicable for indirect food contact.

Thoughts for food

Addivant notched up another success for its Weston 705 antioxidant when it obtained clearance for use of this nonylphenol-free liquid phosphite for food-contact applications in the Mercosur region of South America. Weston 705 already has approvals from US, European, and Chinese regulatory authorities, and Martin Pavlik, Addivant's recently-appointed Global Director of Business Development (he moved to the company in March, after almost 12 years at Dow Chemical) said in late August that approval from the Mercosur Southern Common Market had just been granted. "Weston 705 is currently the only sustainable globally registered liquid AO for polyolefins on the market," he says.

Weston 705 is targeted squarely at polyethylenes, although it is also being used in some TPEs. Pavlik says Addivant is working on obtaining food contact approvals for its use in polypropylene, but this will take around 18 months.

Addivant has also begun developing a new solid AO with improved efficiency, based on what it describes as a novel sustainable chemistry. Market launch is expected to be around 2020. "We think liquids are the most effective for a variety of reasons, but a large part of the industry is still operating with solid antioxidants, so we are committed to developing as quickly as possible a new complete solution system for that sector," says Pavlik. "Our aim is to have a system with a safety profile that complies with current and likely future regulatory requirements and which in any case will be superior to any solid system currently available."

Pavlik notes that most solid AO systems for polyolefins are combinations of a phenolic primary antioxidant and a phosphite secondary antioxidant. "Phosphites are coming under increasing scrutiny," he says. "In three to five years, today`s molecules may undergo a similar phase-out as TNPP recently did. So we are conducting studies on possible alternatives. This is why we developed Weston 705 in the first place. At the end of the day, Addivant wants a portfolio of the safest products possible."

Pavlik says that the expected merger of Addivant with **SI Group**, another major manufacturer of performance additives and intermediates, will


PHOTO: BAERLOCHER

Right: Baerlocher's Baeropol DRS 6812 in "prill" form. Individual particles are about the size of sugar granules

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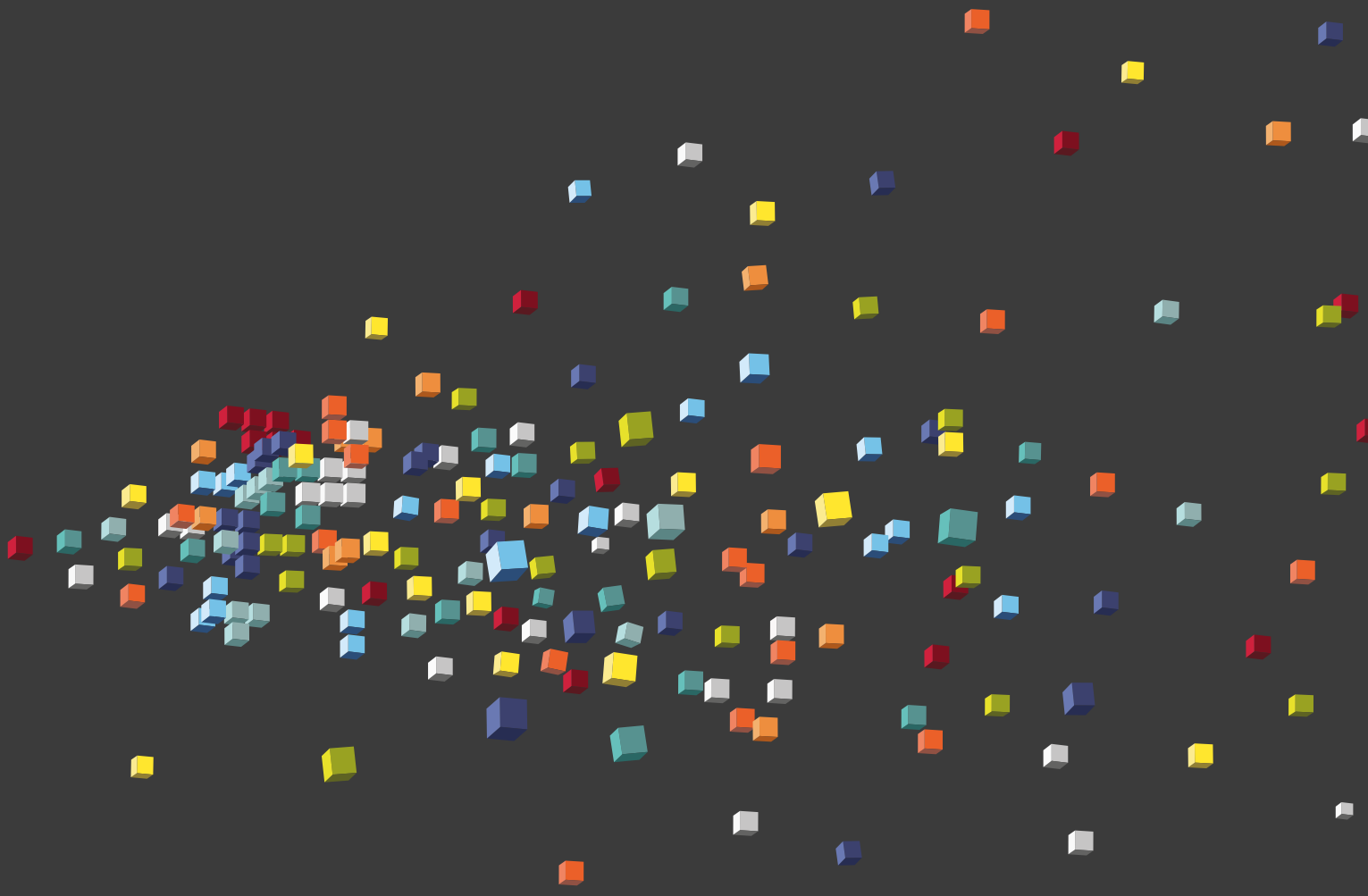

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Giving Shape to Ideas

PHOTO: ADDIVANT

Above: Addivant's Weston 705 liquid AO now has food contact approvals in Europe, China, and across the Americas

provide more momentum for this strategy. SK Capital Partners , the private investment firm that has owned Addivant since 2013, said in June that it had agreed to acquire SI Group.

Headquartered in Schenectady, NY, SI Group operates 20 manufacturing facilities on five continents. At the close of the transaction, expected later this year, SK Capital will combine SI Group and Addivant (which itself makes not only antioxidants but various other additives, including antiozonants, inhibitors, polymer modifiers and UV stabilisers).

Barry Siadat, a co-founder and Managing Director of SK Capital, says SI Group has an excellent fit with the technologies and end markets of several SK Capital businesses, of which Addivant is one. "By combining the complementary strengths of SI Group and Addivant, we will be creating a global technology and industry leader in plastic, lubricant, oilfield, and rubber additives," he says.

Addivant continues to expand production capacity for Weston 705, especially as it hopes to tie up partnerships with two major Chinese polyolefin suppliers - Sinopec and Petrochina - in the near future. Production in China under licence by a production partner is set to begin in Q4. "Additional integration within the Weston 705 manufacturing process will be enhanced by making an intermediate in France and the future combination with SI Group is expected to bring further synergies," Pavlik says.

He also draws attention to Genox EP, a solid phenol-free stabiliser that acts as both a primary and secondary antioxidant and which has been in the Addivant portfolio for some time "but which is only now resonating among suppliers of polyolefins. It also has possibilities in engineering thermoplastics."

Genox EPis 90% vegetable-based and is, Pavlik claims, the best solution for preserving colour. He believes it is especially appealing in such applications as fibres used in hygiene products. It is claimed to be five times more effective than more traditional stabilisation systems, but it is also expensive. Addivant is currently investing to improve production efficiencies, he says.

