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Compounding WORLD

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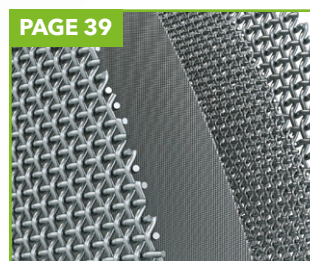
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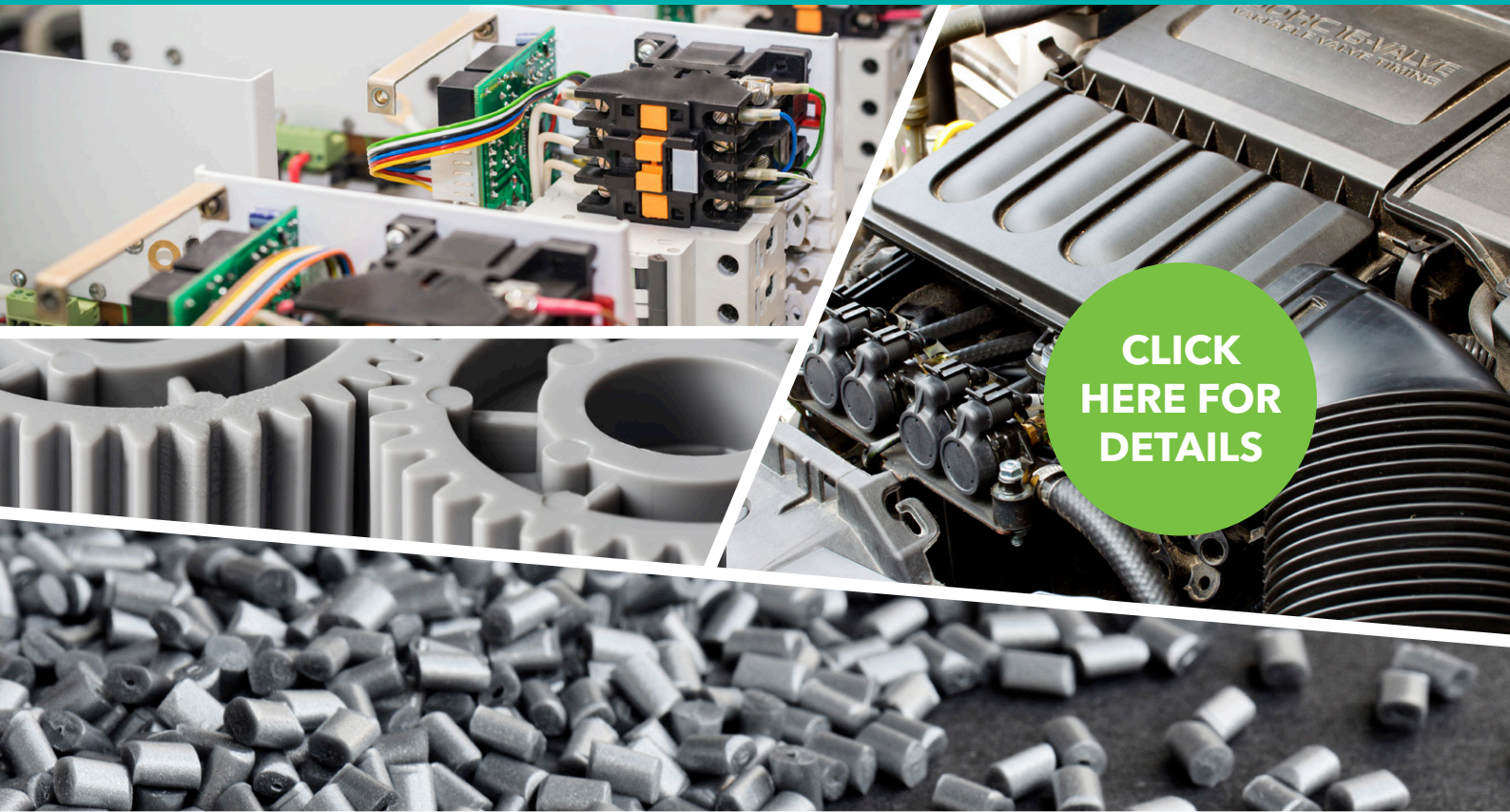
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Lanxess adds more compounding capacity at Krefeld-Uerdingen

PHOTO: LANXESS



New compounding capacity at its Krefeld-Uerdingen will start up next year

Lanxess is to build another compounding plant at its Krefeld-Uerdingen site in Germany to produce Durethan PA and Pocan PBT technical compounds. The company said work will start on the "mid double-digit million-euro" investment in Q4 of this year with production expected to commence in the second half of 2019. Capacity was not disclosed.

This latest investment at the Krefeld-Uerdingen site follows the start up of a new line for production of specialty compounds in March this year. "Krefeld-Uerdingen is our central production platform for high-performance plastics, especially for the European markets. The expansion will enable us to better serve the continuing high demand from this market region in the future," said Michael Sobel, Head of the Lanxess High

Performance Materials business unit.

Lanxess Management Board Member Hubert Vink said the high performance plastics unit is central to the company's growth strategy. "By expanding capacity, we are further strengthening our position as a provider of innovative product solutions for modern mobility. At the same time, we are making even better use of the potential of our integrated value chain for these products," he said.

In addition to compounding, Lanxess polymerises PA6 at Krefeld-Uerdingen. It also produces PA6 at Antwerp in Belgium and produces PBT and compounds at Hamm-Uentrop in Germany. The company also compounds at Porto Feliz in Brazil, Jhagadia in India, Gastonia in the US, and Wuxi in China.

> www.lanxess.com

Volvo puts PCR in spotlight

Borealis and Borouge said its Daplen PP compounds containing post-consumer recycle (PCR) materials were used in five components in a special plug-in hybrid Volvo SUV unveiled at the recent Ocean Summit event in Gothenburg, Sweden, which was organised to "focus attention on innovative solutions to address the crisis of polluted oceans".

The XC60 T8 model was intended to highlight Volvo's ambition to use sustainable materials for at least 25% of its plastics in the future. It included more than 170 components where conventional plastics had been replaced with lightweight, recycled



material equivalents.

Borealis supplied near 10% of the 60kg of PCR resin used in the vehicle. Daplen MD325SY was used in an outer fan belt cover while Daplen ME225SY was used in the belt covers on the D-pillar upper, the tailgate panel window frame and the lid warning triangle.

Both contain 25% PCR.

Borealis launched its portfolio of Daplen PP compound solutions including PCR content for automotive applications in 2014. It claims the grades match virgin materials for performance and cost-efficiency.

> www.borealisgroup.com

Romira launches PA blend

Rowa Group subsidiary Romira has extended its PA product range with a new Romiloy blend of PA6 and PP, which is said to offer the mechanical properties of PA6 but with improved dimensional stability due to its reduced water absorption. Incorporating PP also makes them less costly.

The company said that the new Romiloy blends provide a higher notched bar impact strength than PA6 in the dry-as-moulded state and display a more consistent mechanical property profile after conditioning.

> www.romira.de

Westlake to buy Nakan for \$265m

Houston-based Westlake Chemical has issued an exclusive and binding offer to acquire global compounding business Nakan from its private equity owner OpenGate Capital for \$265m.

The offer has been made in this way to enable Nakan to carry out consultation with works councils in France before entering into a negotiated, mutually binding purchase agreement. The acquisition is expected to close by early 2019, subject to receipt of regulatory approvals.

"The combination of Nakan with Westlake's existing compounding business will present an excellent strategic fit. It will

allow us to expand our compounding business globally and add important speciality products and technology to our existing portfolio," said Albert Chao, Westlake's President and CEO.

Westlake is an international manufacturer and supplier of petrochemicals, polymers and building products. Its downstream products include PVC suspension and speciality resins, compounds and building products, such as pipes, fittings and speciality components, windows, fence, decking and film.

Nakan is headquartered in France and has production facilities there and in China, Germany, Italy,



Westlake Chemical President and CEO Albert Chao

Japan, Mexico, Spain and Vietnam, plus a research facility in France and application lab in the US. It makes PVC and TPE compounds and stabilisers, which are used mainly in automotive, construction

and medical applications. The company generated sales of around \$300m in its most recent financial year.

OpenGate acquired Nakan in 2015 as part of its acquisition of a 70% majority stake in Ivy Group, then known as Kem One Innovative Vinyls, from administration. The company said Nakan had been transformed during its period of ownership and had achieved a high level of growth.

Ivy Group, which also includes PVC profile maker Alphacan and piping systems firm Omniplast, generates annual sales of around €350m. Alphacan and Omniplast remain under OpenGate ownership.

➤ www.westlake.com

Birla invests in Spain

Carbon black manufacturer Birla Carbon Spain (BCS) has announced an investment of €5m that will increase capacity at its Gajano site from 80,000 to 95,000 tonnes/year.

The investment includes new equipment in one of its manufacturing lines and the re-engineering of other critical equipment to improve productivity, sustainability and energy efficiency. The investment was announced at the official opening of a new administrative office and laboratory at the site.

➤ www.birlacarbon.com

Silvergate offers bioplastic compounds from Floreon

UK masterbatch maker Silvergate Plastics has announced a manufacturing partnership with Floreon-Transforming Packaging to produce its specialty PLA-based bioplastic, which is said to provide an alternative to PS for production of single-use packaging and food service items.

The Floreon material was developed with the University of Sheffield and uses a patented combination of additives to create a rigid material with a good surface finish that is claimed to be four times tougher than PLA and processes with 40% less energy consumption.



Floreon bioplastic is intended to replace PS in single-use applications

According to Silvergate the new material is designed to outperform both competing bioplastics and conventional plastics and is compostable.

"When we were approached by Floreon, we quickly realised that this technology can offer a

highly credible alternative to other plastics. We have therefore collaborated with Floreon, as we have the capability and capacity to maximise its commercial potential," said Silvergate CEO Tony Bestall.

➤ www.silvergate.co.uk
➤ <http://floreon.com>

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Booths selling fast for new free-to-attend US plastics shows

More than 50% of booths have already been sold for a major new free-to-attend plastics industry event that will take place at Huntington Convention Center in downtown Cleveland, Ohio, USA, on 8-9 May 2019. Organised by AMI, the event will include three focused tradeshow - the Compounding World Expo, the Plastics Extrusion World Expo and the Plastics Recycling World Expo.

More than 120 companies have already booked their booths at the three shows. The latest leading firms to join the event include Azo, Chemours, Clariant, Colines, Exxel Polymers, Konica Minolta, Nordson, Oden Technologies, Reifenhäuser, Starlinger, Universal Dynamics,



Cleveland's Huntington Convention Center hosts three brand new plastics shows next year

and Wacker.

They join an impressive array of existing exhibitors including Addex, Advanced Blending Solutions, Bausano, Beier, Brabender, Buss, Cabot, Coperion, CPM Extrusion, Cumberland, Davis-Standard, Dr Collin, Doteco, Dover Chemicals, Entek, Farrel Pomini, Ferro, JSW, Kaneka, Leistriz, Luigi Bandera, Macchi, Milliken,

Modern Dispersions, NFM, NGR, Omya, Piovan, PTI, Struktol, Toyota Tsusho, Windmüller & Hölscher, Zeppelin, Zoltek and many more.

"We are delighted by the industry's response to these new tradeshow," said Andy Beevers, Events and Magazines Director at AMI. "The two large halls at the Cleveland Convention

Centre are filling up quickly, and we've seen strong growth in interest in recent weeks as more market leaders book their booths."

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

Online registration for free tickets will go live on 26 November 2018; you can register your interest in advance at the website below.

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



From nets to surf

DSM and Thai watersports company Starboard are working together to collect and recycle discarded PA fishing nets collected from the Indian Ocean and Arabian Sea into parts for new surf and paddle boards.

DSM upcycles the net waste into an Akulon RePurposed grade, which is used for production of fins, fin boxes, SUP pumps and other structural parts that Starboard sells under the NetPositive! brand. DSM said the project contributes to its sustainable development goals and provides work for local communities in India.

The UN has estimated that some 640,000 tonnes of 'ghost fishing nets' end up in the world's oceans annually, accounting for around about 10% of marine plastic waste.

> www.star-board.blue

> www.dsm.com

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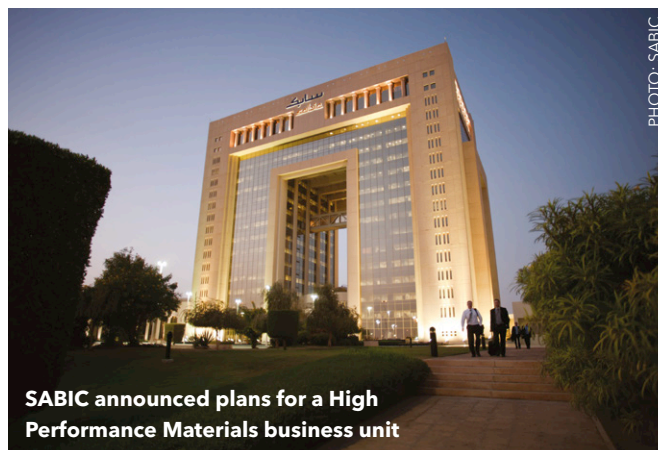
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SABIC performance unit set up: plans to merge with parts of Clariant

Sabic has signed a memorandum of understanding (MoU) with Clariant that will ultimately enable the formation of a new 'High Performance Materials' business. As part of the plan, Sabic will turn parts of its Specialties business - the Noryl and Ultem resins and LNP compounds and copolymers - into a stand-alone business in order to prepare it "to participate in further organic and inorganic growth".

The process is anticipated to take until the end of 2019. If the transaction with Clariant then proceeds, the separated businesses would be merged with Clariant's additives and the "high value" parts of its masterbatch division by the end of 2020. This includes its colour, high temperature resins and healthcare activities.

Sabic has recently acquired a 24.99% stake in Clariant but has stressed



SABIC announced plans for a High Performance Materials business unit

PHOTO: SABIC

that there are no plans for a full merger.

Yousef Al-Benyani, CEO of Sabic, said: "Uncoupling the Specialties business will allow the unit to achieve accelerated organic and inorganic growth as aligned with our broader corporate strategy of creating a sizeable, world class specialties company."

Clariant's remaining plastics and coatings businesses will not be included in the new High Performance Materials unit. Clariant said in a statement

that these businesses, which include pigments, standard masterbatches and medical specialties, will be divested by 2020.

"Despite being well positioned and having significantly increased their profitability over the past years, the businesses to be divested do not match the Group's criteria to differentiate through innovation in higher growth and higher profitability areas," the company said.

> www.sabic.com

> www.clariant.com

NEWS IN BRIEF...

Invista is to add 40,000 tonnes/year of PA66 capacity at its plant at the Shanghai Chemical Industry Park (SCIP), which currently has a capacity of 150,000 tonnes/year. Construction is targeted for mid-2019 and production will begin in 2020.

www.invista.com

Penn Color International has added about 70% to its production space at its site in Venray, in the Netherlands, adding new lines, expanded labs, storage and office space and a new design centre. The move increases the size of the facility from 6,500 to 11,000 m². The US-headquartered company set up the Venray facility in 1992.

www.penncolor.com

Inovyn has announced plans to increase production of general-purpose PVC at its site in Jemeppe, Belgium, by 200,000 tonnes/year. The first phase of the programme is due to be operational in 2020.

www.inovyn.com

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Pentafin is to list its **Piovan Group** business on the Italian MTA stock exchange. Around 35-40% of the shares are expected to be offered, with the process expected to be launched by the end of 2018. During the six-month period to the end of June this year, Piovan generated sales of €127.4m.
www.piovan.com

Silicones giant **Momentive** and an investor group comprised of SJL Partners, **KCC Corporation** and **Wonik QnC** Corporation have entered into a definitive merger agreement which will see it acquired for a sum of \$3.1bn, including assumed net debt.
www.momentive.com
www.kccworld.co.kr
<http://www.wonikqnc.com>

Eni subsidiary **Versalis** has won an Italian court-ordered bidding process for the insolvent Mossi & Ghisolfi's Group's 'green' biomass-based chemical activities.
www.versalis.eni.com

Italian machinery trade balance weaker in H1

Italian imports of plastics and rubber processing machinery grew by 23% in H1 2018 compared to the same period last year while exports edged only fractionally up. This meant the trade balance fell by 7% and is attributed to "the lacklustre performance heralded in the early months of the year", according to the country's plastics and rubber machinery trade association Amaplast.

The plastics machinery industry was still over €1bn in the black in total, but €14m in the red for injection moulding machinery. "The dynamism of purchases from abroad may be interpreted as renewed faith in the domestic market, mainly due to investment incentives that are likely to be renewed and naturally hoped for by businesses in the industry," Amaplast said in its analysis.

Strongest growing import sectors included injection moulding machines (+31%), blow moulding machines (+75%), flexographic

printers (+111%) and moulds (+12%). This was driven mainly by strong demand from the packaging sector, which grew by 14% last year and has continued on a strong growth path in 2018.

Amaplast said Germany remains the largest exporter of plastics machinery to Italy and widened its lead over China in H1.

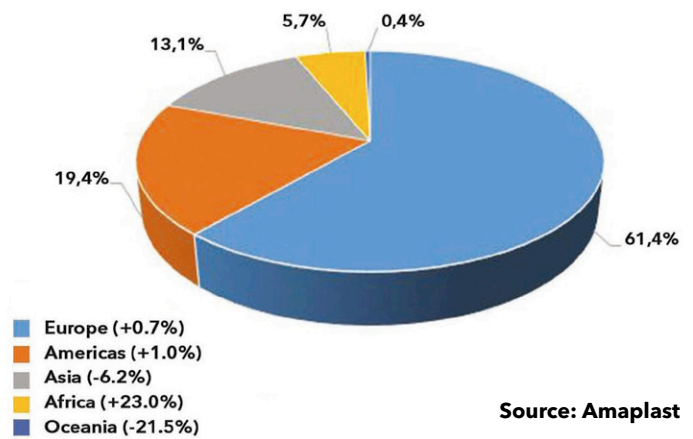
Europe remains the largest export market for Italy's plastics machinery firms, accounting for 61% of the total, although export sales were static year-on-

year. The NAFTA countries were in second place and saw a 7% increase in sales. Russia, which had a very strong 2017, saw a major decline. Sales to Asia, Oceania and the rest of Latin America were down.

According to Amaplast president Alessandro Grassi, its members' July order books were stable to slightly up on both June 2018 and July 2017. "This gives us reason to hope for a rebound in production and exports in the last quarter of the year," he said.

www.amaplast.it

Italian plastics machinery exports by destination (% share and Δ% H1 2018/H1 2017)



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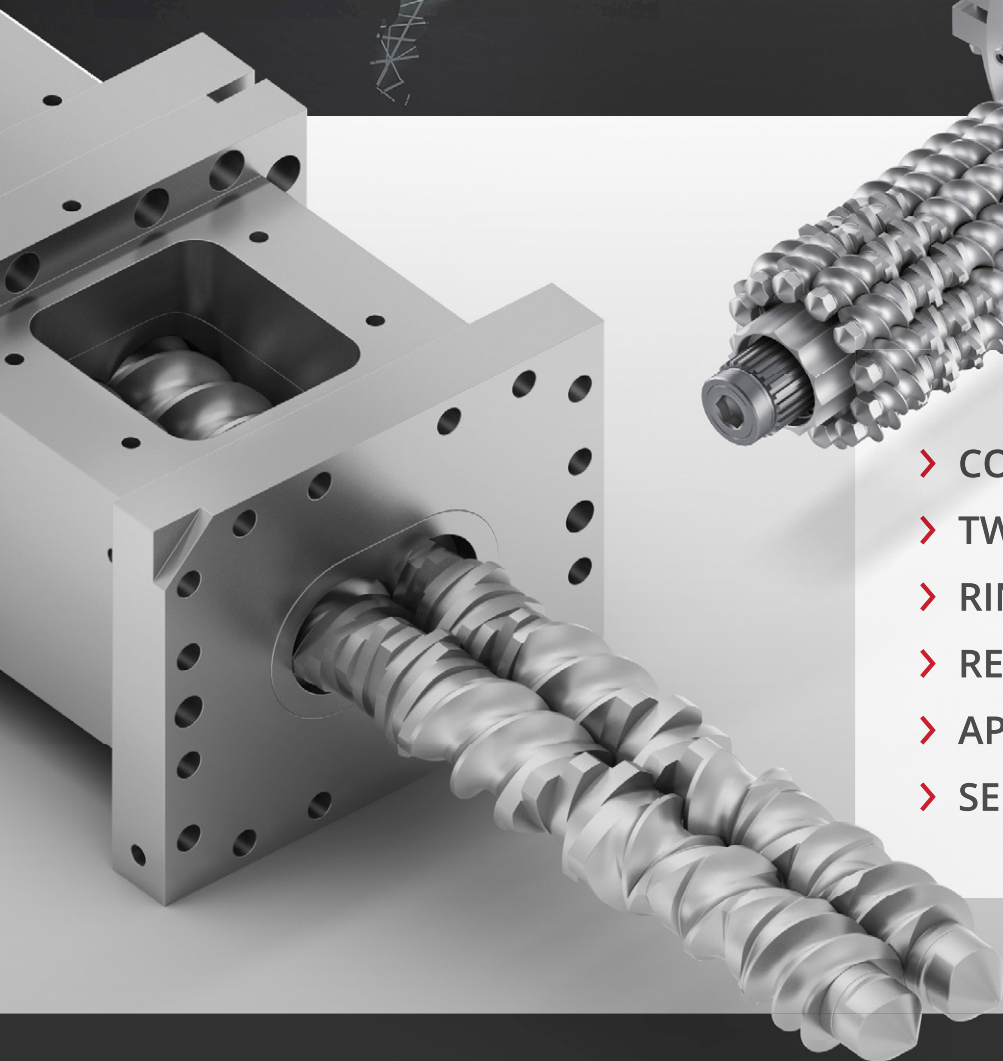
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Univar to buy Nexeo; plastics sale on cards

Univar is to acquire US-based distributor Nexeo in a deal valuing the business at around \$2bn. It has taken on external advisors to evaluate strategic alternatives for Nexeo's Plastics business, which may include divestiture. That process is expected to be completed alongside the close of the transaction, which is scheduled for Q1 2019.