New capacities

Addivant is not the only additives supplier adding capacity. Last October, **Solvay** said it would invest to double the capacity of its Technology Solutions global business unit's high molecular weight HALS production facility in Willow Island, West Virginia, US. The core HALS products currently produced at the site are the foundations for the company's Cynergy and Cyxtra polymer additive product families. The investment is for a second, fully independent HMW HALS manufacturing unit to complement the existing line at Willow Island and is slated to be operational by mid-2019.

This July, **BASF** said it plans to increase global production capacity for its antioxidant Irganox 1010 by 40% through production expansion projects at its sites in Jurong, Singapore, and Kaisten, Switzerland. New production in Kaisten should come online in 2019 and in Singapore in early 2021. The investment includes doubling capacity in Singapore by adding an additional production line that will be integrated into the existing production facilities. An increase of 30% at Kaisten will be achieved through debottlenecking.

BASF is also investing in its McIntosh, Alabama, US, site to improve supply reliability and expand capacity of Irganox 1010 and associated antioxidants. The company has not quantified that expansion.

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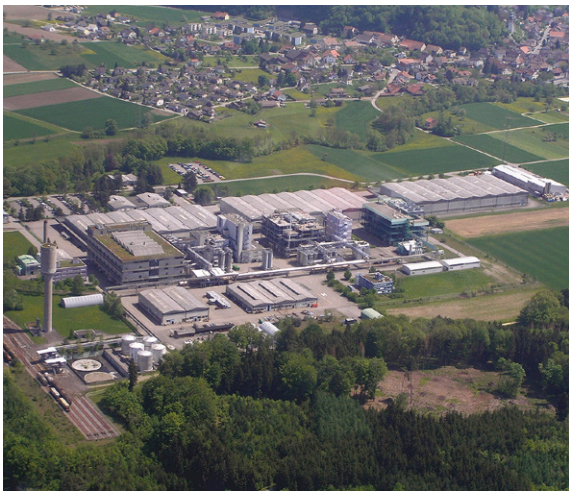

PHOTO: BASF

Right: BASF is adding global capacity for its Irganox 1010 antioxidant at three plants, including a 30% expansion at its Swiss facility at Kaisten

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We preview AMI's latest Wood-Plastic Composites conference, which takes place in Vienna, Austria, later this year

WPCs conference heads back to Vienna in 2018

The market for wood-plastic composites (WPCs) has seen strong growth in Europe, helped by a series of product and process developments as well as improved marketing programmes – yet usage is still far less than its potential. AMI's biennial *Wood-Plastic Composites* has followed the industry's progress over many years, and returns to Vienna, Austria for its 12th edition on 14-15 November this year.

Here we preview the event, with a closer look at the line-up of expert speakers.

Market trends

The opening session kicks off with **Matthew Breyer**, President at **North American Deck & Railing Association** (NADRA) in the USA. As a voice of the deck and railing industry, he will provide an international perspective on composite decking and discuss the introduction of NADRA's 'consumer awareness' programme which will hopefully allow industry leaders to help self-regulate products through standardised testing protocols. This is followed by **Luc Wallican**, Project Manager Technology at leading WPC profile and producer **Deceuninck** in Belgium. A company based on innovative building solutions, Luc will question whether there is a future for hollow wood composite decking.

Peter Kotiadis, Vice President of Innovation at **Fiberon** in the USA, continues the market trends discussion with a paper exploring the impact that geographical factors from across the globe have on wood-plastic composite extrusion. This is followed by **Andreas Haider**, Area Manager at **Kompetenzzentrum hol** in Austria, who focuses on advanced applications of NFC/WPC when applying this in various polymer processes, to open the market to new applications.

Then **Dr Arne Schirp**, Project Leader, **Fraunhofer-Institute for Wood Research** in Germany will present results from an innovative research project in which they developed foamed WPC materials for use in beehives. Closing the session, **Antonia Hantschel**, Product Manager, **J. Rettenmaier & Söhne**, Germany will look at the challenges and opportunities for the future markets of the WPC industry, focusing specifically on the wood and cellulose fibres for wood polymer composites.

Main image: WPCs continue to replace wooden decking in Europe, yet there is still far more potential for market expansion

Speakers at the conference include (from top to bottom) CCWOOD Managing Director Marco Pieterse, Fraunhofer-Institute for Wood Research Project Leader Dr Arne Schirp, TCKT Managing Director and Head of R&D Dr Christoph Burgstaller, Fibres Recherche Développement Materials Innovation Dr Nathalie Benoit, Fiberon Vice President of Innovation Peter Kotiadis, and Kompetenzzentrum hol Area Manager Andreas Haider

Process technology

The second session features **Sonja Terkl**, Product Manager WPC at **Battenfeld-Cincinnati** in Austria who analyses the pros and cons of using different processes during material preparation for NFC materials. This is followed by **Dr Christoph Burgstaller**, Managing Director and Head of R&D at **TCKT – Transfercenter Für Kunststofftechnik** in Austria who investigates different strategies for minimising the amount of water uptake in WPC materials. The session continues with **Dr Joachim Karthäuser**, Director of Technology & IPR at **Re-Organic** in Norway who looks at the incorporation of TMP and MDF into thermoset and thermoplastics composites.

Marco Th.A.Pieterse, Managing Director at **CCWOOD** in the Netherlands discusses the issues surrounding the longevity of WPC, and particularly one solution to this issue with the development of hydrophobicity in wood flour. The final presentation of the day is from **Heath Van Eaton**, President at **Wyocomp** in the USA, who introduces a continuous fibre technology for existing extrusion processes which transforms continuous fibre into fibre reinforced polymer composites.

To round off the day's proceedings, a drinks reception is held in the exhibition room, where delegates and speakers will have the opportunity to network with industry peers.

Decoration and materials

Day two of the conference opens with **Amadeo Farías**, Director New Projects at **Onegrow** in Spain, who will discuss how to produce new business in the highly competitive market of biocomposites for building products.

The conference's third session sees **Michael Berkemeier**, Project Manager Sales at **Wöhler Brush Tech** in Germany, providing an overview of different decoration effects for WPC and the types of finishing technologies that can be used. **Daniel Friedrich**, Lecturer and Researcher at **Baden-Württemberg Cooperative State University/Compolytics** in Germany, wraps up the session debating regulations around cladding. He asks the industry to consider whether EN 15534-5 for cladding should become a construction product norm.

Unsurprisingly, there are also a number of innovative materials developments. **Dr Nathalie Benoit**, Materials Innovation Engineer at **Fibres Recherche Développement** in France, discusses alternatives to wood, focusing on recent developments regarding the use of plant-based fibres in thermoplastic composites. **Dr Norbert Schmitz**, Managing Director at **ISCC System** in Germany, provides a contrast to the technical presentations with a summary of the ISCC's global certification system, which offers solutions to address sustainability requirements for all feedstocks and markets. **Muhammad Ali Malik**, Business Development Manager at **Stora Enso** in Sweden, discusses the idea of how to brand and market wood-plastic composites as a reliable and economical material for the future.

Dr Sara Sorribas, Technical Customer Service Manager at **Elix Polymers** in Spain, continues the session by exploring the latest developments of an ABS-based product which hopes to encourage a more sustainable generation of polymer composite materials. **Dr Kevin Janak**, Director – Application & Product Development – Coatings & Composites at **Lonza** in the USA, examines the development of new lubricants for WPC deck boards, looking at the ways to maintain and improve board properties with an increased wood flour content. The session is brought to a close by **Dr Michael Schiller**, Founder and Owner at **HMS Concept** in Austria, who will present a paper on foamed wood PVC composites from a theoretical perspective.