"This transformational combination is designed to create the premier global chemical and ingredients distributor," said Univar President and CEO David Jukes. "Together we will drive growth and shareholder value with the largest North American sales force



Univar President and CEO David Jukes

in chemical and ingredients distribution, the broadest product offering and the most efficient supply chain network in the industry."

Nexeo's Plastics business distributes thermoplastic resins and other products to OEMs, moulders and design

firms around the world. It would account for less than 10% of the combined companies' earnings. Univar, said disposal would be "consistent with its focus on chemicals and ingredients distribution".

The acquisition is subject to the approval of both sets of shareholders and other customary conditions. It includes the assumption of Nexeo's debt and other obligations. Univar said the deal would be accretive to earnings and cash flow in the first full year post-closing and would generate \$100m of run rate cost savings annually by the third year.

> www.univar.com

> www.nexeosolutions.com

Ineos joins chemical recycling

ReVital Polymers, Pyrowave and Ineos Styrolution have announced a strategic partnership to recycle post-consumer polystyrene packaging from North American households and other sources.

The move was announced at the recent G7 Ministerial Meeting on Working Together on Climate Change, Oceans & Clean Energy.

ReVital Polymers will install Pyrowave's catalytic microwave depolymerisation (CMD) technology at its facility in Sarnia, Ontario, Canada. This will convert sorted PS to a liquid containing monomers, which Ineos Styrolution will convert into new PS resin.

According to the partners, the CMD technology makes PS "infinitely recyclable, even with colour additives and food residue".

> www.revitalpolymers.com

> <https://pyrowave.com>

> www.ineos-styrolution.com

Saudi Aramco takes over Arlanxéo

Saudi Aramco is to acquire Lanxess's stake in Arlanxéo, the 50-50 joint venture in synthetic rubber the two companies founded in 2016. The move should take place by the end of 2018.

Arlanxéo is based in Maastricht in the

Netherlands. It had sales of around €3.2bn in 2017 and employs about 3,800 people at 20 sites in nine countries. It produces high performance rubber for use in automotive, tyres, construction, and oil and gas.

> www.lanxess.com

PA compound firms head to Pittsburgh

A wide range of PA producers and compounders will meet in Pittsburgh, Pennsylvania, USA, next month for the Performance Polyamides 2018 conference.

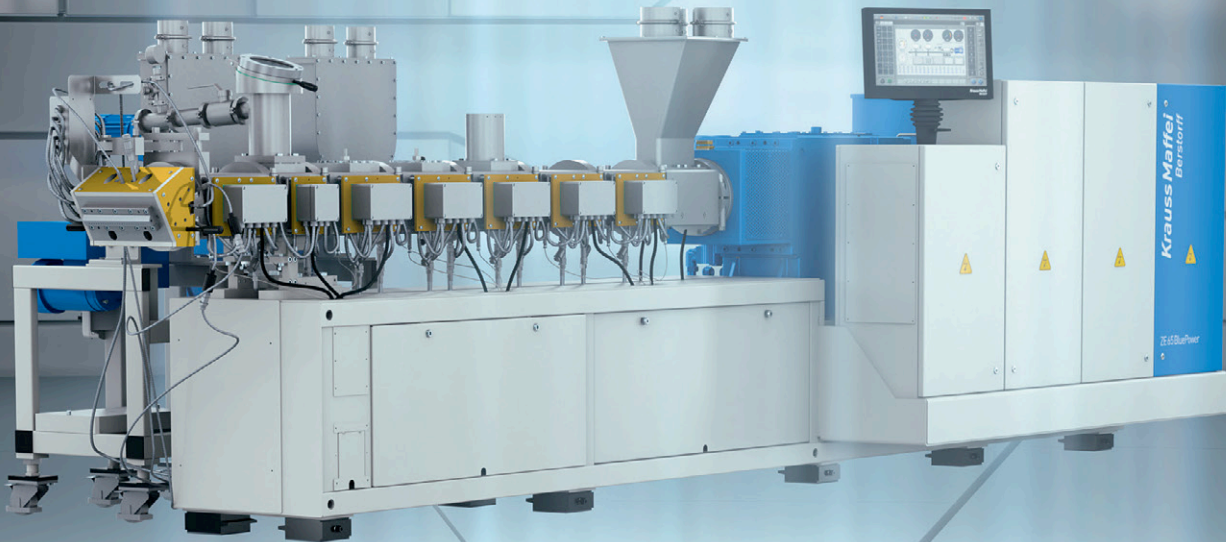
Organised by AMI, the event takes place on 6-7 November and will build on the considerable success of the European Performance Polyamides conference, which attracted 150 leading industry players to Cologne, Germany last month.

Companies that are already signed up to attend the Pittsburgh conference include AdvanSix, Arkema, Asahi Kasei, DuPont, Evonik, Invista, KWI Polymers, Lanxess, Mitsubishi Gas Chemical, Mitsui Chemicals, NYCOA, RTP and Solvay Engineering Plastics.

The two-day conference features 20 expert speakers and will be chaired by Andy Beevers, AMI's Events and Magazines Director. "This conference is the ideal forum to learn about

exciting developments in high-performance polyamides that are opening up high-value applications and presenting new opportunities for metal replacement," he said.

For an up-to-date list of attendees and more information about the event, please contact Emily Renshaw at emily.renshaw@ami.international. The conference website including the full programme and online booking is at: <http://bit.ly/PPUSA18>



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From kneaders to multiple-screw extruders, there are alternatives to the twin screw extruder in compounding. Mark Holmes looks at some new developments in the area

Compounders - the alternative options

The twin screw extruder may be the workhorse of the compounding industry today but there are alternatives. Kneader extruders are well established in the market, while conventional single screw machines can also be turned to specific compounding tasks. Other compounding extruder options include designs with up to twelve screws, while planetary rollers extruders have a role in niche applications and screw-within-screw types have been developed to meet particular market needs. The common driver behind the development of all these alternatives appears to be the need to better handle the most challenging compounding demands.

"Increasing demand for end products with improved properties is driving polymer development towards higher strength, improved scratch resistance, improve flame retardancy, better UV resistance, less weight and more resource saving," says Dr François Loviat, Head of Process at **Buss**. "As the tuning of compounds properties through polymer chemistry is already widely exploited,

further improvement of those properties has to be increasingly achieved by mixing in more and more sophisticated, sensitive and expensive additives. In our opinion, this is where intensive mixing of sensitive ingredients supersedes the requirement for ever higher throughputs. This kind of reliable mixing and precise control of the temperature profile are traditional strengths of Buss kneader technology."

Multifunctional demand

Loviat says the trend towards smaller production lots and more frequent product changes also continues. "This increases the demand for multifunctional compounders, and compounding lines capable of processing a wide range of formulations without changes of the process geometry. In addition, new health or environment related regulations generate new constraints to the compounding industry, such as the ban of hazardous additives, and replacement of established materials through less efficient, more sensitive and difficult to handle ones, for example, glass fibres by

Main image:
The **Compeo** extruder from **Buss** features a new screw design supporting elements with between two and six kneading elements

natural fibres, nanoparticles to improve properties, stabilisers and plasticisers. Another trend is that computer aided modelling of the compounding process will positively influence R&D work and customer trials."

Wolfgang Walter, Buss Head of Design and Engineering, also highlights specific issues faced by compounders. These include the treatment of low bulk density additives that tend to limit throughput rates, while extremely high filler loadings challenge torque and temperature profiles. In addition, there are challenges with the dispersion of new fillers, such as nanoparticles in highly viscous matrices such as rubber. Finally, new regulations in the fields of health and the environment require production technology to be adapted or to be replaced by new technologies developed to cope with the new constraints.

Overcoming limitations

"We are overcoming these previously conflicting compounding tasks, such as gentle mixing at a high specific throughput, by introducing a compounder series featuring screw elements with 2-6 rows of kneading flights," says Max Guntern, Leading Process Engineer at Buss in charge of new development. "Other technical developments include overcoming feeding limitations by a combination of improved venting and use of twin-screw side-feeders to feed fluidising materials. We have also solved potential temperature issues during pressure build-up for pelletising by introducing a conical, counter-rotating twin screw discharge. Finally, we have improved the lifetime of wear parts by using new material combinations, reduced screw RPM and further mechanical adaptations."

Buss introduced its Compeo compounder series at the recent NPE, Plast and Compounding World Expo exhibitions. The company says the development of the machine series was preceded by a market survey involving 80 compounding companies in Europe and North America. This allowed the compilation of key industry requirements that have been worked into the design of this new kneader series.

The Compeo series covers an extremely wide range of applications, ranging from traditional shear and temperature-sensitive compounding of PVC and cable compounds, through reinforced PE and PP to high temperature engineering plastics. The design is said to consolidate the benefits of its previous kneader series, including robustness, high performance, operational safety, easy handling, application flexibility and reduced maintenance cost, in a single modular

compounder series. This is achieved through a number of new developments including novel screw geometries and state-of-the-art control system. The Compeo also comes with a new discharge concept - a conical, counter-rotating low rpm twin-screw unit with degassing option.

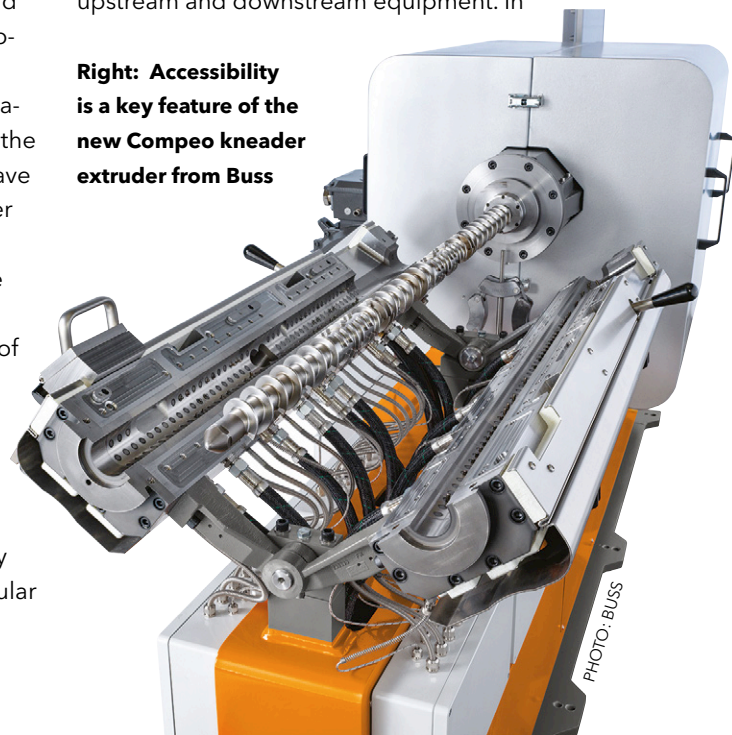
The modular design allows the new machine to be configured for specific compounding applications. Typically, polymer, additives and some fillers would be fed through a first intake to a processing zone. Molten polymer and additives are mixed in a melting zone. Further fillers are added in a second feed zone and distributed homogeneously into the downstream mixing zone. A degassing zone, allows volatiles and air to be removed before transfer to the discharge unit. The specific compounding application defines the processing length, type and number of feeders, temperature, degassing and process geometries.

Niche opportunities

Opportunities for kneading technology exist in niches, according to Hans-Ulrich Siegenthaler at the consultancy **Kneading Experts**. These include smaller and tailor-made lots, recipes with high variability and raw materials choices, integrated solutions for recycling (the Cradle to Cradle concept), integration of Industry 4.0 concepts for compounded products, and addressing higher requirements due to stricter regulations.

Siegenthaler adds that all these trends can cause lower availability due to an increased number of changeovers, with a greater availability of lines required and often whole plants required for a task. This can be addressed by increased flexibility and modularity concepts. These include quick release systems for all connections on the extruder and upstream and downstream equipment. In

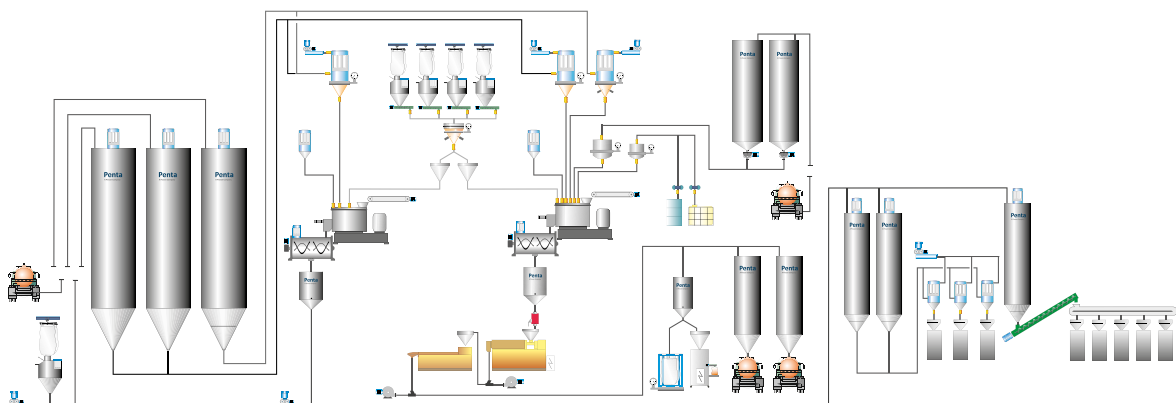
Right: Accessibility is a key feature of the new Compeo kneader extruder from Buss



Advanced feeding solutions for forward thinking compounders



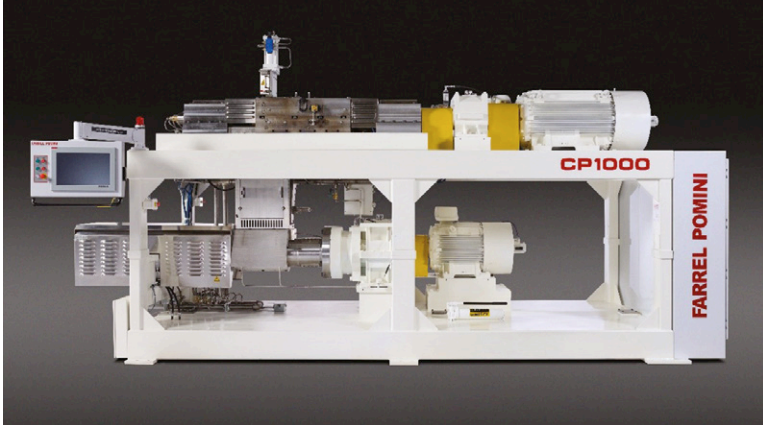
- Flexibility and compactness
- Simplicity of use
- Easy to clean - Easy to restart
- Modular engineering design
- Lowest total cost of ownership



Penta
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PHOTO: FARREL CORP



Above: Farrel says its CP Series II Compact Processor is particularly suitable for processing highly filled compounds

in addition, operators of compounding plants now expect integrated solutions from machinery manufacturers due to an ongoing shortage of internal expertise in these specific areas.

Recent projects that Kneading Experts has been involved with include the integration of bio-based raw materials in existing compound families and supporting the implementation of CPR compliance regulations for cable manufacturers. The company also participates in scientific programmes at German universities and institutes, which work on modelled and simulated individual process steps and the full-integrated systems for new compounding processes.

Compact solutions

Farrel Pomini offers its CP Series II Compact Processor as an alternative technology for the polymer compounding industry. The company says that the unit, which contains an independently controlled continuous mixer and extruder system, is designed specifically for dispersion of highly filled, highly pigmented materials. The Compact Processor is also able to process highly abrasive materials and is designed to support various types of feeding systems and pellet formation components for versatility. It is available in standard and extra-long (XL) configurations to meet a diverse range of processing requirements.

Key machine features include the use of two counter rotating, non-intermeshing rotors, which are available in various pairings and geometries, and the company says that the mixing chamber barrel incorporates a number of features to enhance processing performance, operation and maintenance. The unit includes a hot feed pumping extruder that provides minimal residence time while individual drive motors for the mixer and the extruder mean mixing can be optimised independently of pumping. The control system can be set in automatic mode or adjusted manually during operation.

Right: CPM Extrusion's RingExtruder is a 12-screw co-rotating design with good mixing and degassing performance

The RingExtruder RE, from **CPM Extrusion Group**, is a 12-screw shaft co-rotating multi-screw extruder that has been developed for challenging mixing and degassing work. The machine is built on technology developed by Extricom of Germany, which CPM acquired in 2017, and is currently being introduced into several markets. According to CPM, the RingExtruder RE has been created to develop new business opportunities in areas such as continuous compounding of rubber or recycling. The company says that models are built according to customer's specifications and process requirements.

In continuous mixing of rubber compounds for high performance tyre and green tyre applications, for example, the mixing and degassing capabilities of the RingExtruder are claimed to offer process advantages and enhanced product performance in terms of grip, rolling resistance and durability. In addition, the machine reduces the number of mixing steps for tyre tread mix preparation and lowers operating costs of mixing operations. Currently, CPM says it has more than 10 lines worldwide installed for continuous compounding of rubber.

Flake recycling

A further application for the RingExtruder RE is recycling of PET bottle flake, where rising demand for PET recycling capacity is leading to new recycling approaches. The RingExtruder RE is said to be well suited for projects requiring R-PET flake processing, melting and decontamination where it feeds R-PET melt into a virgin melt stream. This meets brand-owner requirements in terms of economy of scale and quality of the final virgin/ recycle mix.

Other manufacturers of multiple screw extruders include **Keime**, which has developed a triple screw extruder for producing polymer blends, grafting, reactive extrusion and dispersing additives in powder form into polymeric melts. Due to short-



PHOTO: CPM EXTRUSION

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Tie Duan, R&D Manager, Construction Specialties, Inc.



ENTEK's Al Bailey (left) with Tie Duan at Construction Specialties' Fort Valley, GA plant
Inset photo: Construction Specialties team from Fort Valley, GA and Pacy-sur-Eure, France

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The German Soccer Museum in Dortmund features custom graphic wall covering produced by CS. Photo courtesy of Construction Specialties, Inc.

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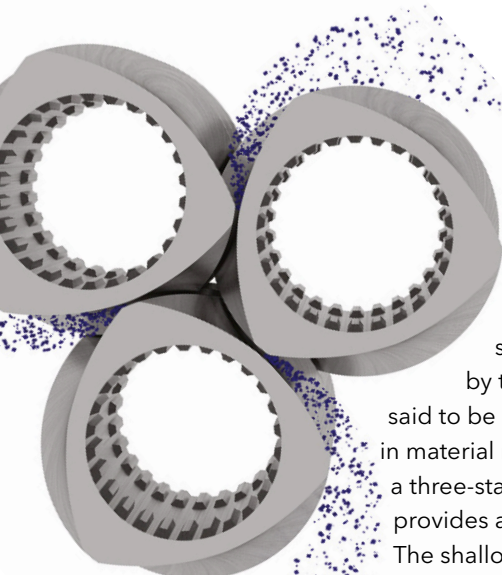


PHOTO: KEIMEI

Above: Schematic showing the layout of Keimei's triple-screw extruder, which is said to be particularly effective for reactive processing

ened process lengths for plastification, the materials are exposed to shorter residence times in the system and potential material damage is avoided.

Keimei says that materials are fed at the feed point via a nine screw-thread spiral groove formed by three screw element units - this is said to be equivalent to a 1.5 times increase in material mixing effectiveness compared to a three-start twin screw extruder, which itself provides a doubly improved mixing action. The shallow groove structure and three-point shear configuration of the system is also claimed to achieve earlier onset of shear and consequently plasticising action and smoother degassing. In addition, the "four-state variability" feature of the gearbox means that the phase of three of the screw shafts can be changed to adapt the system to different feeding materials.

Inside the barrel, the amount of shear produced per screw shaft rotation is tripled when compared with a three-start-screw twin screw extruder, the shear force introduced into the processing material is 1.5 times higher, and the mixing effect across the same cross-sectional area is three times that of a three-start-screw twin screw unit. The company says it has achieved good degassing results as the surface area of the material exposed on the screw surface (the gas exchange area) is 1.5 times higher than that of a three-start twin screw extruder. And the "stirring" effect is three times higher in the cross section.

Planetary roll

The latest addition to the **Entex** planetary roller extruder is a degassing reaction module - Ermo. The company says that this offers a significantly increased process chamber volume in comparison

to the conventional cylinder assembly. It has been developed specifically for degassing applications, where free large-scale process surfaces and large flow cross-sections are important. The unit maximises these aspects without significantly changing the size of the extruder, the company says.

Entex adds that Ermo is also an advantage when used for the addition of fillers with a particularly low bulk density, where the largest possible free cross sections are needed. A further application area is in reactive extrusion, where extending residence time or enlargement of the reaction surface or volume are required. Like all other components of the modular Entex system, several Ermo units can be used in series or at separate positions in a production line. In addition, there are various other options such as side feeders, injection and degassing openings.

Recycling concepts

The **Gneuss** Processing Unit (GPU) - which comprises an MRS extruder for devolatilisation and decontamination in combination with a Rotary Filtration System and online viscometer for intelligent dynamic viscosity control - is widely used for reprocessing bulky PET waste, such as post-consumer bottle flake and industrial waste from fibre and film manufacture without pre-drying. Although originally developed specifically for PET, the MRS extruder component is now also running in polyolefin and nylon applications, and is being tested on a range of other materials and applications.

Gneuss says that the combination of single screw extruder with a multiple screw section means that the MRS extruder is sturdy and particularly well suited for recycling applications. According to the company, the MRS extruder permits processing of PET without pre-drying by using a simple water ring vacuum system. This is achieved by means of its unique processing section. Based on a conven-

DS aims to cut extruder downtime

Compounders operating **Davis-Standard** single or twin screw extruders and compounding systems can now cut potential downtime risk using a new continuous monitoring system - Activ-Check.

The system offers real-time predictive maintenance by providing early notification of potential extruder failures via e-mail or text. Continuous monitoring covers key

parameters such as extruder reducer, lubrication system, motor characteristics, drive power unit, barrel heating and cooling, according to the company.

The system is said to be easy to operate. Users simply touch a location to view details or use on-screen set-up for e-mail or text notifications.

Vibration sensors on the extruder

reducer provide data regarding the condition of the gears, bearings and lubrication system. The extruder motor is supplied with combination temperature sensors and vibration sensors. The reducer lubrication system (if provided) on the machine installation, includes pressure, flow and temperature sensors to indicate system performance.