About Wood-Plastic Composites 2018

Wood-Plastic Composites provides an international forum for companies – along the entire supply chain of wood-plastic composites – to come together and engage with each other over two days. The conference is held at the Imperial Riding School Renaissance Hotel in Vienna, Austria, on 14-15 November 2018.

In addition to the formal conference sessions, attendees will benefit from the chance to discuss and network during informal refreshment breaks and the first-day drinks reception.

To find out more about attending the conference, visit the **conference website**, or contact Heidi Lesiw (**heidi.lesiw@ami.international**) on +44 (0)117 314 8111.

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The compounding industry is making use of recycled polymers and that presents challenges. Mark Holmes discusses recent developments with some leading providers of additive solutions

Recycling options gather pace

Additives are essential in improving the performance and processability of all plastic compounds and that's no different for recycled polymers, which are being increasingly used today as compounders respond to end-user demand to enhance sustainability credentials. In fact, the trend today is to upcycling – where the aim is to lift the performance of recycled polymers back to near virgin.

According to Mike Fulmer, Vice-President of **Struktol Company of America**, recyclers are taking advantage of additive opportunities to provide higher performing compounds. "Recycling compounders have customers that are demanding better performing, tailor-made compounds and using additives can allow them to do this. The growing availability of recycle streams of all quality levels are allowing recycling compounders to take advantage of lower cost streams and modify them using additives to create value added products," he says.

"We get many customers who come to us and tell us they have access to a volume of polymer that typically they would not be able to use. They ask us for additive solutions that would allow them to use this polymer and add value to it. Previously, many would shy away from using additives but the more success they have using them opens many windows of opportunities," Fulmer says.

Processing challenges

Struktol focuses on three key challenges that recycled resin processors face – MFR modification of recycled polypropylene (PP), odour control and homogenisers. "We have a line of viscosity modifiers that allow processors to turn low MFR, high viscosity PP streams into higher MFR products. A lot of available PP streams are low MFR and the ability to create higher MFR compounds allows for access to a wider segment of the moulding market," Fulmer says. "In addition, the ability to turn high odour recycle streams into low/no odour compounds can be important for allowing recyclers to access certain market applications…Finally, mixed polymer recycled streams can have process and property issues if they are not processed correctly by the recycler," he adds.

The company has developed a number of

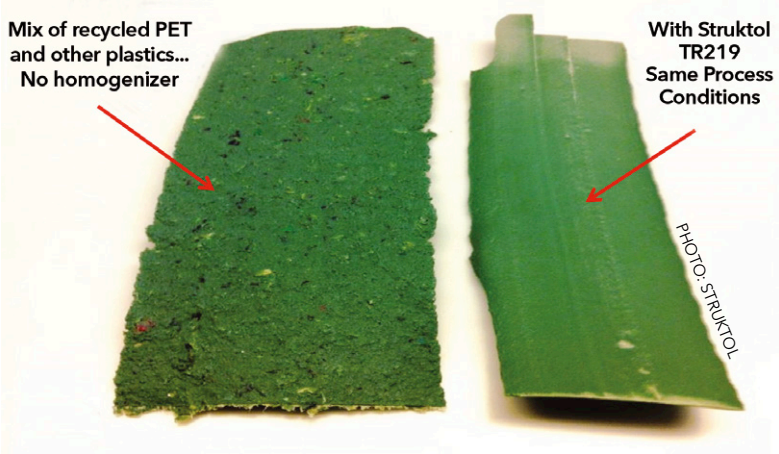
Main image: Additives can help manage the challenges of producing compounds from recycled plastic, improving performance and processing

products for these applications. "RP 23 is our newest viscosity modifier for PP and can be used at low loading levels to give significantly higher MFR," Fulmer says. "The product is easy to handle and feed and provides very consistent viscosity modification. RP 53 is a key odour modification additive. It is a combination odour neutraliser and absorber and can remove odours caused by a variety of chemical species. Low loading levels of less than 1% can provide significant reductions of odour. TR 052 is an important homogenising additive and can be used in commodity and engineered polymer systems. This additive provides for improved melt mixing in any type of processing equipment often leading to higher physical properties and improved processability."

Other Struktol additives include TR 229, which acts as a compatibiliser and lubricant for use in polycarbonate (PC) and PC/acrylonitrile-butadiene-styrene (ABS) blends as well as nylon 6 and 6,6 compounds. It can be used in virgin and recycled blends and is FDA-approved. Struktol also offers TR 219. Developed originally as a compatbiliser and lubricant for use in virgin and recycled nylon 6 and 6,6 compounds, it is has also been found to be effective in polyester (PET and PBT) compounds, especially in recycled or recyclate-containing applications or in cases where the polyester compound is contaminated with other plastics.

RP 38 is designed to provide viscosity modification and lubrication in recycled PP compounds and resins that contain moderate to high levels of polyethylene contamination. It also incorporates some odour control performance. The company says that when used at loading levels as low as 0.2%, it results in increased melt flow and allows for significant improvement in mould filling and release. Processors using RP 38 are said to be able to develop compounds from regrind or recycled feed streams without sacrificing key properties or performance. The RP 38 products can also be tailored to individual compounder's requirements.

Below: Struktol's TR219 has been shown to be an effective compatibiliser for PET recyclates with other polymeric contaminants



Viscosity modification

RP 38 employs vis-breaking technology. "RP 38 is a viscosity modification additive for PP that is designed to work in recycled PP streams that contain high levels of PE contamination," Fulmer says. "This product reduces the molecular weight and viscosity of the PP portion of the recycled stream while at the same time protecting the PE portion from crosslinking, which is a typical occurrence when using other peroxide-based PP viscosity modifiers. A current customer kept having to add more and more of a competitive product trying to increase the MFR of the recycled PP stream but saw no change in the MFR due to the competing crosslinking of the PE portion of his base stream. Switching to RP 38 allowed the use of lower loading levels of viscosity modifier to achieve the target MFR."

Developed as a processing aid, TR 251 is a combination product that includes surfactant and lubricant technology. Struktol says it has proven to be effective in improving mould flow of recycled compounds without significantly changing the melt flow rate, allowing processors to realise improved flow and filling in thin wall products along with enhanced release characteristics. It does this without vis-breaking, so compounds produced using it typically display more controlled physical properties.

Fulmer says the company sees considerable opportunity in the recycling sector. "Struktol will continue to focus on this growing market and provide additive solutions to processing problems based on feedback from the industry," he says. "We will continue to develop new products providing better, more efficient viscosity modification as this is an important, growing need in the market. We are also working on products to improve specific physical properties in several recycled polymer applications."

Sustainability drivers

Lars Öhrn, Chief Marketing Officer of **Nexam Chemical** agrees that there is increasing demand and interest for recycled polymers throughout the value chain for many applications. "Performance from recycled polymers in terms of processability and in final applications is improving and the time when the driver to use recycled material was only cost is over," he says. "Properties are now increasingly expected to be equivalent to virgin material. The driver is sustainability."

Öhrn highlights a number of current issues in the recycled compound industry. These include process stability and increased melt strength, as well as the ability to run long process times without stopping for cleaning or failures. Performance of recycled plastics in different applications is also an

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Above: Many additives are available to improve the performance of recycled PET compounds and alloys

issue. "There are many problems in the recycling business," he says. "The biggest one is probably getting clean material (mono-material). Post-consumer material is usually very difficult to use for this reason. Another problem that is not spoken about so much is product liability. Recyclers must guarantee the full content of their material."