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tional single screw extruder, the Multi Rotation Section is effectively a drum containing eight satellite single screws driven by a ring gear and pinion transmission. The 'barrels' cut into the drum are approximately 30% open and provide optimum exposure of the melt.

Energy savings

The company says the design results in devolatilising performance that is approximately 50 times greater than that of a conventional single screw extruder and at a vacuum of only 25-40 mbar. By avoiding the need for a deep vacuum system and pre-drying, the MRS provides an economically efficient alternative to conventional technologies. It also offers energy savings, a simple and rugged design, small footprint, ease of operation and low maintenance, processing flexibility and good melt quality and homogeneity.

The Gneuss MRS recycling process has now received approvals for use in food packaging applications from around the world. The first *Letter of Non Objection* from the US FDA was achieved in 2009, but now the MRS extruder has received a large number of approvals for processing up to 100% post-consumer and industrial polymer waste for food contact products. In Europe, the Gneuss recycling process has passed the EFSA challenge test for the processing of 100% post-consumer PET. This year, Gneuss obtained food contact approval from Anvisa in Brazil while the Gneuss recycling process has also achieved standards set by the Colombian food safety agency Invima and its Argentinian counterpart Senasa.

According to the company, the devolatilisation



performance of the Gneuss MRS extruder means that contaminants such as oils and other harmful volatiles and odours are efficiently removed from washed PET scrap without the need for pre-drying or any other heat treatment prior to extrusion. This reduces investment and energy costs as a whole inflexible process is eliminated, but the risk of damage to the material is also prevented. In addition, the polymer is processed gently in the low shear MRS extruder so the final product has very good colour (displaying low yellowing) and transparency.

Above: The devolatilising performance of the Gneuss MRS extruder makes it a good option for processing recycled resins

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Tuesday, November 6, 2018

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

SESSION 1: EXPLORING FUTURE OPPORTUNITIES IN AUTOMOTIVE MARKETS

- 9:40 **Applications of new long-chain polyamide compounds for automotive applications**
Dr. Shailesh Doshi, Technical Fellow,
DOWDUPONT (DUPONT CANADA), Canada
- 10:10 **How can companies capitalize on the electrical and gasoline vehicles market utilizing innovative polyamide composites**
Mr. Boney A. Mathew, President & CEO,
MATHSON COMPOSITE GROUP, United States
- 10:40 **Polyamide applications and future uses in e-mobility**
Dr. James Mitchell, Global Automotive Market Director,
SOLVAY ENGINEERING PLASTICS, France
- 11:10 Coffee break

SESSION 2: PUSHING THE BOUNDARIES OF POLYAMIDE PERFORMANCE

- 11:50 **Expanding the windows of processing and applications for aliphatic polyamides**
Dr. Isaac Iverson, R&D Director, New Business Development,
INVISTA, United States
- 12:20 **Advances in semi-aromatic polyamide for industrial applications**
Dr. Nobuhiko Matsumoto, Research Manager,
MITSUBISHI GAS CHEMICAL COMPANY, Inc., Japan
- 12:50 Lunch
- 2:10 **New polyamide resins - expanding the boundaries of polyamide performance**
Mr. Pratik Shah, VP New Business Development / R&D,
NYLON CORPORATION OF AMERICA (NYCOA),
United States

SESSION 3: EXPLOITING INNOVATIONS IN POLYAMIDE-BASED NANOCOMPOSITES

- 2:40 **Introducing a new clay for significantly improved barrier properties in polyamides**
Mr. Daniel Berg, Global Transportation End Use Manager -
Thermoplastics Additives,
BYK USA, United States
- 3:10 **Exploring the use of nano-additives to enhance polyamide properties**
Mr. Yves Laroche, President,
KWI SOLUTIONS POLYMÈRES, Canada
- 3:40 Coffee break

SESSION 4: TAILORING THE PROPERTIES OF POLYAMIDES WITH THE LATEST ADDITIVES

- 4:20 **Analyzing trends in flame retardants for filled and unfilled polyamides**
Mr. Glade Squires, Product Manager,
OMYA, United States
- 4:50 **Introducing the latest developments and concepts for modifying the mechanical performance**
Dr. Marco Bernabo, Technical Service Specialist,
AUSERPOLIMERI s.r.l., Italy
- 5:20 **Making the most of renewable dimer fatty acid technology for high-performance polyamides**
Mr. Wolfgang Geuking, Technology Development Manager,
CRODA, United States
- 5:50 Day one concluding comments
- 6:00-7.30 Networking Cocktail Reception

Wednesday, November 7, 2018

08:30 Registration and welcome coffee
09:00 Opening announcements

SESSION 5: BOOSTING PERFORMANCE WITH REINFORCEMENTS AND FILLERS

- 9:10 **How mineral reinforcements can play a broader role in polyamide-based applications?**
Mr. Maziyar Bolourchi, Senior Manager, Polymer Applications
IMERYS, United States
- 9:40 **Black and brittle or white and floppy! How to get the best from high-performance fillers for polyamides with hybrid solutions**
Mr. Iain Montgomery, Director of New Business Development,
AGY, WORLD HEADQUARTERS, United States
- 10:10 **Modifying surface chemistry to improve the performance of polyamides reinforced with glass fibers and other functional additives to meet automotive industry requirements**
Dr. Ashok Adur, Global Commercial Development Director, Plastics,
VERTELLUS, United States
- 10:50 Coffee break

SESSION 6: ADAPTING POLYAMIDE TECHNOLOGIES TO MEET MARKET DEMANDS

- 11:30 **Complementing traditional hydrocarbon base lines with bio-based ones in times of constrained capacities**
Mr. Peter Rieck, Business Development Manager
- High Performance Polymers,
EVONIK, United States
- 12:00 **Copolyamides with enhanced properties for filled applications**
Dr. John Facinelli, Technical Marketing Leader,
ADVANSIX, United States
- 12:30 **Raising the high-temperature performance of bio-based polyamide resins for under-the-hood applications**
Mr. Adam Toft, Sr. Market Development Manager,
ARKEMA, United States
- 1:00 Lunch
- 2:00 **Waste-based renewable intermediates for current and new polyamides**
Ms. Jeanny Yao, Co-founder and Chief Technology Officer,
BIOCOLLECTION, United States

SESSION 7: RETHINKING POLYAMIDE PROCESSING TECHNOLOGIES

- 2:30 **Producing high-performance polyamide 6 organo-sheet via in-situ polymerization of caprolactam**
Dr. Mingfu Zhang, Research Manager,
JOHNS MANVILLE, United States
- 3:00 **Pelletizing of polyamides - exploring energy savings, maintenance cost and downtime advantages**
Dr.-Ing. Reinhild Bolwerk, Global Product Manager - Pelletizing,
NORDSON BKG, Germany
- 3:10 Concluding remarks
- 3:20 Conference ends

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TiO₂ market remains unsettled

The price fluctuations that have characterised the TiO₂ market in recent years do not seem likely to disappear. Peter Mapleston looks at market and product developments

Supply of titanium dioxide (TiO₂) white pigment has in recent years been characterised by price swings that have hampered planning (among other things) on the demand side. It is not clear if that is likely to change in the near future.

Mark Vergnano, CEO of leading producer **Chemours**, says his company is doing its bit to help in terms of price stability by driving significantly more TiO₂ sales under its Value Stabilization (VS) contracts. Customers may not always pay less than if they buy on the spot market or if they have shorter-term contracts, but at least the uncertainty is taken out of the equation, and inventory can be stabilised, is the company's message.

The Chemours VS multi-year TiO₂ contracts allow customers to have flexibility in volumes while maintaining a more stable price. Vergnano says that, in the long run, they should help stabilise the industry. He also says that overall quality of TiO₂ from Chinese suppliers, many of which operate with sulphate technology, will take "many years" to get to chloride levels. Nor does he see much more capacity coming onstream there, noting that, for all applications, around 200,000 tonnes/year of capacity needs to be added annually, just to meet demand growth.

"Today we are back into balance. China has shut down a lot of inefficient capacity, and I don't see any reason China would re-enter with a lot of

capacity," Vergnano told one news outlet earlier this year. Plants that were shut down as a result of a government crack-down on pollution are not coming back, he noted. Chemours itself is debottlenecking its TiO₂ plants around the world to add an additional 10% of capacity through 2021 from a year end 2017 base of 1.25m tonnes/year.

Other companies too are on growth paths. **Lomon Billions** is now the largest TiO₂ pigment producer in China and the world's fourth largest, operating both chloride and sulphate plants. Marketing Director Julie Reid, based in Stockton-on-Tees, UK (she was previously with Huntsman) said at Chinaplas earlier this year that Lomon Billions plans to significantly grow its production capacity. "We're aiming to become the global market leader with around 1.3m tonnes of TiO₂ pigment capacity by the mid 2020's," she said. Earlier this year, the company said it would add 200,000 tonnes/yr of chloride capacity with two new lines in Jiaozuo, China. Production is forecast to begin next year.

Back in the West, the merger of two other TiO₂ majors hangs in the balance. At the beginning of July, the European Commission approved the acquisition of **Cristal by Tronox** - first announced in February 2017 - conditional on full compliance with commitments offered by Tronox. Commissioner Margrethe Vestager, in charge of competi-

Main image: Structural changes, such as the takeover of Cristal by Tronox that is being challenged in the US, mean TiO₂ markets are likely to remain unsettled for some time



PHOTO: TRONOX

Right: Consumer electronics firms demand the bright whites that can be delivered by Tioxide TR48

tion policy, said: "Tronox and Cristal are two of the four major players in this market, but we can approve their merger because the companies offered a suitable remedy that fully addresses our competition concerns. This decision will ensure that these products can continue to be offered at competitive prices and without reducing the number of suppliers available for consumers."

The Commission concluded that, while the takeover as initially notified would have significantly reduced competition on the European market for chloride-based TiO₂ pigment for use in paper laminate, there were no competition concerns regarding TiO₂ pigment for use in other products, in particular paints and plastics, since there are many suppliers active in Europe and that "customers can and do use a wider variety of TiO₂ pigment types, including those with a sulphate-based production process."

To address the Commission's competition concerns, Tronox offered to sell its global business in TiO₂ pigment for paper laminate. In mid-July, it submitted to the European Commission definitive agreements with **Venator Materials** to divest its 8120 paper-laminate product grade currently supplied to European customers from a facility in Botlek, The Netherlands.

Tronox has also entered into a binding Memorandum of Understanding with Venator providing for the negotiation of a definitive agreement to sell Cristal's Ashtabula, Ohio, two-plant TiO₂ production complex to Venator if such a divestiture is required to consummate the Cristal acquisition.

However, the U.S. Federal Trade Commission (FTC) filed a complaint against Tronox on 10 July alleging the acquisition would violate antitrust laws by reducing competition in the North American market for chloride-process TiO₂. Tronox fired back, saying it believes the FTC's allegations are "substantively wrong." That legal argument is yet to be settled.

Above: Venator claims its Tioxide TR42 pigment is its most durable to date. Applications include PVC profiles

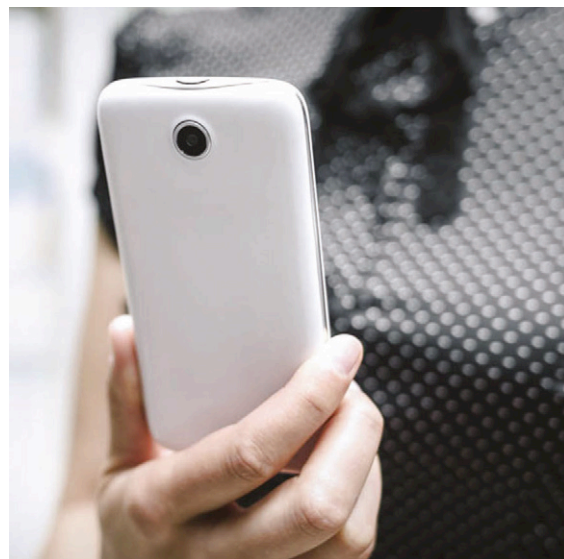


PHOTO: VENATOR

Brighter whites

Meanwhile, some product development goes on. Venator, for example, (spun off from Huntsman in August 2017) says it is introducing "the next level of pigment performance with two new products for customers that want to create whiter, brighter, more durable plastics."

Venator says its new Tioxide TR42 pigment is its most durable TiO₂ to date. "Engineered for use in the plastics industry, Tioxide TR42 pigment is a blue tone, white product that can be easily integrated into a range of polymers including rigid PVC, ABS and LDPE films," it says. "Designed to boost the durability of the plastics it is integrated into, Tioxide TR42 pigment can be used to help polymer products maintain their integrity for the required timescale, better withstanding weather conditions and seasonal changes."

Typical PVC applications include window and door profiles, siding and cladding systems, decking, railing, pipework and roofline products. In ABS, Tioxide TR42 pigment is said to help maintain the lifetime of automotive components including light coloured interior and exterior parts. "The availability of Tioxide TR42 pigment will also be of interest to plastic film and sheet converters," Venator claims. "Integrated into LDPE films for the agricultural sector, Tioxide TR42 pigment can increase the durability of materials used to package mulch and peat and wrap hay and silage bales."

Venator also highlights its Tioxide TR48, which has a bright white, blue tone. Developed for the masterbatch industry, it can be used, the supplier says, to enhance the appearance of premium ABS plastics and can also be integrated into polyolefin masterbatches and used in the production of multi-layered packaging films and for injection and blow moulding applications, where durability is not

PHOTO: VENATOR

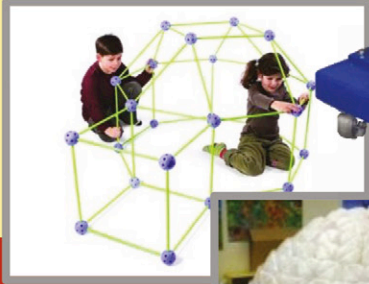
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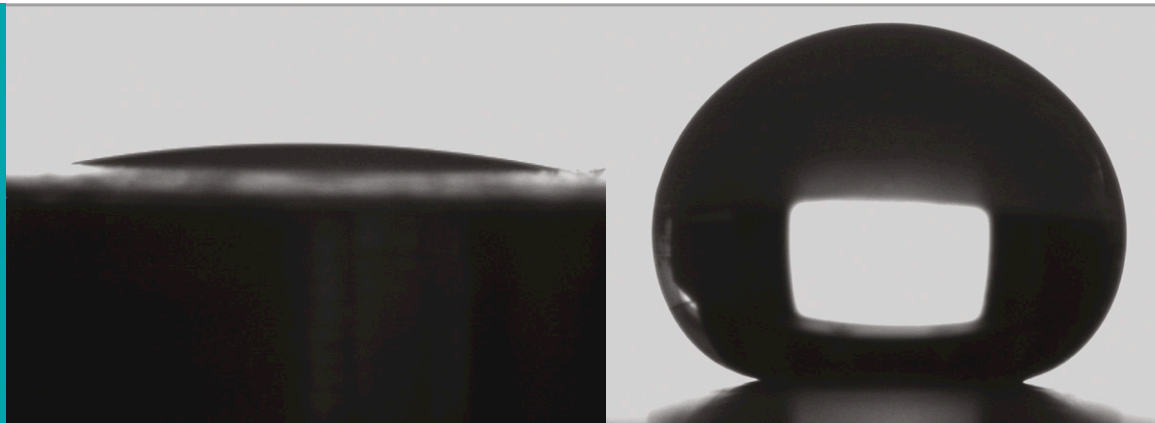


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Photos taken with a DSA100 Drop Shape Analyzer show drops of water deposited onto TiO₂ particles with hydrophilic (left) and hydrophobic (right) surfaces

Source:
RD Titan Group
Innovative TiO₂



a primary requirement.

Made in a process that uses selected organic and inorganic treatments, Tioxide TR48 pigment “delivers a range of excellent processing and performance properties,” Venator says. In ABS, for example, it can enable the production of brighter, whiter parts with reduced susceptibility to yellowing, even when processed at or exposed to high temperatures. “This feature is a major benefit in the consumer electronics industry where there is high demand for bright, white electronic devices and matching charging accessories including headphones, plugs and sockets,” Venator says.

Cutting costs

RD Titan Group Innovative TiO₂ has some interesting news, not only for compounders, but for budding TiO₂ producers too. Company co-founder and director Andriy Gonchar says that most TiO₂ grades for plastics are made hydrophobic by surface treatment of the particles using special organic additives. Such hydrophobic treatment provides improved wettability in melts of non-polar polymers, ensures their better dispersion, and also provides the preparation of less viscous mixtures of the molten polymer and the pigment.

The substances used for TiO₂ hydrophobisation can be divided into two types: additives that are physically adsorbed onto the particles surface (polydimethylsiloxanes, for example), or additives which chemically interact with the surface (such as egg, silane, phosphonic acids).

Additives of the first type have one common drawback - during the mixing of the pigment with the polymer melt, they tend to desorb from the surface of TiO₂ particles and migrate, resulting in the effect of a “greasy” surface of the

pigmented polymer material. In this regard, the use of the second type additives for TiO₂ hydrophobisation is more preferable, because they don’t desorb from surface of TiO₂ particles. Most hydrophobic grades of the world’s leading TiO₂ producers are treated with additives of the second type.

Pigment manufacturers can use different methods of applying hydrophobic coatings. RD Titan Group Innovative TiO₂ has developed a “dry” application technology for the production of “Plastics Type 1” grades (designed for maximum processability). The latest development from the company, working with Swiss candle filter manufacturer Dr Mueller, is a “wet” technology that allows treatment of the TiO₂ in an aqueous suspension, after which (using a specially designed candle filter) the thermal exposure necessary for hydrophobisation and simultaneous drying of the pigment to a moisture content of less than 0.2% is performed.

This technology allows effective hydrophobisation for the production of all three types of TiO₂ grades for plastics. Conventional expensive equipment (filter presses and dryers) can be excluded, significantly reducing capital costs compared to traditional techniques. The technology can be easily implemented at plants currently not producing hydrophobic TiO₂ grades.

Stretching it out

An obvious way for compounders to bring down cost when using TiO₂ is to add less of it. “TiO₂ can be partially replaced using extenders to reduce costs and beneficially, the carbon footprint of the end product,” says Tony Bruce, Business Development Manager, Performance Chemicals at **Cornelius**. “We believe TiO₂ extenders, manufactured by our partners VB Technochemicals and Evonik Silica Finland, will always have a part of play in the TiO₂ market due to continuing long term market volatility. Extenders will generally offer a cost saving to a customer’s inventory so regardless of a TiO₂ shortage, incorporating them can be win : win

Below:
Hydrophobic TiO₂ discharged from the RD Titan Group process does not wet and floats on water



PHOTO: RD TITAN GROUP INNOVATIVE TiO₂

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PHOTO: SHUTTERSTOCK



Above: TDMA is responding to European Commission proposals to list TiO₂ as a suspected carcinogen

for the balance sheet.”

At **FP-Pigments**, Group Technical Director Paul Dietz says business with its FP-500 Series (TiO₂ particles coated in calcium carbonate in a 20:80 ratio) continues to grow as customers find they are able to reduce use of TiO₂ use while maintaining end application performance.

“Over the last couple of years we have seen increased interest in FP-550 for masterbatches and FP-510 for PVC (both rigid and flexible) as TiO₂ prices rose and users tried to maintain cost effect performance,” he says.

Health concerns

In October 2017, the Risk Assessment Committee (RAC) of the European Chemicals Agency (ECHA) proposed classifying TiO₂ as a suspected carcinogen (Category 2) by inhalation. *Compounding World* asked the **Titanium Dioxide Manufacturers Association** (TDMA), a sector group of the European Chemical Industry Council (CEFIC), to explain how it has responded to the move.

“TDMA stands by its view that TiO₂ is safe and has been engaging with the European Commission, the Member States and other interested parties in regulatory discussions to find an appropriate way to take this opinion forward,” according to TDMA. “In November, the European Commission asked the Member States and interested parties whether the RAC’s opinion could be included directly into the CLP Regulation [which aligns the EU system of classification, labelling and packaging of chemical substances and mixtures to the Globally Harmonised System, GHS]. TDMA and others have many questions on whether the CLP is the most efficient tool to address the potential hazard described in the RAC’s opinion.”

The association says that most stakeholders have expressed concerns over a direct inclusion in the CLP Regulation, given the complexity and

precedent-setting nature of the case. It says the discussions between stakeholders have confirmed that the potential concern for TiO₂ is predominantly a question of occupational health and safety, so any solution should take this into account and be appropriate.

“This is a complex issue and the RAC itself recognised that there are several open questions. For example, it highlights that there are open questions in the ECHA guidance on the relevance of using rat data generated under conditions of lung overload for humans,” the association says. “The RAC also concludes that the hazard described for TiO₂ is not an ‘intrinsic toxicity’ in a classical sense but is characterised as particle toxicity. This means that the hazards described are not exclusively characteristic for TiO₂ but apply to a whole group of chemicals referred to as ‘poorly soluble low toxicity particles’ (PSLTs). Therefore, any regulatory decision on TiO₂ would effectively set a precedent for hundreds of other granular dusts.”

TDMA has highlighted that the proposed classification for TiO₂ would have unintended impacts in downstream legislation. As an example, if TiO₂ was classified, waste containing more than 1% of TiO₂ would automatically be deemed hazardous under the EU’s Waste Framework Directive, rendering waste containing more than 1% TiO₂ unrecyclable, even when there is no potential for inhalation of unbound TiO₂. For instance, it estimates that the cost of managing waste paint buckets in Germany alone would increase from €10m (for recyclable buckets) to €200m (for hazardous buckets).

To answer open questions, the TDMA has launched a €14m science programme and has asked the Commission to wait for outcomes of this programme before a decision is taken, as it would build the scientific basis to help resolve the many issues, without setting aside the RAC’s opinion. “The regulatory discussions on TiO₂ continue and TDMA is committed to continue its work with the authorities in this process to find an appropriate solution,” the association says.

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What makes TiO₂ so special?

Lomon Billions Quality and Technical Manager Neil MacDonald, provided a primer on TiO₂ at a recent pigments event, explaining why it is so good at its job. This article summarises his key points

Two allotropes of TiO₂, rutile and anatase, are commercially suitable for use as pigments. This is because they can be manufactured cost effectively, have very high refractive indices (RI), and scatter electromagnetic radiation efficiently - especially in the visible region of the spectrum.

Figure 1 compares the RI of rutile and anatase TiO₂ with other materials that might be considered opacifying pigments. Although some materials have refractive indices approaching those of TiO₂, the optimal combination of high refractive index and ease/cost of production is provided by TiO₂. Figure 2 shows the difference in RI between the two allotropes and a number of common polymers (which determines effective reflectivity).

To deliver opacity efficiently, a pigment must also be present in a well-dispersed particulate form with correct average particle size and narrow particle size distribution. For TiO₂ pigments, the optimal particle size for visible light scattering is about 0.25 microns. Ideally, all TiO₂ particles would be monodisperse with particle size of 0.25 microns. In practice, however, TiO₂ is made with a range of particle sizes centred on the optimal average size.

The amount of oversize pigment particles must be kept to the minimum if a high gloss surface finish is required. "Oversize" in this case means particles greater than about 0.4 microns. The

presence of a high proportion of these particles, which can protrude from the surface of a blown film, for example, would make it difficult to obtain a high gloss.

Process effects

TiO₂ is made via two process technologies - Sulphate and Chloride. In the Sulphate Process, ilmenite ore is purified by a sequence of crystallisation, filtration and washing techniques before being calcined to produce crystalline titanium dioxide. In the Chloride Process, pigmentary titanium dioxide pigment with extremely low levels of transition metal impurities is produced. The latter has benefits for the colour of the pigment - Chloride Process pigments generally have a cleaner, more blue tone than Sulphate Process pigments.

The properties of most TiO₂ pigments are further tailored by application of coatings to the surface of the crystals. These coatings prevent compaction of the pigment during storage and transportation, encourage rapid redispersion during compounding, and minimise photochemical activity in its final application.

While the colour of Chloride Process pigments is generally preferred, Chloride TiO₂ rutile pigments are also more abrasive than Sulphate process rutiles. This can have an effect on compounding

Main image:
Neil MacDonald
explains why
TiO₂ is such a
powerful
addition to the
range of plastic
pigments

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equipment, reducing the lifetime of extruder screws by wearing the flight tips or increasing the amount of metal pick-up when using a high-speed mixer to prepare a dry-blend or pre-mix (with consequences for colour). In some applications where minimal abrasivity is required, softer anatase pigments can be used.

Although the optimum crystal size for TiO₂ pigments for opacity is about 0.25 microns, TiO₂ pigments made for plastics applications are often intentionally made with a crystal size of 0.20 microns or less because this promotes scattering of blue light and imparts a more aesthetically pleasing "clean, blue" tone to white plastic articles, which can otherwise have a slightly yellow tone.

The properties of the TiO₂ pigment are further modified by the application of coating materials to the surface of the TiO₂ particles, applied dispersed as an aqueous colloid. For pigments intended for use in plastics, alumina only, or silica with alumina (to improve durability) are the most common types of hydrous oxide coatings.

In the final stages of pigment manufacturing, the nature of the pigment surface is modified by application of a surfactant, commonly referred to as the "organic." This is intended to compatibilise the pigment surface with the polymer. Siloxanes are widely used in the production of general-purpose plastics pigments. More recently, reactive C-8 surfactants have been used to make TiO₂ pigments with superior dispersibility. These types of pigments allow users to operate production lines at higher throughput rates, while providing excellent pigmentation of plastics materials.

> www.lomonbillions.global

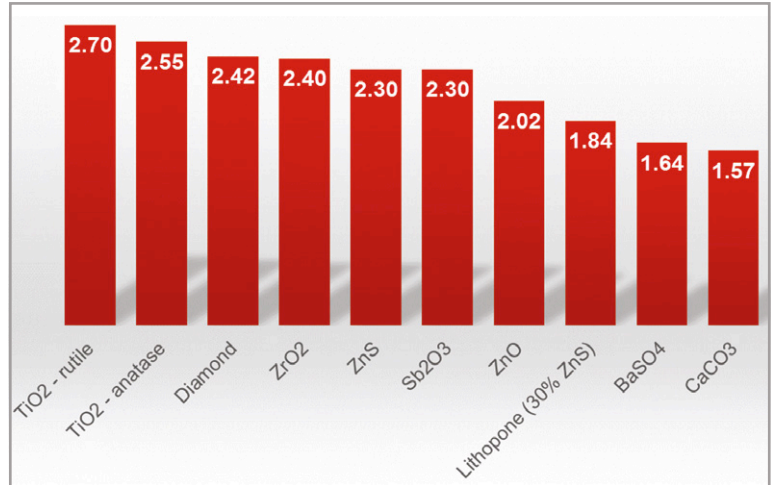


Figure 1: Refractive indices of rutile and anatase TiO₂ compared to other potential white pigments

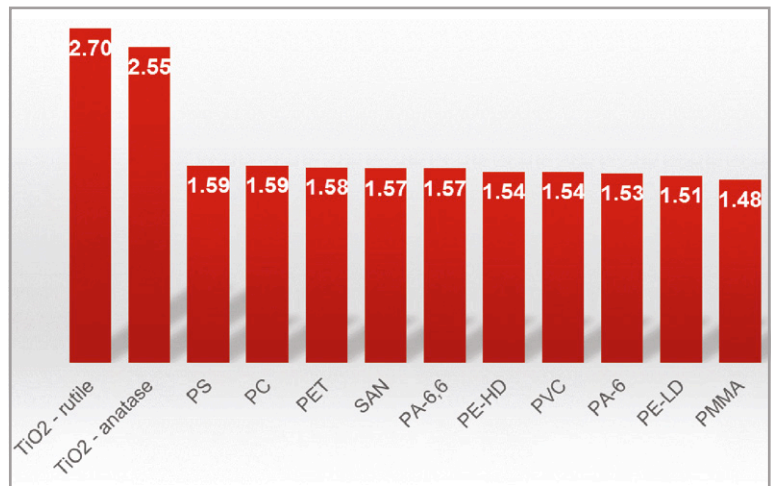


Figure 2: Refractive index of rutile and anatase TiO₂ compared to common thermoplastics. The difference in refractive index between pigment and polymer determines effective reflectivity

Source: Lomon Billions



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PHOTO: PE SCHALL

Fakuma 2018 - what's in store for compounders

As Europe's plastics industry prepares to set out for Friedrichshafen and the 26th Fakuma fair, we take a look at what will be on show for polymer compounders

The 26th Fakuma plastics fair takes place at Friedrichshafen in Germany on 16-20 October. The event - located on Lake Constance where the high tech engineering regions of Germany, Austria and Switzerland meet - runs every year there is no K show. It has grown considerably over recent years and is now arguably one of the most important plastics exhibitions in Europe. Last year's event drew almost 1,900 exhibitors and more than 48,000 visitors, according to organiser PE Schall.

Injection moulding has long been at the heart of the Fakuma exhibition and the organisers see it as the number one venue for this technology. "There's no getting around injection moulding if you want to combine lightweight design and highly complex components", says Fakuma Project Manager

Annemarie Schur. However, there will also be plenty of compounding equipment to see, as well as new compound and additive introductions to explore. Over the next 18 pages we provide a look into what the show holds for plastics compounders.

Agrana Starke will present its Amitroplast thermo-plastic starch (TPS). Suitable for injection and blow moulding and extrusion, the company claims that the biodegradable Amitroplast TPS can be added to compounds at 50% higher loadings than alternatives without compromising processability. It says compounds containing the materials also generate less smoke during processing and particularly in production of blown films.

> www.agrana.com

Main image:
The 26th Fakuma plastics fair takes place this month in Friedrichshafen and is likely to draw close to 50,000 visitors

Akro-Plastic will be showing the first in its new Akromid B+ PA6 family of compounds, which are intended as alternatives to PA66 materials. The first grade in the range is a 50% glass reinforced compound claimed to provide the same strength at 80°C as a conditioned PA66 GF50 (115 MPa breaking stress) and near the same levels of stiffness.

“Our new polymer-modified PA6 grade is priced between PA66 and PA6 and thereby opens up considerable savings potential,” says Thilo Stier, Head of Innovation and Sales at the company. “We will be presenting the first components made of the new material and complemented material values such as ageing and conditioning to trade fair visitors at our stand.”

The company says 30 to 50% glass fibre reinforced Akromid B+ compounds are already available for sampling, with a grade with 60% glass fibres to follow shortly.

Other novelties include a new addition to its Akromid PST range of PA compounds for adhesion to metal during overmoulding. Developed in partnership with Plasmatrete, the product line now includes a grade formulated to adhere to aluminium. “In some aluminium variants, tensile shear tests result in breakage in the aluminium and not in the adhesive surface,” says Cyprian Golebiewski, Akro-Plastic Head of Application Technology.

Also new is Akromid A3 GF 30 4 L black (4678), a new hydrolysis-stabilised PA66/PP blend offering very good mechanical properties and hydrolysis resistance. The company says the proportion of PA66 is reduced in this new grade, providing an additional weight advantage.

> www.akro-plastic.com

Right: A cooling water pipe produced in Akromid A3 GF 30 4 L black (4678) PA66/PP blend from Akro-Plastic



expanded Alco Med range of compounds for medical applications, a new addition to its Alcom Lighting range for high gloss automotive applications, and new high flow additions to its Alfater XL line of TPVs. The latter “Easyflow” grades are high gloss black products available in hardnesses from Shore A50 to D40.

Following its recent acquisition of Wipag, the company will also be showing an expanded range of recycled compounds. These include carbon reinforced PP grades intended to compete with glass reinforced PA as well as a new PET/PBT blend addition to its Altech Eco family.

> www.albis.com

Ampacet will exhibit a number of new products aimed at improving the quality of recycled plastics in terms of odour and colour.

Odor Scavenger 1000258-E is a wide spectrum odour absorbing masterbatch suitable for neutralising odours in post-consumer recyclates, allowing usage at higher percentages without sacrificing end-product quality. REC-O-BLACK 216 is a

black masterbatch produced from carbon black pigment recovered from post-consumer recycling of rubber products such as tyres in a PCR PE carrier resin. Blue Edge 78 (7600078-E) masterbatch counteracts the yellow/brown tint in post-consumer recycled PET, providing a lighter bluish tone that is more appealing to the customer’s eye.

Ampacet will also show its Biorange masterbatches for use with compostable bioplastics and biodegradable resins. All products in the range are compatible with compostable polymers and comply with the EN 13432 composting standard.

> www.ampacet.com

Below: Brabender will show its Plastograph EC torque rheometer

Albis Plastic will be showing a number of new introductions to its own product portfolio as well as the latest developments from principals such as Covestro and BASF.

Its own novelties will be headed up by its

Ascend Performance Materials will introduce its Vydyne R433H PA66, which is designed to reinforce down-gauged steel and aluminium in vehicle body in white (BIW) structures.

Vydyne R433H has improved energy absorption over traditional glass-filled PA66, reducing noise, vibration and harshness (NVH) and absorbing impact energy from crashes, says the company. “The BIW accounts for nearly half the weight of a vehicle,” says Vikram Gopal, Ascend’s Senior Vice President of Technology.

Ascend will also highlight its new manufacturing facility at Tilburg, in the Netherlands. The acquisition of the Britannia Techno Polymer compounding operation this summer gave Ascend its first



European manufacturing base.

> www.ascendmaterials.com

BASF announces the extension of its Ultramid Deep Gloss PA range to include coloured grades. It will also show new additions to its PPA portfolio and colorants from its Color Solutions division for use with recycled resins.

Previously only available in black, the new coloured Ultramid Deep Gloss products offer the same benefits in terms of resistance to scratching, chemical and UV resistance without the need for coating. They also reproduce mould surface details faithfully, allowing a contrasting mix of light and shadow to be created. "This opens up versatile possibilities for car interior design," says Xaver Hopfenspirger, Project Manager for Ultramid Deep Gloss.

Ultramid Advanced T1000 is a new group of compounds based on PA 6T/6I. The new compounds offer the highest strength and stiffness



within the Ultramid family and display constant mechanical properties up to 120°C. The semi-aromatic chemical structure also means the T1000 products offer high resistance to moisture and aggressive media.

BASF Color Solutions will show samples of artificial grass coloured using its Lufilen and Sicolen colorants (which are developed for colouring of natural and recycled resins). It says the colour-intensity of the Sicolen products in particular means recycled resin can be coloured without the need special additives. The company sees potential in production of beverage crates and waste bins.

> www.basf.com

Brabender will demonstrate its Plastograph EC torque rheometer, which is designed for application investigation or processing tasks in laboratories and simulation.

The unit incorporates a 3.8kW digital motor to provide a torque measuring range of 200 Nm and

Right: BASF extends its Ultramid Deep Gloss PA technology to coloured variants

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The FED-MTS extruder is suited to a variety of applications. The **modular design** of the **FED 26 MTS**, a co-rotating twin-screw extruder can be extended in just a few simple steps from 32D to 42D, 52D or more.

The FED 26 MTS is ideal as a lab extruder – the technology inside is similar to that of the larger machines in the MTS series and thus provides the same **gentle compounding processes**.

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PHOTO: CABOT CORP



Above: Cabot will present its latest carbon black additions

a speed range from 0.2 to 150 min⁻¹. With the choice of mixer or extruder measuring heads, it can handle tasks such as raw material and recipe development, material testing, quality control and process optimisation. Lab-scale production of samples for further investigation can also be readily performed.

> www.brabender.com

BYK will introduce Disperplast-1180, its latest wetting and dispersing additive for use in highly filled technical PVC compounds for applications such as LVT flooring. According to the company, incorporation of the new additive allows higher filler levels to be used without loss of mechanical properties. Other benefits include improved and faster plastification and better melt processing.

> www.byk.com

Cabot will be highlighting its expanded capabilities in conductive formulations and new developments in high colour blacks for injection moulding, as well as their sustainable black masterbatch solutions.

The company will present a new technology to provide higher performance in electrically conductive applications. "Leveraging our extensive experience in formulating conductive compounds for new materials is a key part of our strategy. With this we are optimising not only our formulation manufacturing capabilities, but also broadening our scope with innovative materials that will play an important role in enhancing the functionality of plastics in

Right: ColorLite launches its ColorTube spectrophotometer at Fakuma

automotive, medical and industrial applications," says Emmanuel Tarret, General Manager EMEA for Cabot's Masterbatch.

Cabot will also present its latest developments in high colour blacks. Designed for use with styrenics and PAs in injection moulding applications, the new ultra-black formulations require less carbon black to achieve high jetness, reducing the negative impact on mechanical properties.

The company will also introduce its Techblak line of black masterbatches, which are formulated using recycled resins from both post-industrial and post-consumer sources.

> www.cabotcorp.com

ColorLite has added a new stationary spectrophotometer to its colour measurement equipment family. The ColorTube is said to be suitable for reflection and transmission measurements and is a two-channel system that includes a 140mm diameter sphere and spectrometers for sample and reference channels.

The unit offers a measuring range from 400nm to 700nm with a spectral scanning of 3.5nm. An integrated gloss trap allows measurements with and without gloss exclusion, while high performance LED light sources ensure stable measurements. The unit is available as a basic reflection model or with a third channel for transmission operation and is supplied with PC-based colour database software.

> www.colorlite.de

Coperion will be placing its Fakuma focus on feeding technology, showing a Coperion ZS-B side feeder equipped with its patented Feed Enhancement Technology (FET).

The ZS-B twin screw side feeder enables reliable side feeding of fillers and additives in powder, pellet and fibre form into the process section of the twin screw extruder. It features a self-cleaning screw profile and allows product to feed into the screw flights without stagnant zones.

The FET Feed Enhancement Technology option applies a vacuum to the feed zone by means of a porous, gas-permeable wall. The resulting gas extraction is said to increase the material intake capacity when processing feed limited products by up to three times. This means higher throughput rates and the ability to use finer



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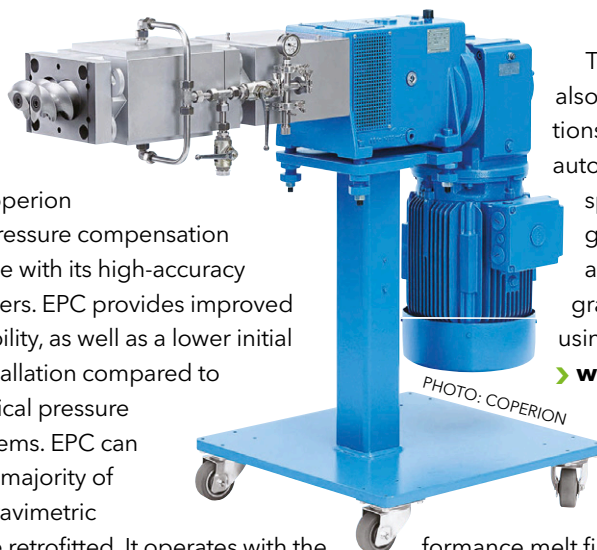
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Right: Coperion will show a ZS-B side feeder equipped with FET for feed limited applications

or non-compact ed fillers, the company says. The display will also include the Coperion K-Tron electronic pressure compensation system (EPC) for use with its high-accuracy loss-in-weight feeders. EPC provides improved accuracy and reliability, as well as a lower initial cost and easier installation compared to traditional mechanical pressure compensation systems. EPC can be installed on the majority of Coperion K-Tron gravimetric feeders and can be retrofitted. It operates with the company's K-Tron's KCM feeder control system. www.coperion.com



The specialty ABS supplier will also feature recent product introductions, including plating grades for automotive and sanitary parts, specialty grades for consumer goods that offer laser-markability and high flow, and special ABS grades optimised for 3D printing using FFF/FDM technologies. www.elix-polymers.com

Below: The SpectraVision hyperspectral spectrophotometer from Datacolor

Covestro's offering in Friedrichshafen includes continuous fibre reinforced composite materials and PC blends for use in demanding new application areas such as electric vehicle batteries and light guides. It will also highlight its materials for additive manufacturing (3D printing), showing a complex shock absorber manufactured using three different additive manufacturing techniques - FFF, SLS and SLA - using a combination of PC filament, TPU powder and liquid PU. www.covestro.com



Datacolor will present its SpectraVision hyperspectral spectrophotometer and Match Pigment 4.0 smart colour matching software for plastics processors. The SpectraVision solution is claimed to enable manufacturers and their suppliers to objectively measure and digitally communicate colour - including "the unmeasurables" such as human perception and metamerism - to save cost and shorten the time from concept to consumer. Using the Match Pigment 4.0 software, the company claims colour match times can be cut by up to 50% and first shot matches improved by 80%. www.datacolor.com

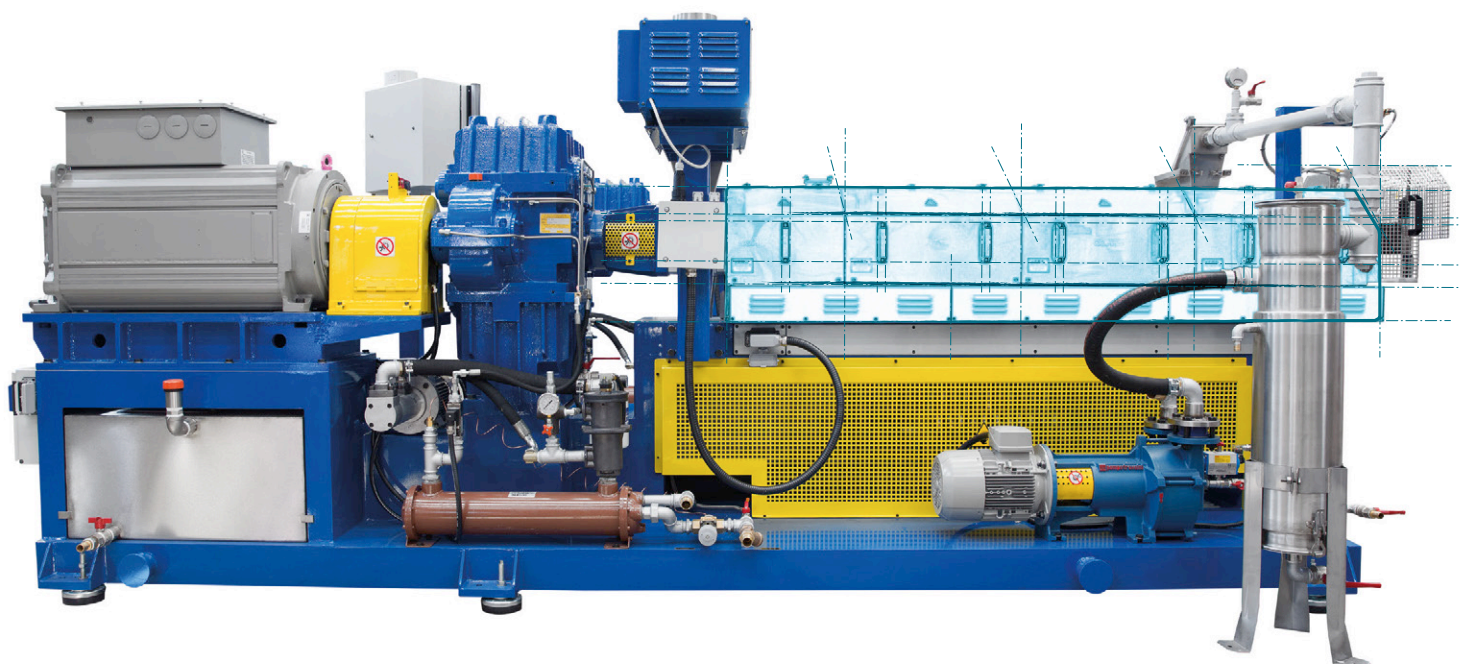
Right: Ettliger will present its ECO 200 screenchanger, available with a 60 micron filter option

ELIX Polymers will introduce its CC (Chemical Compliance) product line at Fakuma. The grades are intended for applications where specifiers are concerned about regulatory aspects. These include toys, cosmetic containers, and products that come into contact with food. CC grades are supplied with additional guarantees on regulatory compliance and are supported with a package of extended verification and stewardship services.