Improving processing and final product performance of recycled polymers remains paramount. "We address this with different combinations of Nexamite products and other additives, such as antioxidants and polymer processing aids in multifunctional masterbatches," Öhrn says. "We also combine reactive extrusion that improves melt strength and physical performance with additives that further decrease the need for cleaning and unwanted production stops. Depending on the challenge the converter has processing the recycled plastic material we have four tools that can be used either stand-alone or combined. These tools are highly effective processing aids that help processing the plastic so that it flows easier, leaving fewer deposits and less die build up. In addition, antioxidant combinations help to protect the polymer during processing from further deterioration. Nexamite can also form long chain branches improving melt strength, and finally we can choose a carrier that can further improve properties in the final product."

Nexam Chemical has recently introduced Nexamite M480502 and M480504, PE0180 and PE0191 – a series of additive masterbatches designed for extrusion applications such as film, pipe and profile, as well as blow moulding applications. The company has also launched several Nexamite masterbatches specifically designed for polyester industrial applications.

Performance tools

Nexam says it will continue to create tools for recyclers to enhance the performance of their recycled material. "The reference point is the performance of virgin material," Öhrn says. "In many cases recyclers are mixing recycled and virgin material. In those cases, we want to try to create solutions that will enable more recycled material to be used. A more difficult task is to create compatibilisers that can cope with the many different polymer fractions in recycled material and still enable high property levels." ›

Compatibilised PP/PE alloy first for paint cans

UK-based paint manufacturer Crown has selected a compatibilised blend of 100% post-consumer PP and HDPE from ImerPlast for production of 2.5 and 5.0 litre retail and all 10 litre plastic paint cans.

The injection moulded plastic cans are produced by Emballator Packaging using IM30 compound produced by ImerPlast, which is part of the Imerys Performance Additives business and is a leading European producer of recycled polyolefin compounds.

ImerPlast describes the introduction of the new pot as a world first and "a significant step in the evolution of recycled resin." The company says until now paint pots have rarely been produced with more than 25% recycled resin content. Even this has often been post-industrial rather than post-consumer material as the mechanical requirements for this application are demanding, it says.

PHOTO: IMERYS

ImerPlast claims Crown's 100% PCR PP/PE alloy paint cans are a world first

ImerPlast's IM30 is an alloy of PP and HDPE compatiblised using a patented mineral-based compatibiliser. It is designed to achieve an optimum stiffness/toughness balance that allowed it to pass Crown's in-use testing requirements – a pot that leaks or cracks in transit or in-store represents significant and costly problems.

Shrinkage of the IM30 compound is the same as standard polyolefins used in this application, so no significant changes to processing were required on the part of Emballator. The compound also met Crown's colour requirements and is claimed to be fully miscible with both PP and PE when recycled.

Imerys claims its patented coated mineral additive technology – introduced under the ImerLink name – both modifies the miscibility of the PP and PE phases and creates a network of bonds between them. Performance is said to be superior to olefin block copolymer compatibilisers. The materials are only available through Imerys Performance Additives' formulation service.

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Below: One of the biggest challenges for recyclers is obtaining consistent and clean material

China's National Sword policy, enacted in July this year, has significantly disrupted the recycling market, according to Salvatore J Monte, President of **Kenrich Petrochemicals**. "The immediate termination of the daily movement of 4,000 shipping containers full of recyclables leaving US ports for China is simply a phenomenon that would mess up any free market segment of the economy," he says.

"The many socio-economic and political facets of recycling limit the current opportunities for additives for Post-Consumer Recycle (PCR). Collecting, sorting, cleaning and developing market applications for PCR is just too costly for a government mandate or financial supplementation by companies. However, there are applications to be explored in the post-industrial recycle segment because the economics work. For example, at the recent Plastics Industry Association REFOCUS Sustainability & Recycling Summit, a session was devoted to additives for upcycling and a focus was put on upcycling automotive bumpers," says Monte.

"Modern bumpers are made with thermoplastic olefins, polycarbonates, polyesters, polypropylene, polyurethanes, polyamides, glass fibres, fillers, pigments, coatings and additives of all types. Many of these materials are intrinsically incompatible with each other. Recyclers will tell you that more than 5% PP in HDPE recycle will cause delamination issues for an injection moulder – or that small amounts of fillers will have a significant negative effect on the mechanical properties of a recycled part," he says. "However, assuming you have a recycle source of reasonable quantity and cost and a market, the challenge becomes processing and compatibility of all of the dissimilar materials."

Monte explains that compatibility can be broken down into the polymer/polymer and filler/fibre/polymer interfaces. Polymer/polymer interface compatibilisers fall into three general categories: thermoplastic copolymers that tie two dissimilar polymers together; maleated polymers that 'couple' two dissimilar polymers; and organometallics that catalyse dissimilar polymers of all types and couple fillers in the melt. "Polymers generally fall into two categories depending on the monomers and the catalyst(s) used to polymerise - addition polymers and condensation polymers. The limitations of the technologies are that thermoplastic copolymers are specific to known streams of recycle, maleated polymer often depolymerise condensation polymers, and organometallic catalysts are expensive and require melt processing experience," he says.

Compatibilisation of filler/fibre/polymer interfaces, meanwhile, requires coupling agents, such as silanes, titanates, zirconates, aluminates and zirco-aluminates and calls for an understanding - or at least an awareness – of the technologies to take advantage of the possible benefits, according to Monte. "It is important to know these technologies because the more you compatibilise the less you have to clean and sort allowing for more favourable economics in producing a functional recycled plastic part," he says.

New chemistries

Monte says that additive technology requires chemicals and a truly 'new' additive requires new chemistry, with the associated inventory registration requirements and outside laboratory toxicological testing. "Ask anybody struggling with the costs of EU REACH registration," he says. "However, materials can always be formulated and called 'new'."

Kenrich Petrochemicals' solutions are based on the discoveries of Natta, Ziegler and Kaminsky. "German Karl Ziegler discovered the first titanium-based catalysts and Italian Giulio Natta proposed using them to prepare stereo regular polymers from propylene, and they were awarded the Nobel Prize in Chemistry in 1963," says Monte. "Ziegler showed that a combination of $TiCl_4$ and $Al(C_2H_5)_2Cl$ gave comparable activities for the production of polyethylene. Natta used crystalline α-$TiCl_3$ in combination with $Al(C_2H_5)_3$ to produce the first isotactic polypropylene. Kaminsky discovered that titanocene and related complexes emulated some aspects of these Ziegler-Natta catalysts but with low activity. He subsequently found that high activity could be

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achieved upon activation of these metallocenes with methylaluminoxane (MAO). The MAO serves two roles. Firstly, alkylation of the metallocene halide and secondly abstraction of an anionic ligand (chloride or methyl) to give an electrophilic catalyst with a labile coordination site."

Ziegler–Natta catalysts have been used in the commercial manufacture of various polyolefins since 1956. Monte says Kenrich uses a neoalkoxy titanate (titanium IV neoalkoxy, tris dioctyl phospha-to-O) in combination with Al_2SIO_5 mixed metal catalyst in powder and pellet forms for in situ macromolecular repolymerisation and copolymerisation in the melt – polymer compatibilisation. In addition, the neoalkoxy titanate proton coordinates with inorganic fillers and organic particulates to couple/compatibilise the dissimilar interfaces at the nano-atomic level reducing the need for sorting.