Ettlinger, now part of the Maag Group of companies, will show its ECO 200 high-performance melt filter. Sharing many features of the larger ECO 250 version, the new model is designed for use with free-flowing polymers such as PET and PA with contaminant levels of up to 1.5%. It is also said to be suitable for polyolefins and polystyrenes. The new model offers a maximum throughput of 1,000 kg/hr, compared to the 3,000 kg/hr of the ECO 250. Typical applications are foreseen in compounding and filtration of gels and agglomerates, in particular of aluminium, paper, silicone or PVC from recycled PET bottles. An extra-high filtration grade of 60 micron is available. www.ettlinger.com

Feddem will show its FED 26MTS twin screw extruder, the smallest in the machine series, supported by examples from its range of compounding accessories such as its strand breakage monitoring system and new barrel cleaning brush. With its 34kW drive and 42 L/D base (extendable to 52 L/D), the FED 26MTS extruder is well suited to product development and pilot plant applications, according to the company. It features wear-protected screws and barrels and is equipped with two FSB side feeders to handle





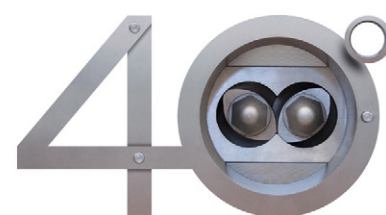
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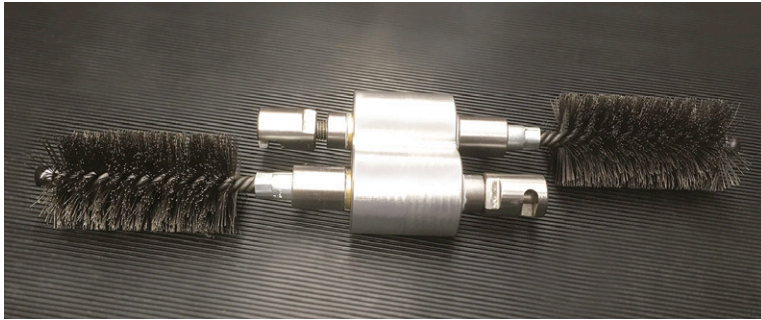


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PHOTO: FEDDEM



Above:
Feddem's new barrel cleaning tool is designed to save time during product changeovers

powder and fibre additives via four side openings.

The strand breakage monitoring system uses infrared technology to provide reliable performance that is unaffected by steam or water splashes. The company will also show its new dual cleaning brush for faster barrel cleaning during product changes. It says the units, which are custom built to suit the customers' extruder and are powered by an electric hand tool, are already in use at a number of sites. They are available for machines with screws from 50mm diameter.

➤ www.feddem.com

Finke will present its range of Fibaplast additive masterbatches for laser marking applications, including grades for creating high contrast and coloured effects. Colour laser markings will be shown on extruded postcard-sized HD-PE sheets coloured with various Fibaplast combination masterbatches. The sheets are manufactured by German extrusion specialist CS-Plastik with laser marking carried out at Finke's laser laboratory. Finke offers laser marking additives for PE, PP and ABS, with grades for a number of other polymers under development.

➤ www.finke-colors.eu

FKuR will show its latest biodegradable injection moulding compound - Bio-Flex S 7514 - plus examples from its range of part bio-based TPE and PP grades.

Based on PLA, Bio-Flex S 7514 is a biodegradable compound with an MFI of 27 (g/10 min), making it easy to process and suitable for use in multi-cavity and long flow length moulds. Its high heat resistance of 110°C (Vicat A) is achieved without using a hot tool, so cycle times are short. The material has a bio-based content of 75% and is available in natural and white.

Other products on display include Terraprene, a range of TPEs with a bio-based content of 40% to 90%. The materials offer similar mechanical properties to fossil fuel-based counterparts and are suitable for 2K injection moulding. Terralene PP is a PP compound with a bio-based carbon content of

Right:
Disposable cutlery produced in FKUR's biodegradable Bio-Flex S 7514 compound

around 35% that can be used as a "drop-in" alternative to conventional PP.

➤ www.fkur.com

Gabriel-Chemie will introduce the first in a series of digital tools designed to make it easier for its customers to communicate - and to satisfy - their colour needs. GABi is a virtual assistant that uses an intelligent search-algorithm to find suitable products based on common colour systems or standardised colour references such as RAL.

The system is also able to recognise colours and propose appropriate products using the X-Rite Color-Eye System via a smartphone camera. The Color-Eye calibration card enables accurate colour measurements to be made on Apple and selected Android phones, removing variation caused by lighting and camera differences. Dosage, temperature stability and light-authenticity are just a few processing parameters that can also be filtered.

GABi is the first tool to be launched under Gabriel-Chemie's "Master of Batch" line. "Master of Batch provides quick digitised access to our masterbatch world," says Digital Colours Project Manager Lukas Houska. "Customers can quickly and easily select their products to shorten product development and time to market."

Other exhibits include the company's Colour Vision No 19 concept, presenting its latest colour and effect ideas in the form of plastic lens plates and surfaces in selected polymers. It will also demonstrate its laser marking additive developments and its halal and vegan masterbatch products.

➤ www.gabriel-chemie.com

Imerys Graphite & Carbon will exhibit its Timrex and Timrex C-Therm graphites for thermal conductivity enhancement and its Ensaco series of carbon blacks for electrically conductive applications. The Timrex and Timrex-Therm graphites are suitable for



PHOTO: FKUR

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use in polymer-based electronics such as heat sinks, geothermal pipes and indoor LED lamp heat sinks; Ensaco carbon blacks are low moisture absorption grades suitable for production of high surface quality compounds for applications such as electronic packaging, fuel hoses, power cables, conveyor and transmission belts, high pressure pipes, ATEX and ESD components.

➤ www.imerys-graphite-and-carbon.com

Inno-Comp will present its range of masterbatches for production of PP LFTs. The company claims that, using its long glass fibre masterbatch and optimised LFT additive masterbatches, processors can produce performance and cost optimised LFT compounds on the injection moulding machine. The company says the Innopol PP LFT Open-Compound System allows development of application specific LFTs offering performance attributes such as halogen-free flame retardance, electrical conductivity, reduced friction as well as custom colours.

➤ www.inno-comp.hu

KD Feddersen's theme for Fakuma will be focused on lightweight construction, improved aesthetics and low noise and emission compounds, with examples of solutions to all these challenges from its principals.

With its "soft touch" feel, Softell PP compounds from LyondellBasell require no painting to create leather-grain effects, including seams, direct from the mould. Softell also boasts high noise dampening, good colourability, and high weld-line and impact strength. Also from LyondellBasell, HiFax PP compounds are UV-stabilised metal effect grades designed to replace metal in exterior automotive applications.

The company will also show two Hostaform products from Celanese. Hostaform SlideX POM offers increased durability for heavy-duty slide/friction applications; Hostaform XAP² POM is a low-emission formulation that meets Asian and European automotive industry requirements for interior applications.

➤ www.kdfeddersen.com

Kuraray will present its new Kuarity acrylic block copolymers for light guide applications. The resin combines (meth)acrylates in AB or ABA type block

copolymers and offers high clarity, self-adhesion, and compatibility with other polar materials. In light guides, the company says that just one LED is needed to illuminate up to 3m of guide.

The company will also show its Hybrar TPE, which comprises SBC with a high vinylpolydiene block to provide good damping ability and a glass transition temperature of around room temperature. Hybrar can significantly enhance the properties of PS or PO material when added as a blend. Kuraray will also show its Eval EVOH high barrier resin and heat, water and chemical resistant Genestar PA9T polymers.

➤ www.kuraray.com

Lanxess will highlight a number of PA6 and PBT compounds designed to replace PA66. Durethan Performance PA6 grades are said to be several times more resistant to fatigue under cyclic loads than standard Durethan grades with the same glass content and also offer enhanced mechanical performance at elevated temperatures under static loads. Meanwhile, it says that unreinforced halogen-free flame retarded Pocan BFN2502 PBT provides an alternative to halogen-free unreinforced PA66 in applications where cost or water absorption are concerns.

The company will also show infrared-transparent PA6, PA66 and PBT compounds developed for laser transmission welding applications. One example is the halogen-free flame-retarded Durethan AKV30FN04LT grade, which achieves V-0 at 0.4mm in the UL 94 test. "With these products, we are responding to the growing demand for housings for sensors, control units, and display systems, which are needed for applications ranging from driver assistance systems to autonomous driving," says Jan Bender, Head of Marketing EMEA in the High Performance Materials (HPM) business unit.

➤ www.lanxess.com

Lehvoss Group, which marks its 35th anniversary this year, will present its Luvobatch PA BA 1001/1002 blowing agent system for production of lightweight PA components produced from compounds containing glass or carbon fibres and mineral fillers.

Using the Luvobatch system, it is possible to

Below: Lehvoss Group will show its products for injection molding, extrusion, 3D printing and electrostatic coating



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Right: Maag will present its Extrex X⁶ high performance gear pump at Fakuma

reduce part weight by up to 30% while maintaining most of the original mechanical properties, the company claims. It says foamed components produced with the system exhibit a performance factor for bending stress in the range from 1 to 1.3, meaning the change in flexural strength is less than the reduction in weight.

In addition to the weight saving, the PA-optimised endothermic blowing agent enables sink marks and shrinkage cavities to be avoided. Delamination in components subject to high mechanical stress, which may arise during the addition of masterbatch based on polyethylene or universal carriers, is reduced or prevented by the use of a PA carrier system. Luvobatch PA BA 1001/1002 can be used in all common processing techniques.

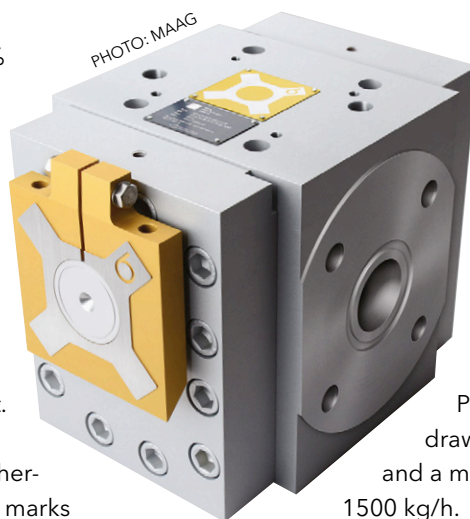
Lehvoss will also show its Luvosint and Luvocom 3F products for 3D printing, its Luvotech line of technical compounds, and Luvocom P powders for electrostatic coating.

> www.lehvoss.de/en

Maag's display at Fakuma includes the Extrex X⁶ class gear pump, which is designed for particularly high melt pressures and is suitable for operation over a wide range of viscosities, and Primo 200 and Pearlo 160 pelletisers.

The company says that the X⁶ gear pump features a completely updated design, from the gears and shafts to the bearings and seals. It says the unit has been optimised to ensure maximum product quality, volumetric efficiency and consistency of the production process.

The Primo 200 E model pelletiser at the show is an example from Maag's WSG dry-cut range and is said to be suitable for reliable production of



high-quality cylindrical pellets or micro-pellets. It features a variable system configuration for processing of soft, brittle or abrasive polymers while a fast tool and roller exchange facility enables optimum flexibility for product changes. With a 200 mm draw-in width, The Primo 200 E is designed for draw-in speeds up to 120 m/min and a maximum throughput rate of 1500 kg/h.

The Pearlo range of underwater pelletising systems will be represented with a Pearlo 160 model. Combining the best technologies from Maag's Gala and Automatik divisions, it achieves throughputs of 1,000 kg/h to 6,000 kg/h. Pearlo models are characterised by a small footprint while the electronically controlled EAC technology ensures precise positioning of the pelletising knives during operation, ensuring long runtimes and consistently high pellet quality.

> www.maag.com

Nordson will introduce a new line of screen packs for its BKG series of screenchangers that are claimed to withstand higher pressures and offer longer lifetimes.

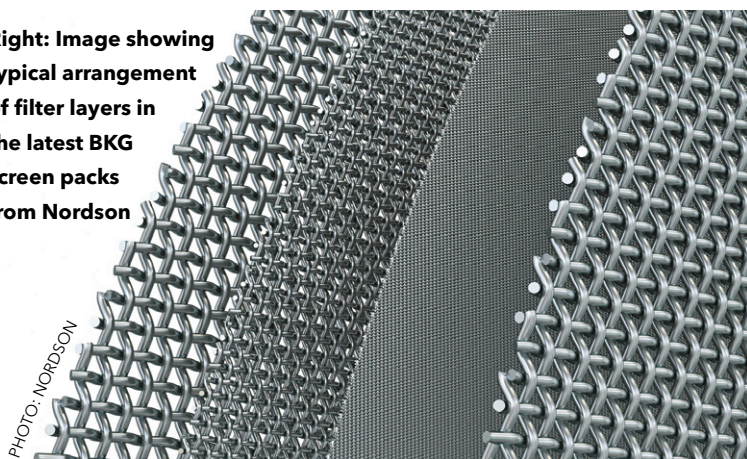
The new screen packs feature a robust multi-layer structure that is said to prevent failures caused by the pressure differentials of up to 200bar encountered during filtration. It is particularly effective at preventing "screen dimpling" where screen layers are forced into the holes of the breaker plate, breaking the peripheral seal and allowing contaminants to bypass the filter.

"The new Nordson screen pack design maintains structural integrity while efficiently filtering out contaminants and ensuring optimal melt permeability," says Christian Schroeder, Global Product Manager Melt Delivery Systems. "As a result, our screen pack yields more output between screen changes than screen packs offered as low-cost alternatives, increasing the productivity of the extrusion line and enhancing profitability."

The new packs are supplied with different layer combinations to suit customer requirements. However, a typical structure would include four layers - two coarse square-weave layers outer components, one fine square-weave fine filtration layer and a high permeability Dutch weave fine filtration layer.

> <http://www.nordsonpolymerprocessing.com>

Right: Image showing typical arrangement of filter layers in the latest BKG screen packs from Nordson





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Right: Automotive compounds feature heavily among Polykemi's latest developments

OCSiAl will display its Tuball single wall carbon nanotubes, which can enhance the electrical conductivity, thermal resistance and flexibility of thermoplastics such as PE, PA, PC, ABS and PVC plastisols. The company says the products, which have a diameter of 1.6nm and measure more than 5 microns in length, are being produced on an industrial scale and are already being used in commercial applications. These include semi-conductive compounds for medium and high voltage power cables with a volume resistivity below 20 Ωcm at 23°C and below 100 Ωcm at 90°C. They are also being used in injection moulded ABS parts for a mining lamp where a surface resistivity below $10^8 \Omega/\text{sq}$ is said to be achieved without sacrificing impact resistance.

> www.ocsial.com

Oka-Tec will show its full range of heat stabilisers for technical plastic compounds. Okabest PAT stabilisers are particularly suitable for PP compounds where, in addition to extensive long-term stability, low values for volatile and condensable emissions and good odour ratings are required. The company's Okaflex range includes organic long-term heat stabilisers that additionally improve resistance to media such as oils, lubricants, glycols, greases, electrolytes and detergents. They also offer good electrical properties.

> www.oka-tec.com

Piovan Group will show new materials blending equipment from its Piovan and FDM brands, together with its latest plant-wide control innovations and Aquatech cooling systems.

In the materials handling area, it will present a Piovan Quantum E gravimetric batch blender with a continuous extrusion control system and FDM GDS series gravimetric dosing system designed to handle pellet, flake, regrind and powder materials.

Below: Piovan will display its latest blending and plant management developments



PHOTO: POLYKEMI

The company will also be demonstrating the latest versions of its Piovan Winenergy and Winfactory 4.0 supervision software. Winenergy, as the name implies, provides energy monitoring and in-depth analysis; Winfactory 4.0 provides plant-wide monitoring and control. It will also show an Easylink+ EL20 materials handling system with automated pipe cleaning.

> www.piovan.com/en

Polykemi, which marks 50 years of compounding this year, will be presenting the latest additions to its technical and recycled compounds product lines, including previewing a new translucent non-reinforced PC for use in automotive switches and light guides.

With its €1m plant upgrade at its Ystad site now complete, the company has intensified development of its flame retardant portfolio. Its POLYfill PP HC has been extended to include flame retarded glass fibre reinforced grades with up to 25% filler content while a new glass reinforced UL94 V-0 PBT for thin wall moulding is under development.

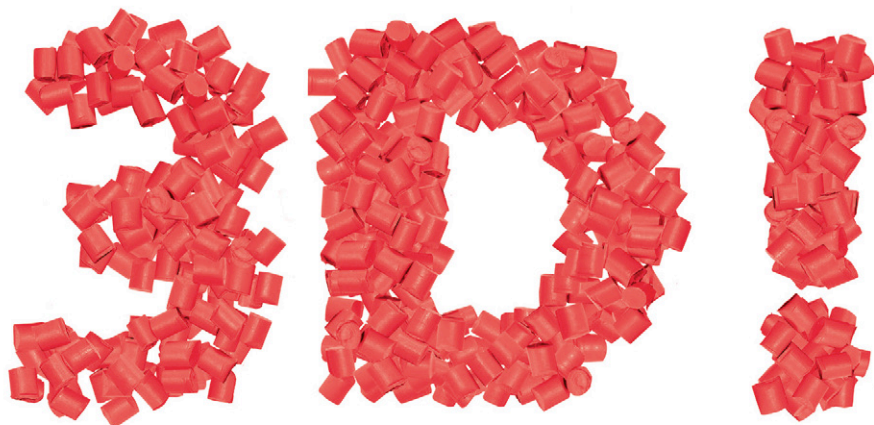
It will also show examples from its POLYfill PP HC line. These high performance reinforced PP compounds can be used as an alternative to PA6, PA66 and PBT in some applications - it says several customers have replaced PA6 GF 30% with POLYfill PP GF5030HC. Polykemi says it is now developing a 35% glass reinforced PP HC to substitute 30% glass reinforced PA66. Benefits are said to include reduced weight, easier processing and low moisture absorption.

The display will be completed with a full range of recycled compounds, including examples from its REZYcom line which combine selected recycled and virgin material. It will show a REZYcom PC/ABS grade formulated to meet automotive finish and colour requirements and a new fire retarded

PHOTO: PIOVAN

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PHOTO: QUARZWERKE



Above:
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light control
masterbatch
for PMMA
glazing

product - REZYcom PP R15000FR V0 - that meets railway industry specifications.

➤ www.polykemi.se

Polyplastics will exhibit the latest developments of its Duracon POM, Duranex PBT, Durafide PPS, Laperos LCP, and Topas COC resins.

New Duracom POM grades include low-VOC emissions for the production of automotive interiors while the latest Durafide PPS grade is said to deliver improved heat shock resistance for a range of demanding applications. It will highlight an example part produced in Durafide PPS using "bump-off" moulding techniques, allowing undercuts to be created without the use of moving mould cores.

The company will show its newly introduced Duranex 457EV an unfilled high-impact PBT, which meets the UL2251 standard for electrical/electronics and automotive, and a range of laser welding resins.

➤ www.polyplastics.com

Quarzwerke will present its Silatherm thermally conductive and Kaolin reinforcing fillers. It will also demonstrate its Acrysmart masterbatch for production of "intelligent" acrylic glazing.

Five Silatherm grades are available, providing improved thermal conductivity while maintaining mechanical properties. High filling levels can be employed due to the optimised particle size distributions, while customised surface treatments allow performance to be adapted to the polymer system.

Kaolin TEC 110 is a phyllosilicate filler with an extremely hexagonal plate-like quality that provides good reinforcing performance. It is available with a number of silane coating options. In addition to its reinforcing effect, Quarzwerke says tests at its HPF Plastics Research Centre show that addition of Kaolin TEC 110 AST grade can significantly reduce the use of expensive flame retardants due to its release of crystal water.

The Acrysmart masterbatch reacts to temperature to provide an automatically variable shading effect - it is clear at lower temperatures and turns a milky-white at higher temperatures. Intended for use in acrylic glazing sheet, the additive allows solar energy to be controlled without further energy input, the company says.

➤ www.quarzwerke.com

Sikora will show its Purity Concept V pellet inspection system configured for automatic offline inspection using an optical camera. It is the first time it has demonstrated an automatic system of this type at a show.

The Purity Scanner is claimed to be more precise, repeatable and reliable than human or conventional manual light table techniques. The Purity Concept V optical system uses a CMOS line scanning colour camera to identify and measure contamination and black specks in transparent materials and on the surface of non-transparent materials. It can work with pellets, sheets or moulded parts.

The Purity Concept system is also available in an X-ray based variant for detection of metallic contaminants in opaque pellets.

➤ www.sikora.net

Teknor Apex will introduce a new series of high-heat glass-reinforced PA66 compounds that it says bridge the cost-performance gap between standard heat-resistant PA grades and costly specialty polymers.

The Creamid 240 H7.5 Series compounds provide the strength and stiffness of high glass filled engineering polymers while maintaining mechanical properties even after continuous service at temperatures of 240 °C.

"These new materials exhibit lower melt and mould temperatures than competing PA66 compounds and high-performance products like PPA, providing economies in terms of energy consumption, cycle times, and tooling requirements," says Dr Hartmut Elsässer, Global Director of Technology for Engineering Thermoplastics at the company.

Currently available unfilled or with glass fibre contents of 35, 50 or 60%, the company says the compounds exhibit dramatically improved property retention when compared to similarly glass-filled standard PA 66 alternatives while costing around 30% less per kilo than high-performance polymers such as PPA or PA46.

The new compounds process at around 280 to 300 °C; typical mould temperatures are in the range of 80 to 110 °C. Both are considerably less than PPA and PA46.



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Teknor Apex sees applications for the Creamid 240 H7.5 compounds in automotive under-hood components such as charge air cooler end caps, air intake manifolds, quick-fit connectors and radiator end tanks, as well as electronic connectors and lamp sockets.

> www.teknorapex.com

Trexel, which is best known for its Mucell physical foam injection moulding technology, will be promoting its recently-developed TecoCell chemical foaming system. The company claims its patented TecoCell chemistry is superior to current foaming agents. The system uses CaCO₃ nanoparticles measuring less than 0.08 microns to create a highly uniform and evenly distributed cell structure. The result is said to be injection moulded components with impressive weight savings, good mechanical characteristics and high quality surfaces.

> www.trexel.com

Velox will show the latest developments from principals Asahi Kasei, LIFE materials and Völpker Spezialprodukte. The company, acquired by IMCD in August, will also present new Lubrizol TPUs.

Velox will demonstrate the latest Asaclean purging compounds from Asahi Kasei throughout the show on a live extruder exhibit. The LIFE Materials display will include two antimicrobial additives: LIFE CI/AM-00-1A is a low VOC grade

developed for car interior parts; LIFE DS/R-00-1A is a silver-based additive for use with polymers such as PC or ABS at dosage rates half that of competing products.

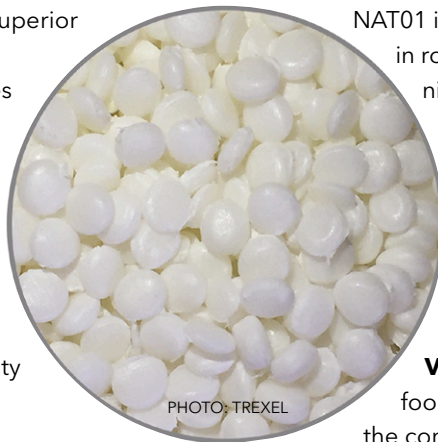
The latest introduction from Voelpker is a new version of its Waradur OP montan wax ester containing a higher level of calcium montanite. The Wardur OPplus grade is claimed to further reduce viscosity of PA66 compounds to allow shorter fill and cycle times.

Velox will also show the latest addition to Lubrizol's Estane TPU family. Estane ZHF 90AT8 NAT01 is designed especially for cables in robotics, construction and communications and offers flame retardant performance with good mechanical properties and heat resistance (UL 105°C rating). It will also show the Lubrizol range of TPUs for 3D print applications.

> www.velox.com

Victrex will introduce its FG food-grade range at Fakuma. New to the company's portfolio, the move is intended to meet the specific regulatory and quality requirements of OEMs in the food equipment sector. Offering significant benefits in terms of cost and performance compared to metals, the new grades are aimed at applications in cookware and beverage dispensers for commercial and domestic use through to industrial applications in conveyor systems, aseptic processing, sensors, gears, and nozzles.

> www.victrex.com



Left: Trexel will promote its TecoCell chemical foaming technology

Fakuma 2018 - Key Information

Dates: 16-20 October 2018 **Hours:** 09:00-17:00 Tuesday-Friday (09:00-15:00 Saturday)

Tickets: One day €28.00, Two day €47.00 (Students €20.00)

Venue: Messe Friedrichshafen, Neue Messe 1, 88046 Friedrichshafen, Germany

Website: www.fakuma-messe.de/en

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Wednesday 28th November 2018

08.30 Registration and welcome coffee
09.30 Opening announcements

SESSION 1 - HOW ADVANCES IN MATERIALS ARE OPENING UP NEW APPLICATION

- 09.40 **New generation building blocks for low density polymeric foams in the automotive and construction industries**
Mr. Emanuel van der Ven, Global Technology Leader, Foam & Lightweighting, SABIC, Netherlands
- 10.10 **Exploring how innovative translucent aliphatic foams are creating new interior and exterior design opportunities**
Dr. Lutz Boehnke, Senior Manager, COVESTRO DEUTSCHLAND AG, Germany
- 10.40 **Novel polyolefin foam solutions - properties, applications and processes**
Dr Antti Tynys, Application Development Engineer, HMS PP, BOREALIS POLYOLEFINE GmbH, Austria
- 11.10 Morning coffee

SESSION 2 - GOING GREEN WITH BIOBASED AND RENEWABLE MATERIALS

- 11.50 **Advanced rigid polyisocyanurate foams with enhanced properties based on original biobased polyester polyol**
Mr. Pierre Furtwengler, Research Engineer, STRASBOURG UNIVERSITY, France
- 12.20 **Reinventing wood chemistry for the development of innovative foams**
Dr. Samuele Giovando, Research & Innovation Manager, SILVATEAM Spa, Italy and
Mr. Pascal Xanthopoulos, Developer Wood Chemistry, POLYBRIDGE Sàrl, France
- 12.50 Lunch

SESSION 3 - FOCUS ON PHYSICAL FOAMING

- 14.20 **Comparison of the physical foam injection molding processes: MuCell, CellMould and ProFoam**
Prof. Dr.-Ing. Volker Altstädt, Managing Director, NEUE MATERIALIEN BAYREUTH GmbH, Germany
- 14.50 **Implementing a new physical foaming process that requires no modifications to the injection moulding machine**
Dr. Pawel Szych, Expert Plastics & Cryogenics, LINDE AG, Germany
- 15.20 **Physical foaming in thin wall rigid packaging**
Mr. Martin Jacobi, Sales Manager, TREXEL GmbH, Germany
- 15.50 Afternoon tea

SESSION 4 - UNDERSTANDING THE PROCESSING AND PERFORMANCE OF FOAMS

- 16.30 **Investigation of the influence of processing parameters on the mechanical properties of physically foamed TPE**
Ms. Yuxiao Zhang, Research Associate, INSTITUTE OF PLASTICS PROCESSING (IKV) AT RWTH AACHEN UNIVERSITY, Germany
- 17.00 **Modelling the thermal properties of polymer foams: recent advances and perspectives**
Mr. Rémi Coquard, Research Engineer, EC2-MODELISATION, France
- 17.30 **Testing the foaming of EPDM rubber and TPE with thermally expandable microspheres**
Mrs. Lena Jönsson, Senior Application Engineer, AKZO NOBEL PULP AND PERFORMANCE CHEMICALS AB, EXPANCEL, Sweden
- 18.00-19.30 Networking Cocktail Reception

Thursday 29th November 2018

08.30 Registration and welcome coffee
09.00 Opening announcements

SESSION 5 - ADDING FUNCTIONALITY AND VALUE

- 09.10 **Advances in flame retardants for XPS/EPS - studying the environmental and technical advantages of a new monomeric HBCD-free solution**
Dr. Micaela Lorenzi, Managing Director / Head of R&D, and Dr. Ethel Garlaschi, General Director GREENCHEMICALS SPA, Italy
- 09.40 **Preventing microbial growth to maintain the functionality of polymer foams**
Ms. Christine Niklas, Product Manager, SANITIZED AG, Switzerland
- 10.10 **Improving the melt strength and foaming ability of LLDPE using nanofibrillated nylon**
Prof. Chul Park, Professor, UNIVERSITY OF TORONTO, Canada
- 10.40 Morning coffee
- 11.20 **Implementing innovative endothermic additives for the eco-friendly chemical foaming of thermoplastics**
Dr. Theresa Wassmer, Business Development Manager Polymers, CHEMISCHE FABRIK BUDENHEIM KG, Germany

SESSION 6 - IMPROVING THE EXTRUSION OF POLYMER FOAMS

- 11.50 **Developing innovative mixing dies to improve the extrusion of polymer foams**
Dr. Heinz Gross, Director, DR. GROSS KUNSTSTOFF-VERFAHRENSTECHNIK, Germany
- 12.20 **Combining melt cooling with static mixing to open up new possibilities for foam extrusion**
Mr. Christian Schlummer, Director Foam Extrusion, PROMIX SOLUTIONS AG, Switzerland
- 12.50 Lunch
- 14.20 **Development of an inline unit for chemical material modifications during foam extrusion that is process-technically decoupled from the remaining extrusion system**
Mr. Nicolas Reinhardt, M.Sc., Research Assistant Foam Extrusion, INSTITUTE OF PLASTICS PROCESSING (IKV) AT RWTH AACHEN UNIVERSITY, Germany
- 14.50 **Optimising the extrusion of XPET sheet - studying the effect of blowing agent, chain extender and die design on foam morphology**
Dr. Daniele Tammaro, R&D Engineer, SULZER CHEMTECH, Switzerland
- 15.20 Afternoon tea and conference ends

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Today's stringent product quality requirements demand the highest levels of compounding equipment cleanliness. Schwing Technologies' Senior Expert Udo Heffungs provides some advice on cleaning options



PHOTO: SCHWING TECHNOLOGIES

Cleaning: the key to quality

Main image:
Cleaned parts being removed from a thermal cleaning oven at Schwing Technologies' contract cleaning facility in Germany

The increasing quality requirement for plastic compounds calls for the highest degree of cleanliness in the equipment used. Contamination leads to significant losses in quality and to plant shutdowns. Effective cleaning provides the solution but also interrupts production. So when should users clean extruder and melt-conveying components? The expert recommendation is to clean down when changing the polymer being processed, when changing polymer viscosity (particularly when moving from a high to low viscosity resin), when changing color (especially from dark to light) or to remove deposits from flow surfaces and out of dead zones.

The purging option

Many compounders would like an "inline" option, allowing equipment to be cleaned without having to disassemble it. A purging or cleaning compound can provide a solution, however, the cleaning material used must be adjusted individually to ensure it suits the process or quality requirements.

There are a variety of cleaning compounds available on the market each with different modes of action: depolymerisation types work by decomposing low-melting or low-viscosity materials; interlacing types use elastic phases to rub surfaces clean; non-melting types use non-abrasive components to rub or scrub surfaces; abrasive types contain components that impart a grinding or

polishing action. Cleaning compounds can also contain a variety of solvents and reagents selected to achieve a particular result.

Unfortunately, there are problems with what is, in principle, an interesting solution. Dead zones may not be reliably purged and purging media, once introduced, can remain in the equipment. Contaminant deposits may remain trapped in the pores of the tool surfaces. Problems can also arise from non-overlapping elements, at pushing/shear edges or undercuts, from partial decomposition, from swelling and extrusion of hot substances, and from the amount of waste generated.

Manual cleaning

An alternative is to use a manual cleaning method. Rough blast media, such as duroplast granules, can remove organic contamination from the surfaces of the screws. Cleaning with blast media offers a number of advantages: the surfaces are cleaned without leaving residues; investment and operating costs are comparatively low; the cleaning process is environmentally friendly; and cleaning can be performed economically with low quantities of media. This approach can only be used, however, to remove surface contamination. Internal contaminants in die plates or pelletising dies cannot be tackled.

The welding torch (or open flame) is still also frequently used today as a cleaning option. The

problems that can arise from this, however, are often overlooked. Uncontrolled development of heat poses a high risk to expensive tooling. The subsequent costs for repair or new procurement often show this to be anything but a low cost option. In addition, the gases created pose a risk to the operator and the environment.

Thermal cleaning

The optimal cleaning method must ensure perfect cleaning of the parts - externally and internally - while also protecting the components from mechanical or thermal damage and avoiding environmental problems. Thermal cleaning systems are able to fulfil all these aspects.

Large gas-fired cleaning ovens (such as the Schwing Maxiclean) are well suited for cleaning larger components, such as pelletising heads, and leave no residues. They offer an automated process that can be adapted to suit the item to be cleaned and the amount of polymer to be removed.

Parts to be cleaned are loaded onto a cart at room temperature. After the door of the oven is closed, heating of the thermal afterburner and the oven is started and the adhered plastic contamination is slowly carbonised. Temperature control of the oven prevents any thermal damage occurring to the metal parts while the carbonisation gases that are formed enter a separate downstream afterburning unit. The oven chamber is slowly cooled down at the end of the cleaning process. An entire cleaning cycle (without cooling time) takes around four to five hours.

Vacuum pyrolysis systems (such as Schwing's Vacuclean) comprise an electrically-heated chamber ovens with a catalytic afterburner. The advantages of this system include more precise control of temperature through direct measurement of the workpiece as well as a slower and more gentle heat-up of the parts. The Vacuclean system is suitable for parts up to six metres long.

Parts to be cleaned are loaded into a chamber at room temperature in a basket. Once the lid is closed, the cleaning process is commenced. A vacuum pump extracts the air from the oven chamber (to around 220 millibar) and this reduced atmosphere causes pyrolysis and some oxidation, which removes organic contaminations. The low-temperature carbonisation gases are cleaned in the downstream catalytic converter. The entire cleaning cycle lasts around 8 to 16 hours.

Fluidised bed

Where a particularly short cleaning time is required, fluidised bed technology can be used (Schwing has its own Innova-clean system). Adhered plastic contaminants are carbonised through thermal-oxidative decomposition. At the bed temperatures of used (400°C to 480°C and up to 520°C in special cases) only inorganic pigments and filler media remain.

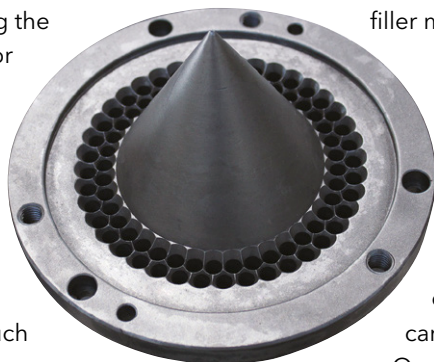
Fluidised bed systems are suitable for all polymers, including PVC, PTFE and PEEK, and can handle assembled and disassembled tools. Other advantages include short cleaning times with no mechanical (abrasive) or thermal damage to the tools and without carbon residues.

Operation is simple. The system is preheated to the required operating temperature by an electric heater and the parts to be cleaned loaded directly into the hot fluidised bed in a basket. Thermal-oxidative decomposition takes place through the atmospheric oxygen of the fluidised air. Cleaning time is typically from one to two hours, depending on the size of the part. Generated off-gas is directed to the thermal afterburner and in special cases (such as for halogenated polymers) it is possible to install a scrubber.

Contract cleaning

All compounding equipment parts can be cleaned using thermal methods. Where there is insufficient capacity to justify an in-house system, a contract cleaning company can offer a suitable solution. The decision whether a user performs their own cleaning or contracts the process out to an external company depends on the individual situation.

> www.schwing-technologies.com



Above and left: Before and after images showing a pelletising plate that has been cleaned at Schwing
Image: Schwing Technologies

About the author

Udo Heffungs is Senior Expert at Schwing Technologies. Based in Germany, Schwing has been actively involved in thermal cleaning for almost 50 years. The company manufactures its own range of thermal cleaning systems. It also offers contract cleaning services from seven locations worldwide and currently handles up to 250,000 parts annually.



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Expanding options for 3D print

PHOTO: SLANT 3D

No longer just a prototyping tool, 3D printing is now moving into the manufacturing mainstream and new developments in compounds are helping to drive this. Mark Holmes finds out more

Additive manufacturing – or 3D printing – is not just an ideal way to produce a prototype quickly and to reduce time to market. Costs of both equipment and materials are coming down and this novel technology is now finding increasing use in applications as varied as making injection moulds and replacements parts through to small scale production and mass customisation. Aiding that transition are developments being made by polymer manufacturers and, particularly, compounders that are yielding materials more ideally suited to the specific characteristics and requirements of the 3D print process.

The 3D printing compounds market is now concentrating on final properties and performance, according to Luis Roca, Head of the Compounding Department at **AIMPLAS**, the Spanish plastics technology research and development organisation. “3D printing is now considered a processing method to obtain final parts and therefore final functionalisation is vital. This includes mechanical properties with continuous fibres, electrical conductivity, metal replacement with high perfor-

mance polymers, food approval developments and more biocompatibility,” he says.

“A further trend is that of part size. Previously, due to the small size of the printer, parts were no bigger than 30cm. Now parts of one metre or more are possible, particularly for the automotive industry. Another important subject is the overprinting of other materials like metals to create new structures with very specific functions, for prosthetics for example,” Roca says.

Roca says that the 3D printing industry now realises the importance of appropriate polymer modification and the need to obtain a good balance between processing and final properties. This is especially important where final parts are being produced. He says that the main issues include the final mechanical properties and the need to add fillers or additives to achieve customer requirements, which impacts on processing characteristics. Roca believes that 3D processing methods will change to allow more challenging materials to be used.

Another important issue is the build speed,

Main image:
Slant 3D
manufactured
these functional support
brackets using
Ingeo 870 PLA
resin from
Natureworks

Right: AIMPLAS researchers are investigating the use of 3D print technologies in areas such as sensors, short run moulds and conductive compounds



PHOTO: AIMPLAS

although this is more difficult to solve from a compounding perspective. However, he says rheological issues have not yet been considered sufficiently by the 3D print industry.

Strong interest

NatureWorks launched its first compounded 3D print grade - Ingeo 3D870 - in February last year and since then reports strong industry interest. "A number of filament companies have their own modified or compounded solutions, but many have found this grade to combine the printability they are accustomed to with our 3D850 base 3D grade with substantially improved impact performance on a par with ABS," says Dan Sawyer, Global Leader, New Business Segment.

"In addition, when parts are annealed, impact performance exceeding that of ABS and greatly improved heat resistance can be achieved. Users are surprised at the combination of impact and clarity with parts printed from 3D870. We are really seeing rapid growth stemming from what some are calling the professional desktop user market, meaning users who print in the work environment, but with a printer in the \$2,500-\$20,000 range. These users prioritise print performance and reliability over unique colours or effects in the raw material and we feel that it is a great fit for our compounded 3D870 and even 3D850, which is being used increasingly in industrial markets like investment metal casting and in anatomical models," he says.

"The industrialisation that is now happening with printers in a more moderate price range than the traditional industrial 3D printers has been something to take note of. Applications like metal casting, jigs and fixtures for manufacturing or medical models will each have their unique perfor-

mance requirements and those are more critical in such an industrial application," he says. "These applications of 3D printing are all about saving time and money in a particular industry so things like break-away support materials or better fusing and finishing grades are areas we are looking at to go further with compounded products."

Sawyer says that one particular area where new compounding solutions are needed is for increasingly complex and larger parts where support materials will allow users to build over them. Other technical areas of interest include the need for a tougher than general-purpose PLA with impact performance for applications such as jigs and fixtures for manufacturing (although NatureWorks says that Ingeo 3D870 goes a long way towards addressing this for a wide range of applications).

Sawyer says the company is in the late stages of developing and testing a grade formulated specifically for this application. "We hope to bring the new breakaway support material to market very soon. Another area we have been working on is a recycled 3D grade. In fact, the podium used at our recent *Innovation Takes Root* conference used post-industrial recycled material and we are continuing to determine if post-consumer scrap could be incorporated into this grade."

Fixture application

Slant3D - a large printing service bureau - recently showed examples of fixtures produced from 3D870 where it was possible to leverage the improved performance in a more demanding application, says Sawyer. "We are working with some of the initial adoptees of this grade to expand on this and add to our collection of case studies," he says. "We are also aware of a case study put out by Ultimaker, where Volkswagen used Ultimaker printers and a formulated version of PLA to produce fixtures used in manufacturing automobiles in their Portuguese factory. The tool was a template used in putting the wheels on the cars without scuffing the rims of the car with automated tooling. Users in these industrial

Right: Filaments are the most popular 3D print option today, offering low equipment cost and easy material customisation



PHOTO: AIMPLAS

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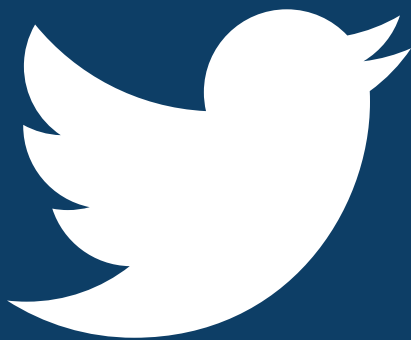


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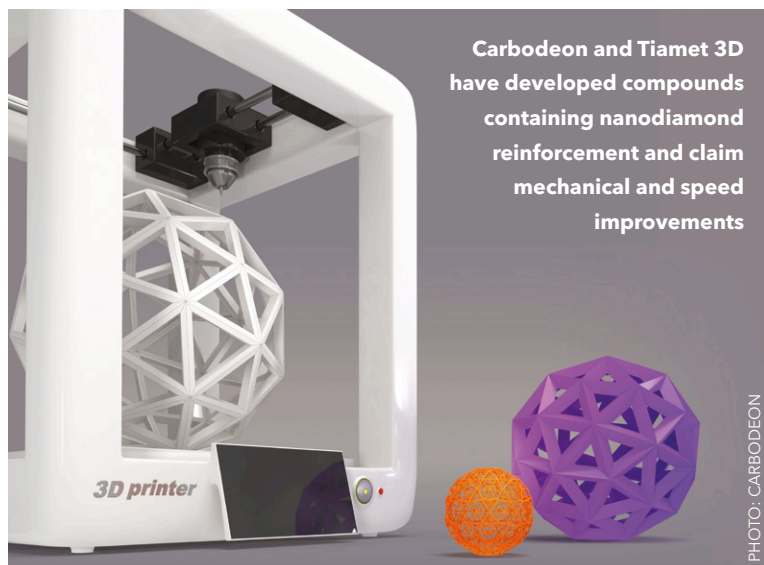
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settings are really demonstrating the time and cost savings in such distributed manufacturing that is growing so rapidly.”

Sawyer says that other future developments are likely to address more flexible applications in printing, which may end up as a reactively compounded product or a compound. Composites that could be used in large tooling used in making thermoset or glass reinforced moulded articles is another area of interest.

Specialty filaments

Solvay has launched three speciality polymer filaments for 3D printed parts. Based on its KetaSpire PEEK and Radel PPSU polymers, the three filaments are to become part of a broader portfolio of speciality polymer filaments and powders designed specifically for high-end additive manufacturing (AM) applications. The range includes a neat PEEK product and a 10% carbon fibre-reinforced grade, both of which are said to be formulated to allow good fusion of printed layers to ensure high part density and part strength (including the challenging z-axis). The third filament is based on PPSU and offers high transparency, good elongation and toughness. Solvay says that it is also developing an AM-ready powder based on its NovaSpire polyetherketoneketone (PEKK) polymer, which will target AM applications in aerospace and healthcare.

Finnish nanodiamond manufacturer **Carbodeon** and Dutch 3D printing specialist **Tiamet 3D** have developed nanodiamond-enhanced filaments for 3D printing. The companies claim a 100% increase in tensile strength, improved printability and better thermal properties. Printing is also said to run more quickly and more reliably.

Nanodiamonds offer the potential to make 3D

printed components that perform as well as or better than comparable injection moulded components, according to the developers, but with large cost reductions and production speed improvements. As well as improving thermal management, conductivity and tensile strength of the base polymer, nanodiamonds can increase the glass transition temperature making the resulting compounds more suitable for challenging environments. The first Carbodeon/Tiamet 3D filaments will be PLA based, with further development focused on higher-performance thermoplastics.

Carbon reinforcement

DSM has launched a new carbon fibre reinforced PA6/66 filament - Novamid ID1030 CF10 - for 3D printing. Despite the low carbon fibre loading of 10% - much lower than other carbon filled materials - the company says that it produces functional prototyping and industrial parts with properties close to what is usually achievable only by injection moulding. Processing is said to match the easy and fast printing of unreinforced plastics.