Right: ZeMac Link NP, from Vertellus, allows effective production of polyamide/ polyester blends and alloys

Monte believes that future developments will include the use of recycled plastic compounds and rubber as functional fillers in concrete and asphalt compositions. A recent study [Appl. Sci. 2018, 8, 1029; doi:10.3390/app8071029] looked at the effects of titanate coupling agents on the engineering properties of asphalt binders and mixtures incorporating LLDPE-$CaCO_3$ pellets to overcome the problem of asphalt rutting. The researchers concluded that the coupling agent was used to enhance the crosslinking between materials by means of winding up covalent bonds or molecule chains, improving the performance of the composites. The addition of modifiers and coupling agent significantly improved the resistance to permanent deformation of asphalt binders.

Upgrading polyesters

Vertellus recently introduced ZeMac Extend P, a chain extender additive that facilitates upgrading of recycled polyesters such as PET for use in a variety of target applications. The company says that ZeMac Extend P increases molecular weight and intrinsic viscosity of both recycled and virgin PET. Delivering improved melt viscosity and increasing melt strength, it is claimed to reduce sagging of the extrudate, resulting in faster production. It also counteracts hydrolytic degradation and improves impact strength.

From a performance perspective, the company says ZeMac Extend P can be used in a broad range of target applications and delivers performance close to that achieved using 100% virgin materials. Examples of suitable applications include staple and filament fibres; injection moulding; film, sheet, tape and profile extrusion; bottle blow moulding; and strapping and foamed sheets.

ZeMac Extend P also supports sustainability efforts, enabling low cost post-industrial and post-consumer recycled PET to be utilised, as well as incorporating glass fibre, minerals and impact modifiers. "As varied industries seek technologies to improve material performance and support sustainable production processes, ZeMac Extend P offers an innovative solution for improving intrinsic viscosity and impact strength while supporting efficient production," says Prasad Taranekar, Marketing Manager at Vertellus.

The company has also developed new additive technology that allows compounders and moulders to reduce costs and boost sustainability efforts while integrating previously incompatible materials into their alloys. ZeMac Link NP is a compatibiliser additive that permits the inclusion of polyamide and polyester materials – including recycled and post-consumer polyethylene terephthalate (r-PET) – in the alloy production process.

Effective at very low levels, ZeMac Link NP is claimed to provide a cost-effective approach for combining virgin nylon and r-PET materials. Vertellus says ZeMac Link NP is well suited for use in a range of alloy applications including office furniture, fasteners, hand tools, outdoor equipment, textile bobbins and automotive accessories such as hubcaps. ZeMac Link NP allows lower cost post-industrial and post-consumer polyesters to be included in alloy compounds, supporting sustainability initiatives. Glass fibre, minerals and impact modifiers may also be used with ZeMac Link NP.

The company says that as compounders and moulders seek to cost-effectively improve material performance while boosting sustainable production processes, ZeMac Link NP provides an innovative and cost-effective solution for including recycled nylon and r-PET materials with virgin nylon in various alloys.

CLICK ON THE LINKS FOR MORE INFORMATION:

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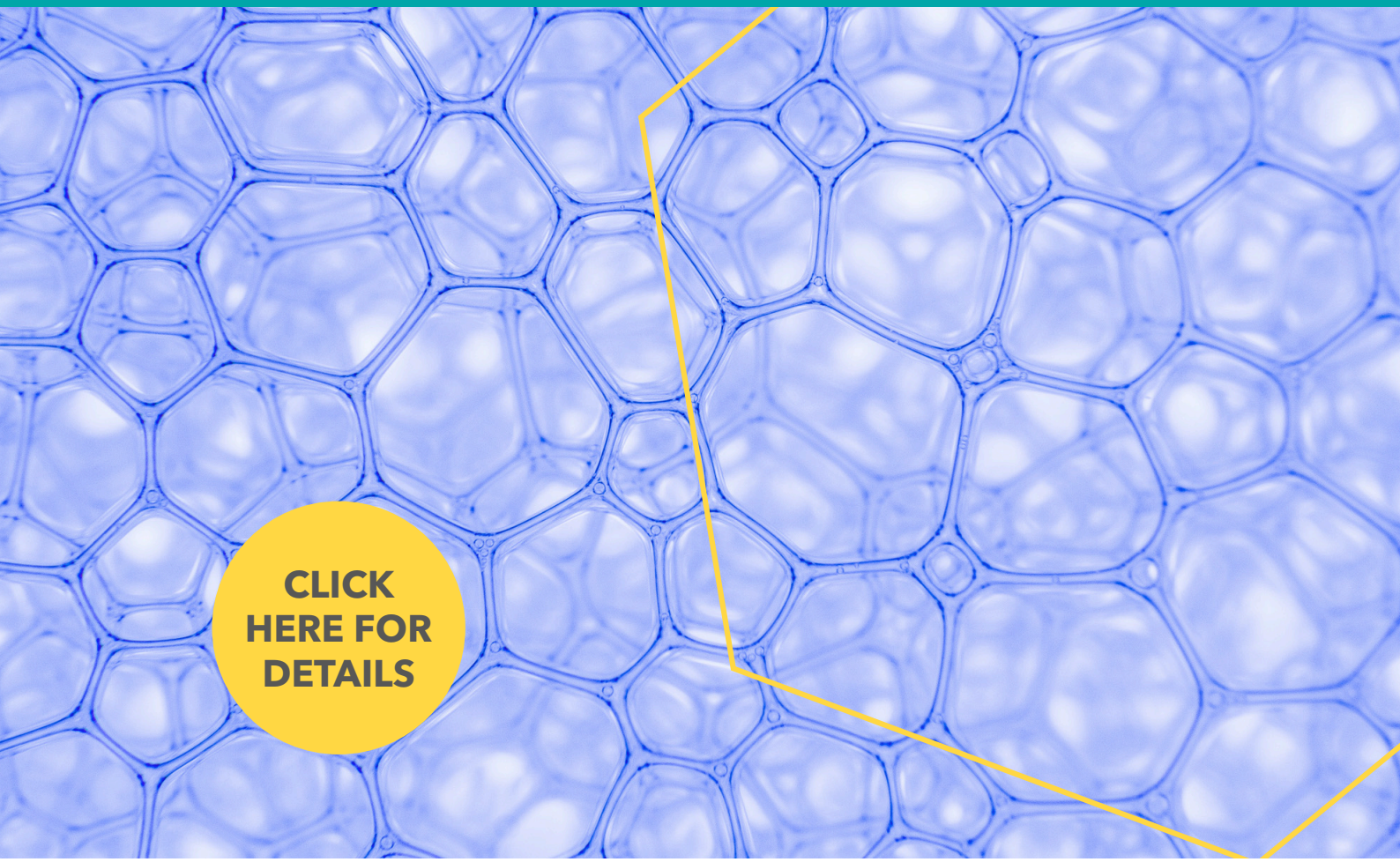

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***Chris Middleton** explains how blockchain aims to make sensitive supply chains smarter and more trustworthy. But the technology is not without its challenges...*

Blockchain: redefining industry supply chains

Blockchain – the encrypted ledger technology that secures cryptocurrency and potentially a whole raft of business transactions – is simultaneously one of the most hyped and criticised technologies in living memory. And it is sometimes hard to sift the truth from the fiction.

Last month, the professional services specialist PwC published global research suggesting that 84% of organisations are experimenting with the technology. 25% of organisations have projects that are either live or at the pilot stage, it said, while 32% have projects in development and a further 20% are researching the market.

However, in May the technology analyst firm Gartner had published a very different set of findings. Its 2018 CIO survey said that only 1% of CIOs report live blockchain programmes within their organisations and just 8% are either planning blockchain initiatives or looking at or experimenting with the technology. According to Gartner, 77% of CIOs said their organisation had no interest in the technology and/or no plans to investigate or develop it.

Two highly reputable organisations and two detailed, global surveys presenting contradictory findings published just three months apart. These extremes of claim and counter-claim have typified discussions about the technology. However, Gartner's latest Hype Cycle report, published at the end of August, acknowledged that blockchain is a fast-maturing technology.

Blockchain explained

Essentially, a blockchain is a distributed ledger. It is a continuously expanding chain of records (blocks) that are linked and secured via strong cryptography to create a networked audit trail of transactions. Because each block, ledger, or record usually contains a cryptographic hash of the preceding one, together with a timestamp and data about the

Main image: Blockchain technology could reshape supply chains in industries such as chemicals and plastics

Right: The development of smart cities is paving the way for real time data collection to create permanent and inviolable records

PHOTO: SHUTTERSTOCK

transaction, the system is designed to be resistant to tampering and modification.

Typically, blockchains work using the processing and mirroring power of distributed/peer-to-peer computing systems, which is both the technology's advantage and, some argue, its inherent problem, because it replaces trust with networked complexity.

Theoretically, tampering with any one record creates a ledger entry that differs to all of the verified copies across the network. This is why blockchain's proponents believe it could become the foundation of a new data commons, challenging the concept of proprietary data and data landlords. The disadvantage is that this type of distributed processing is typically slower and more resource intensive than others. And that means that the cost of every transaction is higher and uses more energy.

Most blockchains are either public/permissionless – meaning anyone can join or add their processing power – or private/permissioned. The latter demands that someone's identity can be verified before they are allowed onto the closed system.

Linked with blockchain are the concepts of digital tokens and cryptocurrencies. Indeed, the technology was developed as a decentralised computing model to support cryptocurrencies and verify transactions. On some distributed, blockchain-supported systems, digital tokens are exchanged for work/processing and may represent an asset of any kind – that could include plastics, chemicals and compounding or mixing services.

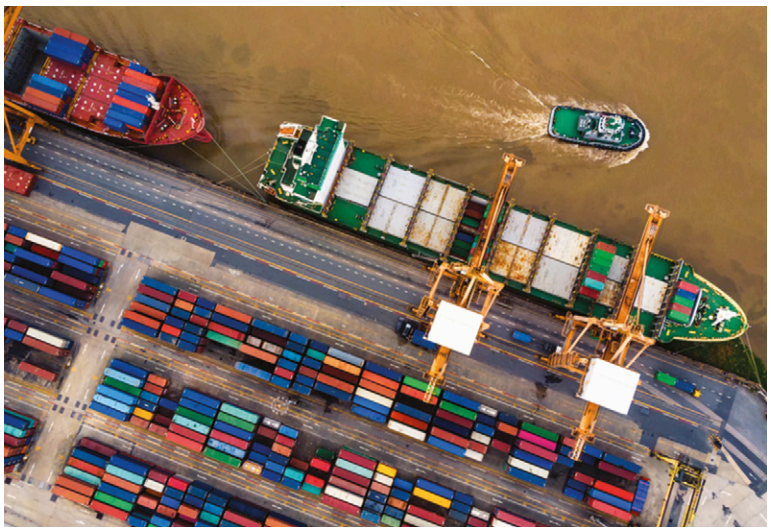
Below: Blockchain technology provides a mean to track, monitor and record condition of goods at every point in the supply chain

The big attraction

The concept of an immutable system of record makes blockchain attractive for many applications that demand verification and authentication, which is why use cases are fast developing in supply chain management, logistics, transport, manufacturing, financial services, publishing, intellectual property, contracting, legal services, and more.

And in an increasingly interconnected world of smart things – from smart, connected cities, transport networks, factories, industrial installations, offices, and homes, to smart trucks, shipping containers, delivery boxes, and even sensor-filled labels on perishable goods – the idea of an inviolable system of record, together with smart contracts and automated payments, is even more attractive.

Blockchain is making its presence felt in all of these areas, because of the Internet of Things (IoT), the same technology, incidentally, driving interest in Industry 4.0 manufacturing management systems. Imagine a supply chain for sensitive, fragile, and/or perishable goods on which they could be authenticated at source and throughout the chain, shipped in ideal conditions, and delivered safely, on time, to the correct recipient. Each stage of that process could be logged and stored on an immutable ledger, with payments made automatically if and when all conditions are satisfied. That's the promise of blockchain in the chemicals sector – and in others that face similar challenges.



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Blockchain realities

So how does blockchain look in practice? In March IoT supply chain specialist Brieftrace developed a blockchain solution to transform the way that pharmaceutical companies track their assets and perishable goods, allowing them to ensure that they are being handled correctly and delivered safely. The firm teamed up with transport and logistics company DSV on a pilot programme that deploys blockchain-connected tracking and sensing devices to monitor shipments. The pilot is based on the Traceum blockchain, which facilitates smart contracts, fiat currency transactions (currencies backed by a government as legal tender, rather than by a commodity such as gold), fixed transaction fees,

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Above: Systems such as IBM's Blockchain World Wire aim to provide trusted "near real time" international payments

partner transparency, trusted data, and archiving.

The new system gives companies the ability to monitor issues such as product temperature, humidity, and light exposure, which can affect many drugs, chemicals, and other sensitive or perishable goods. This information is then stored on the blockchain, along with the vehicles' locations at every point.

Meanwhile, in the meat supply chain, the Arc-net initiative connects each step of pork product journeys using blockchain technology. This extends to encoding the DNA signature of each pig into the blockchain so the system can ensure that the same meat is being processed throughout the supply chain.

Blockchain is also being used in the diamond industry to authenticate the origin of each stone from a specific pit in a specific mine, and to then trace it all the way to the end customer.

There are other indications that blockchain is changing the business landscape, according to the August PwC report. For example, the concept of tokenisation is spreading to raw materials, finished goods, income-producing securities, membership rights, carbon offset trading, and even charitable donations. At the same time, initial coin offerings (ICOs), in which a company sells a predefined number of digital tokens to the public, are funnelling billions of dollars into blockchain platforms. ICOs raised $13.7bn in the first five months of 2018 alone, according to PwC.

There are other potential advantages in the technology. "Using blockchain in concert with enterprise resource planning platforms will enable companies to streamline processes, facilitate data sharing, and improve data integrity," said the PwC report. As a distributed, tamperproof ledger, a well-designed blockchain doesn't just cut out intermediaries, reduce cost, and increase speed and reach, it also offers greater transparency and traceability for many business processes, the firm said.

Securing transactions

However, while such a blockchain validates data and eliminates the need for a central authority to approve and process transactions, cutting out that authority also removes the institutions important to ensuring market stability, combating fraud, and more. And that is a challenge to any long-established, risk-filled sector. Some organisations are working to ensure that centralised trust and blockchain are not mutually exclusive concepts by being in the vanguard of the change. In September 2018, for example, IBM officially launched its Blockchain World Wire (BWW) banking payments network.

Blockchain World Wire uses the Stellar block-

Learn at Blockchain for Chemicals

Blockchain technology is much more than cryptocurrency – it holds the potential to redefine supply chains across industry. Blockchain for Chemicals is a two-day conference that will focus on application of this emerging technology in the chemicals and plastics industries. It will explain how it could be used in the future to demonstrate traceability of materials, save time with paperwork, prevent fraud and lost goods in transit, build trust in the supply chain, and provide the plastics/chemical industries with a new tool for growth.

Taking place at the Sofitel Kurfürstendamm in Berlin, Germany, on 12-13 December 2018, the event will bring together industry leaders to discuss the opportunities for the chemicals industry and to explain how early adopters can save time and money for their businesses through fast and secure access to end-to-end supply chain information.