“FFF [fused filament fabrication] technology is growing rapidly, for use in both prototyping and industrial applications,” says Hugo da Silva, Vice-President of Additive Manufacturing at DSM. “With high-performance materials like our new carbon fibre filament, manufacturers can take it into many more applications like functional prototyping as well as durable and structural industrial parts for harsh environments.”

Novamid ID1030 CF10 3D is designed for printing structural parts which are stronger, stiffer and tougher with higher tensile strength and modulus, high dimensional stability and free of warpage. The good mechanical properties and smooth appearance make it ideal for applications that require robust performance at elevated temperatures such as automotive under-the-hood, protective and supporting sports gear, manufacturing jigs and fixtures, medical braces and prosthetics. The material can be printed on standard desktop FFF machines with a hardened nozzle. Tests have shown that users can run their printers at the same speeds as with unreinforced plastics, while achieving considerably better strength and toughness. DSM says Novamid ID 1030 CF10 has been tested on several open FFF platforms, including on GermanRepRap and the new Ultimaker S5.

Evonik has developed a flexible plastic material based on PEBA (polyether block amide) for use in 3D printing. The new high-performance powder has high elasticity and strength and is suitable for a variety of powder-based 3D printing technologies.



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Right: Lehvoss is supplying materials for the Livrea yacht, claimed to be the first 3D printed sail boat

3D printed parts made from the new PEBA powder show a high degree of flexibility and good resistance to chemicals and durability over a temperature range from -40°C to 90°C. The powder is also ideally suited for the manufacture of functional 3D high-tech plastic parts – for prototypes as well as series products. The material is suitable for a variety of powder-based 3D printing technologies such as laser sintering, high speed sintering or binder jetting.

The flexible synthetic powder has been optimised for use in **EOS** laser sintering systems. “Flexible polymer materials significantly expand the options for additive manufacturing because they allow us to realise new, demanding applications in attractive markets,” says Fabian Stoeber, Senior Product Manager for polymers at EOS. “In addition, the variety of materials not only enables us to produce individual high-tech functional components, but also to develop much more sophisticated 3D concepts that make use of the entire material range.”

Below: This metallic-look spinner toy is manufactured using filament materials developed by Gabriel-Chemie, Schlenk Metallic Pigments and Herz

Special effects

Effect pigment producer **Schlenk Metallic Pigments**, filament specialist **Herz** and masterbatch manufacturer **Gabriel Chemie** have collaborated on developing an authentic metallic look in 3D printing filaments. The masterbatch formulation developed by Gabriel-Chemie using ultra-fine pigments from Schlenk creates a silky, homogeneous surface of the filament. The 3D printed end product is noted for having a deep shine and an authentic metallic look.

The best results are achieved with PETG polymer. Gabriel-Chemie recently expanded its product range of coloured masterbatch for 3D printing filaments with PETG, which is noted for its particularly high degree of transparency and low viscosity. As a 3D printing filament, it combines the positive properties of ABS and PLA.

The PETG metallic range currently consists of five colours - Ocean Blue Metallic Gloss, Calm Red Metallic Gloss, Gunmetal Black Metallic Gloss, Brown Metallic Gloss and Fir Tree Metallic Gloss. Further colours are being developed or are available on request. All colours provide brilliance and depth, even at low doses.

Lehvoss Group has supplied carbon fibre reinforced thermoplastics for the Livrea Yacht, a first 3D printed sail boat. The Livrea Yacht is a project of two Italian boat builders, Francesco Belvisi and Daniele Cevola, and is intended to



participate in the Mini 650 class Minitransat race, which takes place across the Atlantic Ocean from Europe to South America and is next scheduled for 2019. In parallel to the yacht design, the two entrepreneurs have driven the development of a dedicated direct extrusion 3D printing technology with their company **OCORE**. Besides improving the printing hardware - robot, extruder and nozzle - they have patented a new material deposition strategy using a fractal-inspired algorithm.

Lehvoss Group supported the process development and engineered and delivered customised 3D printing materials dedicated to this technology and application. These materials - Luvocom 3F - are based on thermoplastic polymers, such as high-performance polyamides and PEEK, and to achieve the required mechanical properties are reinforced with carbon fibres. The materials are modified to improve inter-layer strength and to minimise warping during printing.

FDM developments

SABIC has launched three new filaments for fused deposition modelling: Ultem AM1010F filament for general high-temperature applications, including tooling; and Ultem AMHU1010F and Lexan AMHC620F filaments for healthcare applications. The company says that the materials can be used for end-use parts as well as prototypes. Ultem AM1010F filament provides high-heat resistance (a glass transition temperature of 217°C) and high mechanical strength. It can also be used in applications such as short-cycle injection moulding tools, carbon-fibre layup tools and automotive components. The filament is UL94 V-0 compliant at 1.5mm and 5VA compliant at 3.0mm.

Ultem AMHU1010F and Lexan AMHC620F filaments are made with SABIC healthcare-grade resins, which are included in the company's Healthcare Product Policy and offer traceability. Both offer biocompatibility according to ISO 10993 or USP Class VI standards, and FDA Drug or Device Master File listings. SABIC says healthcare applica-



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Right: This complex-shaped shock absorber was manufactured using three different 3D printing technologies in PC, TPU and PU from Covestro

tion development can be more efficient using these filaments in prototypes, as the same base resin materials are available in injection moulding grades for production.

Ultem AMHU1010F filament is a polyetherimide (PEI) product, manufactured from Ultem HU1010 healthcare-grade resin that provides inherent high-heat resistance. Printed parts can be sterilised using gamma radiation, ethylene oxide (EtO) or steam autoclaving. It is UL94 V-0 compliant at 1.5mm and 5VA compliant at 3.0mm. Lexan AMHC620F polycarbonate (PC) filament, available in white, is also biocompatible and can be sterilised with gamma or EtO methods. This filament meets UL94 HB rating at 1.5mm.

The company says that both the new healthcare filaments deliver good mechanical performance. They are suitable for a wide variety of medical device applications, from conceptual modelling to functional prototyping and end-use parts. Possible customised or personalised applications include surgical instruments, single-use devices and casts/splints.

PEEK performance

PEEK polymer manufacturer **Victrex** is preparing newly developed materials for additive manufacturing (AM). The first of these is a high strength material for laser sintering which attains lower refresh rates, resulting in improved recycling of unsintered powder. The second is a filament with better Z-strength than existing polyaryletherketone (PAEK) materials.

The company says that incumbent PAEK materials currently on the market, although used in some AM applications, are designed for conventional manufacturing methods, such as machining and injection moulding. As a result, they are not optimal for AM processes. First generation PAEK materials for laser sintering, for example, can only be recycled to a minimal extent, requiring near full refreshment of the printing bed with new powder. And similar PEEK filaments for filament fusion displayed relatively poor interlayer bonding, leading to a loss in Z-strength. The newly developed Victrex grades overcome both challenges.

“Breakthrough technology is paving the way for an exciting



PHOTO: COVESTRO

future for additive manufacturing in PAEK. The powder recycle work for laser sintering, using the new Victrex development polymer grades, has gone very well with no measurable loss of properties when test components were made from partially recycled powder. We believe it will be possible to re-use all of the non-sintered powder that is recovered after a build run. This will result in a significant reduction in material costs compared to current PAEK materials where up to 40% of the polymer is wasted and cannot be recycled,” says John Grasmeyer, Chief Scientist at Victrex.

Victrex is also leading a consortium funded by the UK’s agency for innovation, Innovate UK, to carry out intensive research and development to advance AM technologies. This focuses in particular on high-temperature, affordable polymer composites for AM aerospace applications. Other members of the consortium include Airbus Group Innovations, EOS, University of Exeter Center for Additive Layer Manufacturing, E3D-Online, HiETA Technologies, South West Metal Finishing, and 3T-RPD.

Industrial focus

Eastman has introduced Amphora SP1621 3D polymer - its first powder-based material for industrial 3D printing. Amphora SP1621 powder will be manufactured in collaboration with **Advanced Laser Materials** (ALM), a company specialising in material research, development and consultation for industrial 3D printing. Eastman says that Amphora SP1621 is an advanced, production-ready material for laser sintering. It is a high-perform-

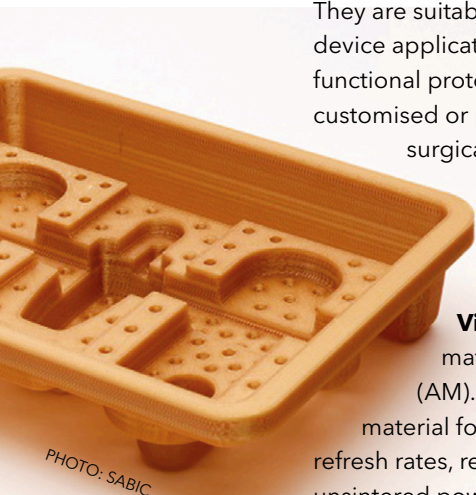


PHOTO: SABIC

Above: SABIC is targeting its new Ultem and Lexan-based filament materials at applications in the healthcare sector

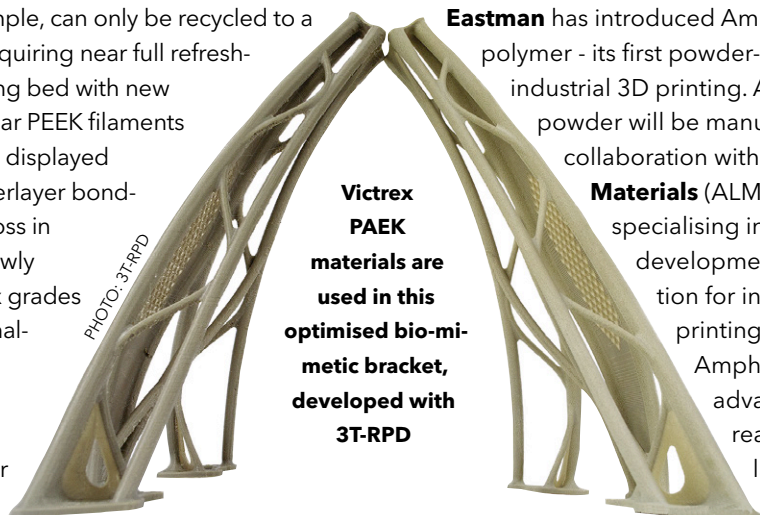


PHOTO: 3T-RPD

Victrex PAEK materials are used in this optimised bio-mimetic bracket, developed with 3T-RPD

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The basics of 3D print production

All 3D print technologies are additive, meaning they build parts by adding material to a structure rather than removing it. Most use a raster-technology to build parts layer-by-layer. However, there are several different techniques in use, which are most easily defined by the type of raw material they use.

Liquid resin

Additive manufacturing started out back in the 1980s using light-cured liquid resins – Stereolithography (SLA). In this process, a laser is used to selectively cure resin in a tank. The process is particularly good for production of fine details but material choice is limited and it is not possible to use “production” resins – only photopolymers that simulate them. As SLA can be a little slow in build terms, newer techniques such as Digital Light Processing (DLP) and Material Jetting have been developed to speed production.

Solid filaments

Filament machines use material in the form of a rod (filament) that is melted and jetted as drops via a heated nozzle. Now the most commonly used AM process, due to its lower investment cost, it is referred to as Fused Deposition Modeling (FDM) or Fused Filament Fabrication (FFF). Typical filament materials include PLA, ABS, PET, TPU and more recently PEEK. While the resin is only applied where it is required, it is sometimes necessary to use a second material to support the structure during build and to avoid warpage. These “support structures” can be designed to be broken away or dissolved in water.

Powdered resin

Rather than applying the polymer where it is needed, powder systems use a laser to fuse selected parts of a thin layer of powder, repeating this layer-by-layer to create the final part. The resulting component is built

within the powder, so support structures are not required. However, the unfused powder materials cannot always be reused so wastage can be an issue. The most common technology is Selective Laser Sintering (SLS). Available materials include PA and PEEK.

Production resins

A number of additive manufacturing systems use conventional granular polymers that are plasticised in an extruder before being fed to a print nozzle. Perhaps the best known within the plastics industry is Arburg’s Freeformer. Such machines can use standard production plastics, which keeps cost down and allows closer simulation to injection moulded parts. However, the range of materials that can be processed, while in theory broad, is limited due to difficulties passing fillers or fibres through the print nozzles. Support structures are required for many geometries.

ing material that enables new product designs from concept to solid 3D objects in a fraction of the time it takes for traditional manufacturing. The polymer’s tailored properties enable Amphora SP1621 to have good in-process and post-production capabilities, including high recyclability, toughness and flexibility, and ease of processing.

At Fakuma 2018 **Covestro** will be presenting a demonstrator of a complex shock absorber, produced using three different AM processes. The outer spring of the 404mm by 70mm part is made of powdered thermoplastic polyurethane (TPU) shaped using selective laser sintering and is notable for its elasticity and high abrasion resistance. The adjusting screw inside the shock absorber is made of a polycarbonate material using the fused filament fabrication process. The air chamber in the interior is created from a liquid polyurethane resin produced using a light processing method proven to be effective for components with filigree structures.

“This complex structure would not have been possible with conventional production processes,” says Lukas Breuers, Marketing Manager for 2D and

3D printing at Covestro. “Another new development is the combination of different materials with various, tailor-made properties. This has enabled us to significantly expand the possibilities of additive production and its areas of application.”

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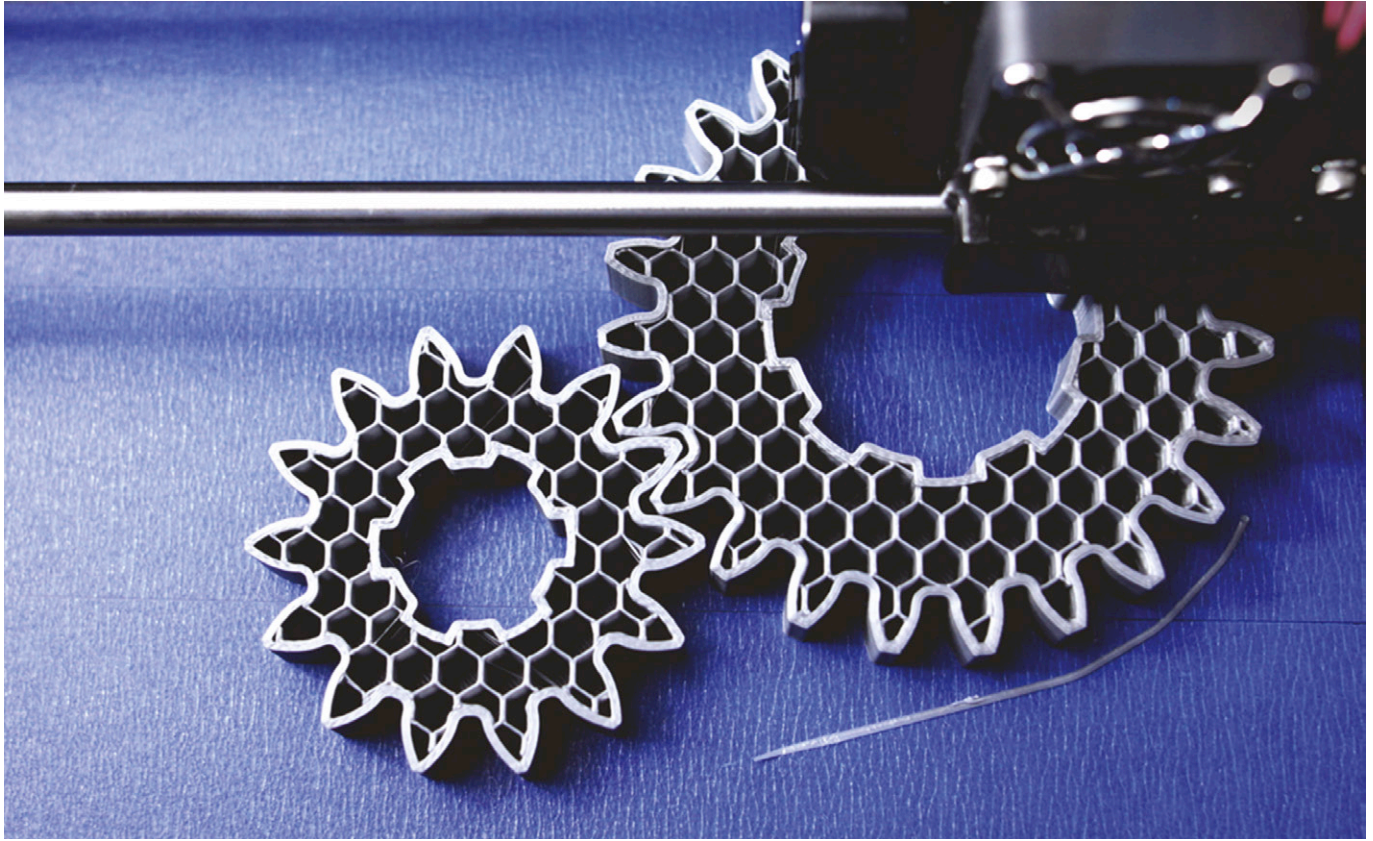
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Building a future in 3D print

AMI's Polymers for 3D Printing conference will explore the opportunities this fast developing technology offers

Main image: As 3D print technology transits from prototyping to production new demands will be placed on materials, presenting new opportunities for plastics producers and compounders

3D printing is growing globally. The technology has already secured its place as a powerful tool for design and prototyping and is now increasingly being considered for manufacture of low volume and highly customised final-parts. Polymers for 3D Printing is a new conference that will provide a timely international learning opportunity for anyone considering the development of specialised polymers for 3D printing, filament extrusion, or rapid prototype production. The two-day event takes place on 11-12 December 2018 in Dusseldorf in Germany. This article previews the expert speakers sharing their insight at the event.

The conference will open with an additive manufacturing overview delivered by **Dr Suveni Kreimeler**, Head of the Part Design/Materials Technology Department at **IKV** (Institute of Plastics Processing) in Germany. Then **Dr Luca Chichio**, Business Development Manager for **Elix Polymers in Spain**, will look at the evolving property requirements of ABS for additive manufacturing technol-

ogy, and **Deepak Venkatraman**, Applications Development Engineer at **Natureworks** in the US, will share details of some of the company's developments in PLA for industrial 3D printing applications.

The next session will be opened by **John Jones**, EMEA Materials Business Group Director at **Stratasys** in Germany, who will showcase some of the exciting and unlimited innovation potential of 3D printing. **Dr Richard Janssen**, Business Development Manager at the **Brightlands Material Centre** in the Netherlands, will explore the challenges and opportunities of additive manufacturing using continuous fibre. Then **Brian Alexander**, Global Product and Application Manager at **Solvay Speciality Polymers** in Germany, will speak about tailored high-performance materials for additive manufacturing and related simulation.

Lukas Pawelczyk, Senior Manager Additive Manufacturing at **Arburg** in Germany, will discuss the company's experience with new materials for rapid prototyping and low volume production. ➤

Then **David Pascual**, Global 3DP Marketing Manager for **Lubrizol Advanced Materials** in Spain, will explain some techniques to elevate performance in 3D printed applications. The session will then move on to look at flame retardant filaments, which will be delivered by **Dr Joanna Marguier**, 3D Printing R&D Manager at **Clariant Produkte** in Germany. And **Gary Pooley**, Ink Development Manager at **Haydale Graphene Industries** in the UK, will explain how graphene can be used to enhance PLA for 3D applications.

The final session of the first day will explore the material science behind some of the emerging 3D print technologies. **Varun Srinivas**, PHD Lead at **Maastricht University** in the Netherlands, will discuss the relationship between polymer molecular structures and 3D printing. And the day will be brought to a close by **Dr Harold van Melick**, R&D Director at **DSM Additive Manufacturing** in the Netherlands, who will explain how material science can drive digital manufacturing applications forward.

The second day of Polymers for 3D Printing will look at innovations driving the use of additive manufacturing from prototyping towards volume manufacturing. **Jean-Marie Maldjian**, Material Senior Expert at **Schneider Electric** in France, will share developments in the company's use of 3D printed resin cavities for injection moulding, which enables it to achieve a 10-day part turnaround. He will be followed by **Luis Roca**, Head of Compounding at **AIMPLAS** in Spain, who will present an update on the centre's studies on composition, thermal behaviour and performance of 3D printed mould inserts. The final presentation in the session will be delivered by **Dr Thomas Joffre**, Project Manager at **Innovation Plasturgie Composites** in France, who will look at the use of heat pipes in polymers made by 3D printing to aid cooling.

The focus of the conference will then shift to process developments. **Fabien Stöver**, Senior Product Manager Polymer at **EOS** in Germany, will explain how the company is adapting its polymer



Expert speakers sharing their insight at Polymer for 3D Printing include (top row from left) IKV Head Part Design/Materials Technology **Dr Suveni Kreimeler**, Stratsys EMEA Materials Business Group Director **John Jones**, Solvay Specialty Polymers Global Product and Application Manager **Brian Alexander**, Arburg Senior Manager Additive Manufacturing **Lukas Pawelczyk**, (bottom row from left) Lubrizol Advanced Materials Global 3DP Marketing Manager **David Pascual**, Maastricht University PHD Lead **Varun Srinivas**, Thermo Fisher Scientific Leader Technical Marketing **Dirk Leister**, and TNO Scientist **Margot Segers**

laser sintering technology for serial production.

Dirk Leister, Leader Technical Marketing at **Thermo Fisher Scientific** in Germany, will explore how novel polymeric materials are enabling more advanced fused filament fabrication (FFF) applications. Then **Daniel Cohn**, General Manager at **Protolabs** in Germany, will speak about selection of 3D print materials for parts ranging from micro to macro scale.

The final session of the conference will look at developments in the use of multi-material 3D print. **Margot Segers**, Scientist at **TNO**, the Netherlands Organisation for Applied Scientific Research, will discuss multi-material printing using photopolymers. Then **Dr Kevin Eckes**, R&D Engineer at **Aerosint** in Belgium, will bring the two-day event to close with an explanation of how selective powder deposition can allow multi-material SLS printing.



About Polymers for 3D Printing

Polymers for 3D Printing is a new two-day conference from AMI exploring the development, production and application of innovative polymers and compounds for 3D printing and other rapid manufacturing technologies. Taking place at the InterContinental Hotel in Düsseldorf, Germany, on 11-12 December 2018, it will cover the latest developments in resins and compounds for a variety of 3D printing and rapid manufacturing methods. Expert speakers will detail developments in established 3D print polymers such as ABS, PLA and PETG, as well as emerging high-performance polymers and compounds offering additional functionality.