The conference will be chaired by Chris Middleton, an expert author and journalist covering blockchain technology and application. Other key participants include: Peter Busch, Mobililty Lead Distributed Ledger Technologies at Robert Bosch in Germany; Heinz Lux, Senior Digital Strategist at Evonik Industries in Germany; Rafael Cayuela, Chief Economist at Dow Europe in Switzerland; Nicolas Buhmann, Commercial Manager at Maersk in Denmark; and Dr Stefan Guertzgen, Global Senior Director Industry Marketing and Communication for Chemicals at SAP in Germany.

For information about attending the event, taking an exhibition space, or sponsoring the conference, visit the **conference website** or contact Grace Midgley. Tel: +44 (0) 117 314 8111; **grace.midgley@ami.international**.

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2018

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PHOTO: SHUTTERSTOCK

Above: Blockchain is being touted as a means to assess and rank logistics suppliers and create new on-demand options

chain to clear and settle international payments between banks in "near real-time", according to IBM, via a mutually agreed digital currency. Using the new system, two financial institutions agree to use a digital asset as the bridge between any two fiat currencies. That digital asset facilitates the trade and supplies settlement instructions.

Using their own payment system, the first bank converts the fiat currency into the digital asset. IBM's World Wire system then simultaneously converts that digital asset into the second fiat currency, completing the transaction, which is then immutably recorded on the Stellar blockchain for clearing.

The financial services industry has been in the vanguard of exploring blockchain and what IBM terms "programmable money" for some years. In July, for example, a number of European banks, including HSBC and Deutsche Bank, adopted their own blockchain platform – we.trade. Earlier in the year Japan's biggest bank, Mitsubishi UFJ, announced its own blockchain payment platform in partnership with US cloud provider, Akamai.

Linking to business

This summer, Swiss B2B blockchain company Equidato Technologies announced the launch of its SophiaTX blockchain – main net. It is a decentralised computing system that extends traditional enterprise applications, such as enterprise resource planning (ERP), supply chain management (SCM), and customer relationship management (CRM), into the blockchain environment.

The aim of main.net is to use the distributed ledger and decentralised processing structure of the Graphene blockchain to underpin enterprises' operational and management processes "to ensure maximum transparency, traceability, and trust",

Blockchain for Chemicals 2018

Exploring how blockchain technology will transform the chemicals and plastics supply chain

12-13 December 2018,
Sofitel Kurfürstendamm, Berlin, Germany

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Right: GDPR is one of the challenges blockchain technology providers and users will have to address

according to the company.

Meanwhile, DB Schenker, the transport and logistics division of the German railway company Deutsche Bahn, has co-developed a decentralised application for supplier evaluation using the VeChainThor blockchain. Its system aims to rank and track service providers by such factors as the quality of their packaging, transportation times, and overall service.

Blockchain could also underpin an entire integrated transport system in the future without the need for large, costly, centralised control mechanisms, according to a UK research paper from the Transport Systems Catapult (TSC) and the University of Sheffield.

Counting carbon

Another novel venture, which is being billed as the "world's first retail platform that connects consumers to their own carbon footprints" was launched as a pilot programme in the UK by non-profit organisation the Poseidon Foundation earlier this year. The Poseidon retail platform uses blockchain technology to integrate carbon markets into transactions at the point of sale. Poseidon is partnering with ice cream giant Ben & Jerry's to demonstrate the system at one of its stores in London. The back end of the system runs on the Stellar blockchain network.

Environmental fintech company Veridium Labs is also working in the area of carbon offset trading. The company is partnering with IBM to transform carbon credits into fungible (exchangeable or interchangeable) digital assets that can be redeemed or traded on Stellar. In this relationship, Stellar acts as the underlying ledger, IBM as the token manager or broker, and Veridium provides the environmental expertise and industry structure. The resulting 'digital environmental assets' are designed to help companies and investors purchase carbon credits to mitigate their own environmental impacts, and/or hedge against future liabilities.

Also in the summer, the Mobility Open Blockchain Initiative (MOBI) announced its foundation

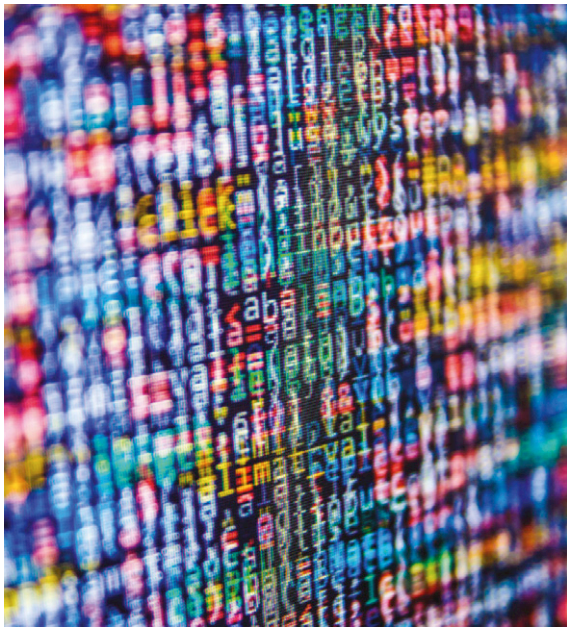

PHOTO: SHUTTERSTOCK

across the transport industry. The aim is to create "a minimum viable network" for the technology that includes car makers such as Ford, GM, Renault, and BMW, public transportation and toll road providers, technology firms such as IBM, blockchain innovators such as Fetch and the IOTA Foundation, academic institutions, startups, and regulatory bodies across the globe.

Blockchain challenges do remain in terms of complexity, cost, energy usage, and, some argue, GDPR compliance. GDPR stipulates that data should be permanently erased from storage systems, should that be requested by a data subject. In theory, blockchain makes that impossible, although various initiatives claim to work around the problem, as **this report** explains.

Taken together, however, it seems clear that the potential that these and other blockchain initiatives are demonstrating to transform supply chains for fragile or sensitive goods in terms of authentication, transport, contracting, finance and payments will see this emerging technology adopted across the chemicals sector in the future. And these initiatives are being backed by some trusted names. Welcome to blockchain!

About the author

Chris Middleton is a leading business and technology journalist and author specialising in information technology, artificial intelligence, machine learning, automation, enterprise policy and technology ethics. He is editor of InternetofBusiness.com, contributing editor to diginomica and Computing, and a former editor of Computing and Computer Business Review. He has also written for The Guardian, BBC, Computer Weekly and The Times. Middleton will be chairing AMI's Blockchain in Chemicals conference, which takes place in Berlin in Germany on 12-13 December 2018.

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10-11 October 2018
Maritim Hotel, Cologne, Germany

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

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COPERION: ZSK EXTRUDER

The ZSK co-rotating twin screw extruder marked its 60th year of production last year. This 26-page brochure details all the features and options available for a machine the company describes as "the forefather" of twin screw extruders.

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Hamburg Marriott Hotel, Hamburg, Germany

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AMI's well-established Agricultural Film conference series continues on 17-19 September 2018, in Madrid, Spain, bringing together agricultural and horticultural cover specifiers, raw material and film manufacturers and agricultural stakeholders.

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WEAR-RESISTANT PLASTICS

This brand new conference will focus on the critical area of polymer tribology and explore how it can open up new applications, particularly in metal replacement. The event takes place in Dusseldorf in Germany on 19-20 September 2018.

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POLYMERS IN FLOORING USA

The second North American edition of AMI's Polymers in Flooring conference takes place in Atlanta, GA, USA, on 20-21 September 2018. It provides a unique forum in which to explore the latest flooring market, materials and technology trends.

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AMI's Compounding World Asia conference returns to Bangkok in Thailand for 2018. Taking place on 27-28 September, the fourth edition of the conference provides a learning and networking opportunity for compounders across the Asia region.

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SELF-HEALING POLYMERS

This brand new conference takes place in London, UK on 8-9 October and will explore the fast-developing world of polymeric materials designed to repair themselves in industries as diverse as automotive, aviation, medical, and oil & gas.

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POLYOLEFIN ADDITIVES EUROPE 2018

Now in its 11th year, AMI's European Polyolefin Additives conference takes place on 9-11 October in Cologne in Germany. It examines commercial developments and technical innovations impacting on the PE and PP additives market.

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SMART PACKAGING 2018

Taking place in Hamburg in Germany, the third edition of AMI's Smart Packaging conference brings together brand owners, retailers, packaging producers, plastics suppliers and technology providers to explore active and intelligent packaging.

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AMI's Field Joint Coating conference returns to London in the UK for its fifth edition on 9-10 October. The two-day event brings together pipeline owners and operators with installers, coaters, contractors and technology providers.

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OIL& GAS NON-METALLICS

AMI's fourth Oil & Gas Non-Metallics conference takes place in London in the UK on 30-31 October. It will explore all polymer-based solutions for O&G industry infrastructure and equipment, including thermoplastics, thermosets, elastomers and composites.

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CONDUCTIVE PLASTICS EUROPE 2018

The third European edition of AMI's Conductive Plastics conference takes place on 6-7 November 2018 in Vienna in Austria. It presents a unique opportunity to learn about the latest technologies for achieving electrical and thermal conductivity.

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PERFORMANCE POLYAMIDES USA

The second US edition of Performance Polyamides will provide a forum for the entire polyamide supply chain to examine the latest advances in polyamides, reinforcements and additives for applications in industries such as automotive and E&E.

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Now in its 12th year, AMI's Wood-Plastic Composites conference will be held in Vienna in Austria on 14-15 November, bringing together expert speakers to discuss the latest product, process and materials developments in the US and European WPC markets.

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Modern Dispersions Inc

Head office location:	Leominster, MA, USA
Date founded:	1967
President	Janos Kozma
Ownership:	Incorporated company
No. of employees:	250
Sales 2018:	€300m (AMI estimate)
Production 2018:	135,000 tonnes (company data)
Plant locations:	Leominster, MA, and Fitzgerald, GA, USA
Profile:	Modern Dispersions Incorporated (MDI) was founded in 1967 in the garage of Janos Kozma, a Hungarian immigrant to the US. However, it quickly outgrew that location and, in 1983, finally settled in its current premises in Leominster, MA. Further growth lead to the opening of a second production site, Modern Dispersions South Inc in 1987 in Fitzgerald, GA. The company now operates 18 productions lines between the two sites producing both compounds and masterbatch.
Product line:	MDI specialises in black masterbatch, concentrates and compounds, producing a wide variety including UV resistant, high-jetness, high loading, blue-tone and low-tint performance grades. It offers customisation of products to meet client specific specifications. The company's product portfolio also includes colour concentrates, conductive compounds and wood composites.
Product strengths:	MDI produces its black masterbatch from carbon black as well as other pigments, such as nigrosine dye and bone black, allowing for use in a broader range of applications and resin systems.

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

Compounding WORLD FORTHCOMING FEATURES

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

October	**November**
Reinforcing additives	Carbon black
TiO_2/white pigments	Bioplastics
Compounds for 3D printers	Active packaging additives
Fakuma 2018 preview	Continuous and batch mixers

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

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Compounding World August 2018
The August edition of Compounding World magazine takes a look at the latest regulatory and technical developments in the world of plasticisers. It also details some innovations in functional fillers, dosing technology and screw and barrel design.

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Compounding World July 2018
The July issue of Compounding World explores the latest colour management systems to control visual factors and effects. The edition also reports on innovations in antimicrobial additives, melt filters and impact modifiers.

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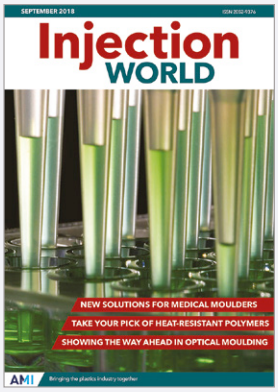

Injection World September 2018
The September edition of Injection World magazine takes a close up look at the latest medical polymers and processing technologies. It also reviews developments in heat-resistant polymers and moulding of optical parts.

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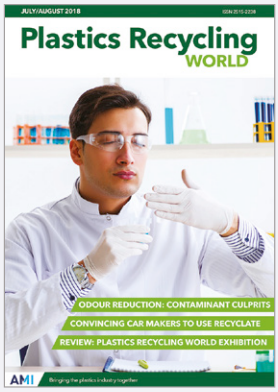

Plastics Recycling World July/August 2018
The July/August edition of Plastics Recycling World looks at technologies to tackle odours. It also explores recycling developments for the car industry and and the latest washing systems innovations. PLUS, reviews of the Plast 2018 and the Plastics Recycling World Exhibition.

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Pipe and Profile September 2018
The September edition of Pipe and Profile Extrusion features medical tubing, window profiles, trenchless pipe technology, PVC additives and news of AMI's first Extrusion Expo in Cleveland, US, in May 2019.

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Film and Sheet September 2018
The September 2018 edition of Film and Sheet Extrusion magazine takes a detailed look at the latest developments in the plasticiser sector. It also reviews innovations in biaxial films, laboratory extruders and downstream equipment.

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	24-28 September	ColombiaPlast, Bogota, Colombia	www.colombiaplast.org
	14-17 October	Pack Expo, Chicago, USA	www.packexpointernational.com
	16-20 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
	7-9 November	Expo Plasticos, Guadalajara, Mexico	www.expoplasticos.com.mx
	26-29 November	All4Pack, Paris, France	www.all4pack.com
	5-7 December	Plastic Japan, Chiba, Japan	www.plas.jp/en
	5-8 December	Plast Eurasia, Istanbul, Turkey	www.plasteurasia.com/en
2019	**5-8 January**	ArabPlast, Dubai	www.arabplast.info
	12-15 March	Pro-Pack Africa, Johannesburg, South Africa	www.propakafrica.co.za
	12-16 March	Koplas, Seoul, South Korea	www.koplas.com
	19-21 March	EU Coatings Show, Nuremberg, Germany	www.european-coatings-show.com
	25-29 March	Plástico Brasil, São Paulo, Brazil	www.plasticobrasil.com.br
	8-12 April	Feiplastic, Sao Paulo, Brazil	www.feiplastic.com.br
	8-9 May	Compounding World Expo, Cleveland, USA	www.compoundingworldexpo.com
	21-24 May	Chinaplas, Guangzhou, China	www.chinaplasonline.com
	21-24 May	Moulding Expo, Stuttgart, Germany	www.moulding-expo.com
	18-21 September	T-Plas/Tiprex, Bangkok, Thailand	www.tplas.com
	16-23 October	K2019, Dusseldorf, Germany	www.k-online.com

AMI CONFERENCES

19-20 September	Wear-Resistant Plastics, Dusseldorf, Germany
20-21 September	Polymers in Flooring USA, Atlanta, GA, USA
27-28 September	Compounding World Asia, Bangkok, Thailand
8-9 October	Self-Healing Polymers, London, UK
9-11 October	Polyolefin Additives, Cologne, Germany
6-7 November	Conductive Plastics, Vienna, Austria

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