To find out more about the event, or to book your place, visit the [conference website](#) or contact the Conference Organiser, Harriet White. Tel; +44 (0) 117 314 8111; Email: harriet.white@ami.international.

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Reinforcing options for compounders

Glass reinforcement makers are improving products and enhancing their supply positions to cater for increasingly global customers. Peter Mapleston finds out more

Glass fibre reinforcements are a pretty mature product. While there may be opportunity to further improve performance in thermoplastics applications, judging from some of the most recent announcements and conversations with fibre manufacturers it seems we may be nearing the limits. Even so, potential surprises remain, as one major has recently demonstrated and we will discuss later.

For the most part, however, industry focus has turned to ensuring compounders can count on continuity and consistency of supply wherever they are in the world. Outside the world of glass, meanwhile, interesting work is going on to provide reinforcement with alternative materials – and in one case at least not using fibres at all.

Japan's **Nippon Electric Glass** (NEG) is certainly on a growth path in glass fibre. Last year, it acquired PPG's manufacturing facilities, R&D and administrative operations in the US, adding them to the European PPG glass fibre operations it acquired in 2016. The move means it now has production locations in the three main market

regions. PPG also divested its ownership interests in two Asian glass joint ventures co-owned with Nan Ya Plastics in 2016 as well.

NEG has a 42-year history in production of glass fibres and has been building up its presence in the sector for several years. Its operation in Malaysia is the largest chopped strand production site in the world and its global glass fibre capacity is over one million tonnes.

Co den Besten, Marketing and R&D Director EMEA at NEG, says that the company has invested more than €100m in the European and US locations to support the growth of the business. In Lexington in North Carolina in the US, for example, a furnace has been switched from production of yarns to chopped strands as of July this year. And at its Wigan location in the UK, a furnace has been rebuilt to give the company the chance to introduce improved technology that den Besten says will result in improved efficiency and increased capacity. In Hoogezand in the Netherlands, a large investment is underway in a new furnace that is projected to start up early next year. In addition, an

Main image: Owens Corning says almost all of its chopped strand products are now boron-free Advantex glass, which offers environmental gains over standard E-glass

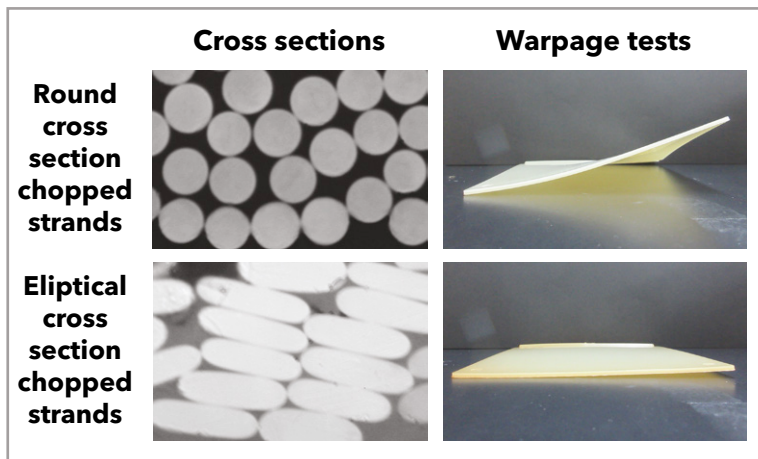


Figure 1: Images showing warpage in two edge-gated square test plaques (approx 170mm by 170mm by 2.2mm), moulded in PA66 30% reinforced with round and flat fibres respectively. Test bars (80 mm by 25 mm) were cut from the centres of the plaques in the flow and transverse directions and tested for flexural strength. Flexural strength in round fibre-reinforced test bars cut in the flow direction was 1.7 times higher than in bars cut in the transverse direction, while the ratio in test bars moulded with flat fibres was much lower, at 1.2.

Source: Nippon Electric Glass

incremental capacity increase is planned for the Malaysia location.

Flat innovation

NEG has also strengthened its global research operations with a new R&D building opened early this year at Notogawa in Japan. One of the most recent results of its research activities is the development of a “flat” glass fibre for thermoplastics. The products, which are more elliptical than flat, are currently produced on a pilot line in Notogawa, but den Besten says NEG it will scale up soon to a larger capacity. Products are available for various polymers, including PA, PP, PBT, and PPS.

“The main advantages for flat glass fibre are reduced warp, higher flow and better surface quality of moulded products, but it also shows very promising mechanical properties at higher glass contents,” den Besten says (see Figures 1 and 2).

In the US, NEG has launched an improved roving for long fibre-reinforced PP. TufRov 4520 is said to show improved processing with very low fuzz, while mechanical properties are claimed to be better than existing LFT rovings for this segment. The company is now considering marketing it in Europe. Also for the LFT segment, it has introduced a roving for food compliant polyamides. TufRov 4515 is said to show good processing performance while meeting all requirements for latest European Food compliance standards.

In the chopped strand segment, NEG says demand for higher performance in a number of thermoplastic polymers can be met with products based on a modified glass composition. It now offers several chopped strands based on its Innofiber XM technology, which was originally developed for the wind energy segment but is now offered for PA and PBT with a grade for PP in the offing.

Other chopped strand products launched in Europe for the thermoplastics segment include ChopVantage HP 3720, designed for PBT and PET compounds requiring food contact compliance, and ChopVantage HP 3293 and HP 3290 (13 and 10µm diameter respectively), developed for improved performance in products coming into contact with hot detergents. Further products are set for introduction next year.

Den Besten says NEG has also decided to support global customers by producing traditional Asian “T” products in Europe and the US as well. “We are also transferring HP products to Malaysia,” he says. “NEG will continue to invest in capacity in all regions in the world and we will continue to develop new products to meet new requirements from our customers.”

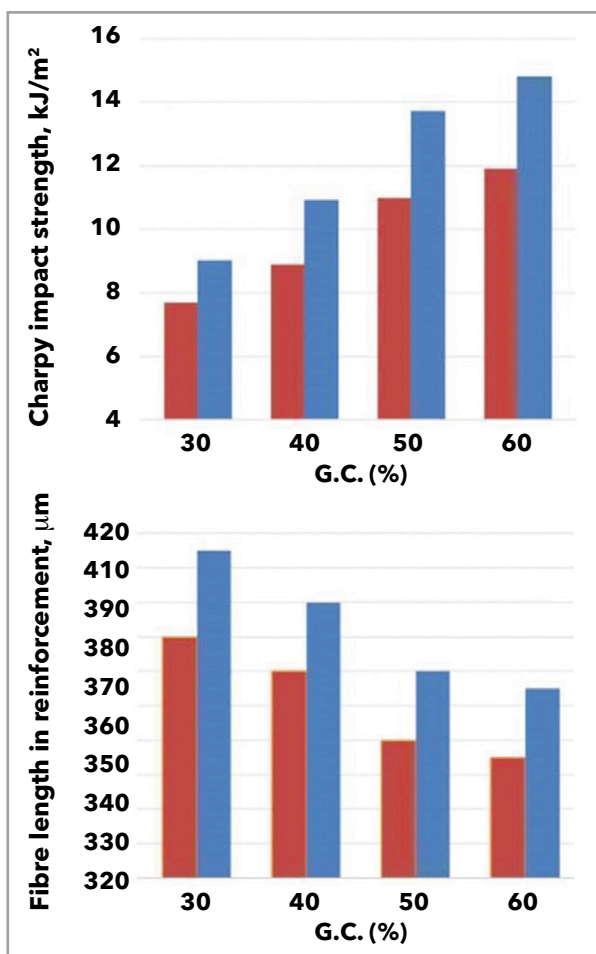


Figure 2: Comparison of impact strength and fibre length retention of PA66 reinforced with conventional round glass fibres (red) and flat glass fibres (blue)

Source: Nippon Electric Glass

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PHOTO: OWENS CORNING



Above: Owens Corning has invested \$50m at its glass reinforcements facility at Chambéry in France, expanding capacity for chopped strand products

Supporting demand

NEG is not the only company investing in the sector. **Owens Corning (OC)** recently spent some \$50m to rebuild a glass melter and expand production capacity by approximately 25% at its composites manufacturing facility at Chambéry in France. It says the investment, which came on stream in the summer, will support growing demand for reinforced thermoplastics in Europe.

Announcing the expansion, Umberto Rigamonti, OC's Vice President and Managing Director of Glass Reinforcements Europe and Global Thermoplastic Products, said: "This investment will support our customers' growth in the thermoplastic chopped strand market by ensuring that we continue providing consistent, high-quality products. It also strengthens our value proposition to thermoplastic customers, supporting our respective growth agendas."

With the rebuild now completed, all thermoplastic chopped strand products from the Chambéry facility are based on boron-free Advantex glass. In fact, according to Chris Skinner, Vice President of Strategic Marketing, Composites, virtually all of the company's production of chopped strand fibre is now boron-free. He says Advantex glass contributes to decreased emissions and reduces the environmental impact of manufacturing fiberglass compared to standard E-glass. Advantex also provides superior performance in composites used in corrosive environments compared to E-glass, he adds.

Discussing other changes in product line-ups, Skinner says that, as reinforced thermoplastics take on more roles in structural and semi-structural parts in areas such as automotive, reinforcement levels are creeping up. He says 15 years ago the average glass fibre level in polyamides was around 18%. Today it is more like 30% and some compounds have much higher levels. To facilitate these higher

fill rates, OC and other fibre makers are now enhancing the dispersibility of the fibres, improving consistency, and offering thinner fibres - 10 micron diameter rather than 13 micron, for example.

Beyond product development, which Skinner admits is moving at a slower pace now than in the past (something he says applies to the glass fibre industry in general, not just to OC), the company is putting strong emphasis on being able to respond to developments in demand all around the world.

Global customers

Globalisation of the customer base, especially in the automotive sector, is pushing globalisation of reinforcement supply - something which favours majors such as OC and NEG over smaller, more regional companies, Skinner says. Beyond its major bases in Europe and North America, OC is also expanding its presence in Asia. The company has, for example, invested around \$110m over the last two years to expand capacity at its composites operations in India, installing an 80,000 tonne/yr glass melter at its facility in Taloja, which started up earlier this year.

Further east, OC entered into technology licensing and manufacturing supply agreements in April this year with Taiwan Glass Ind Corp, based in Taipei in Taiwan. The agreements will leverage its Advantex glass fibre reinforcements and the manufacturing platform of Taiwan Glass to produce a mix of products for both thermoplastic and thermoset applications. The companies will continue to operate as separate commercial entities.

OC said the agreements with Taiwan Glass will

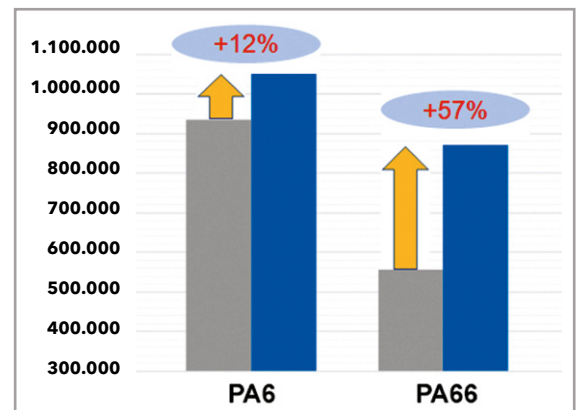


Figure 3: Chart showing the fatigue performance of test samples in PA 6 and 66 compounds reinforced with ThermoFlow 675 (blue) and a competing chopped strand product (grey). Samples were put under sinusoidal stress (50-5.0 %) with a frequency of 1 Hz and tested to fracture. The vertical axis indicates the number of cycles before fracture
Source: Johns Manville

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Right: The latest Thermo-flow grades from Johns Manville target PA applications requiring high fatigue performance

support its growth in the Asia Pacific region beyond China, while also expanding capacity to supply its existing customers in Europe and North America.

Polyamide focus

At **Johns Manville**, Karin Demez, Global Marketing and Portfolio Leader for Fibres, says the company's latest products for PA compounds provide "excellent performance in fatigue performance, which become more and more demanding when long-term testing and vibration tests are performed for demanding automotive applications." She says ThermoFlow 675 short-glass fibres have outperformed benchmarking fibres in PA6 and PA66 during fatigue testing by more than 10% and 50% respectively (Figure 3).

According to Demez, ThermoFlow 675 chopped strands yield excellent tensile strength in PA6 after aging for more than 2,000 hours at 190°C. "Those properties enable compounders to continue to develop new solutions for demanding under-the-hood applications in both petrol/diesel engines and new critical electrical components for e-cars," she says.

Alternative solutions

Development work is continuing on mineral-based reinforcements that may provide alternatives to glass or to other mineral fillers that have only minimal reinforcement effect. At basalt fibre producer **Mafic**, Head of Sales and Marketing Jeff Thompson says the company has been making good progress in its thermoplastics work. Basalt fibres have a similar structure to glass fibres. It offers chopped basalt fibres in various lengths, as well as rovings, and is pitching them as a lower-cost alternative to glass, claiming they still provide high stiffness and strength.

"We are also excited about our new basalt fibre production facility in North Carolina," Thompson says. Mafic is targeting furnace heat-up at the facility, which will be the first to produce basalt fibre in the US, for December this year. Mafic already produces at Kells in Northern Ireland, not far from the Giants Causeway, possibly the most famous basalt deposit in the world.

Independent technical consultant Chris DeArmitt, who has worked for numerous functional filler companies, points to the high pace of growth in such materials. Notable among

Right: Basalt fibres from Mafic are among the potential alternatives to glass for polymer reinforcement applications



PHOTO: MAFIC



PHOTO: JOHNS MANVILLE

recent developments, he says, is a new alternative to wollastonite, the dominant mineral filler in the marketplace at present. Supplier of the new product, called FiberFlex, is **Arctic Minerals**.

"This new amorphous mineral fibre product is just being introduced as an experimental product with samples available shortly," DeArmitt said earlier this year. "It has a higher aspect ratio than wollastonite to provide superior mechanical properties and unlike wollastonite, it contains no detectable crystalline silica. The main applications are as a reinforcement and to provide scratch resistance in PP automotive parts. Arctic Minerals have a waiting list for first samples."

Reacting to lignin

Another alternative for providing reinforcement that sits on the border between filler addition and polymer blending has emerged from the **Oak Ridge National Laboratory** in Oak Ridge in Tennessee in the US. "We are using reactive compounding method to produce new materials based on natural polymer-lignin," says Armit

Naskar from its Carbon and

Composites group. "Lignin is historically treated as filler. It is an organic material with branched chemical architecture and can be mixed at submicron scale in the polymer matrices to yield materials with outstanding properties."

Naskar recently co-authored a paper reporting on a new class of thermoplastic elastomers created by

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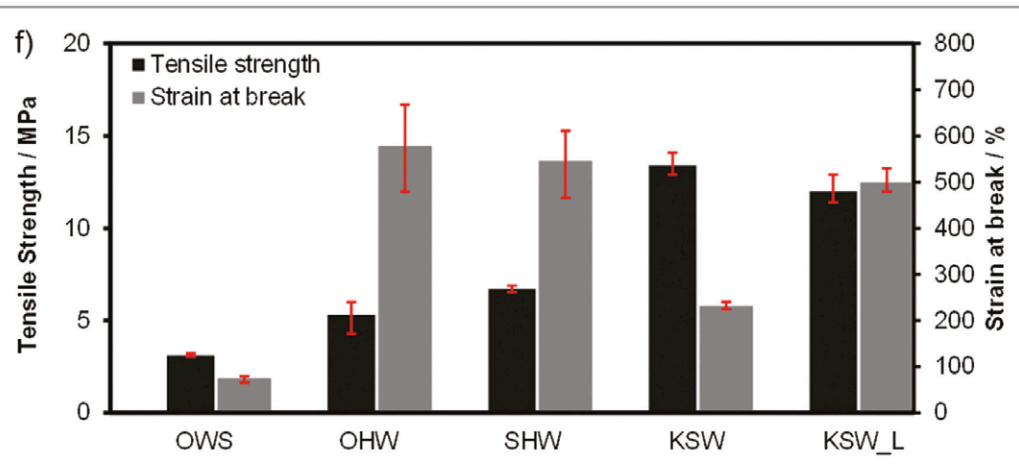
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Figure 4: Tensile failure strength and elongation at break of mixtures of NBR-33 with different lignins at 50/50 ratio, including organosolv wheat straw (OWS), organosolv hardwood (OHW), sodium hydroxide extracted hardwood lignin (SHW), Kraft softwood (KSW), and methanol fractionated low-molecular-weight Kraft softwood lignin (KSW_L).

Source: ORNL



introducing nanoscale-dispersed biomass-derived lignin into nitrile rubber. The authors say the material is “a compositional analogue of ABS, where the styrene fraction is completely replaced with lignin.” The researchers say the material offers significantly higher toughness than ABS (Figure 4).

“Temperature-induced controlled miscibility between the lignin and the rubber during high shear melt-phase synthesis allows tuning the material’s morphology and performance,” the researchers explain in a paper published in the journal *Advanced Functional Materials*. They say the product has “unprecedented” yield stress (15–45 MPa).

Stiff thermoplastic elastomers would find immediate use if they were based on low-cost renewables, the researchers argue. “The common bio-based thermoplastic elastomers have low softening points and most of these elastomers require expensive polyesters or polyamides that have poor hydrolytic stability, which limits their end uses. Hydrothermally stable, higher performance thermoplastic materials made of renewable polymer hard segments bridged with soft segments will offer a great solution for renewable thermoplastic elastomers.”

Energy efficient

The team’s energy-efficient method for synthesizing and extruding high-performance thermoplastic elastomers based on lignin involves fractionating a rigid, thermally malleable lignin that can then be melt-mixed with appropriate soft commodity rubbers to form high-performance polymers with precisely controlled morphology.

Previous reports on incorporation of lignin into rubbers as a potential candidate for the replacement of the conventional reinforcement - carbon black - showed little effect on rubber reinforcing due to its large particle size and lack of interfacial

interactions, they say. “Our method...eliminates the need for costly and energy-intensive chemical functionalisation of lignin and obviates the need for a separate unit operation of polymer synthesis in a reactor with solvents,” the researcher team claims.

Morphology challenge

“Common styrenic thermoplastic elastomers typically contain homogeneous distribution of chemically bonded domains of polystyrene (50–200 nm in length) in a soft matrix. Our research strategy was to replace polystyrene segments with lignin in similar soft matrices. The ‘grand challenge’ in this approach is that of controlling the morphology of lignin domains in the soft rubbery matrix and retaining these domains during processing, testing, and end use.”

The ORNL group used nitrile rubber with 41% and 51% acrylonitrile contents (NBR-41 and NBR-51, respectively) with methanol-extracted low-molecular-weight fractions of Kraft softwood lignin. In their conclusion, the researchers report: “Temperature-induced controlled miscibility between the lignin and the nitrile rubber during high shear melt-phase synthesis allowed us to tune the material’s morphology and performance. Lignin-rubber interaction was further improved by using fractionated melt-stable lignin in the composition with nitrile rubber of optimal acrylonitrile content. The products from equal-mass mixtures of lignin and rubber exhibit unprecedented yield stress and strain harden at large deformation.”

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Exploring conductive plastics

PHOTO: SHUTTERSTOCK

Smart devices and safety-critical electronics are driving interest in polymer compounds offering enhanced electrical and thermal conductivity. Conductive Plastics 2018 explores the enabling technologies and potential opportunities

Main image: Polymer compounds that offer enhanced thermal and electrical conductivity could find applications as varied as heat exchangers to smart sensors

The increasing penetration of electronics into today's industrial and consumer products, together with the emergence of critical application sectors such as autonomous vehicles, is driving demand for enclosures that can eliminate the risk of signal interference while protecting sensitive electronic components and dissipating heat. Meanwhile, traditional applications for conductive polymer applications, such as ATEX and ESD products and trace heating, could extend to include heat exchangers and decorative surfaces with optimised haptics.

AMI's third European Conductive Plastics 2018 conference, which takes place in Vienna in Austria on 6-7 November, explores the latest developments in additive and compounding technologies that will enable the production of electrically and/or thermally conductive plastics compounds capable of meeting these demanding new requirements.

With automotive a key potential market for conductive plastics, the conference will open with a presentation by **Dr Tamim P Sidiki**, Global Marketing Director at **DSM Engineering Plastics** in the Netherlands, who will identify some of the key upcoming application areas. He will be followed by **Klaus Rathberger**, Managing Director of **Georg H Lüh** in Germany, who will discuss carbon-based additives ranging from graphite to graphene. Then

Seçil Yilancioğlu, R&D Manager at **Eurotec Engineering Plastics** in Turkey, will talk through the performance of some electrically and thermally conductive PA materials.

The focus then turns to electrically conductive additives. **Michael Claes**, Chief Technology Officer and Global Strategic Account Manager at **Nanocyl** in Belgium, will detail its work on creating cost-optimised compounds using multi-wall carbon nanotubes (MWCNTs). **Dr Christian Maus**, Development and Support Leader at **OCSiAl** in Luxembourg, will explain how its single-wall carbon nanotubes (SWCNTs) can be used in thermoplastic compounds. And **Tom Daniels**, Market Manager Conductive Plastics at **Bekaert** in Belgium will discuss the use of its stainless steel fibres products.

Moving on to thermally conductive additives, **Dr Stefanie Wildhack**, Senior Specialist Product and Application Development at **3M Technical Ceramics** in Germany, will cover the latest experience with its boron nitride filler products. **Dr Carsten Ihmels**, Head of Department R&D at **Nabaltec** in Germany, will cover the use of mineral FR fillers and metal oxides to enhance thermal conductivity. **Péter Sebő**, Head of Marketing & Market Development at **Quarzwerke** in Germany, will cover fillers for white and colourable applications. And **Dr Bashar Diar**

Bakerly, Senior R&D Specialist at **Huber-Martinswerk** in Germany, will detail the use of alumina-based fillers in thermal management applications.

Day One ends on novel conductive technologies. **Morten Lindberget**, VP Business Development & Sales at **Conalign** in Norway, will explain how it is producing conductive films using a particle alignment technique, and **Dr Daniela Sordi**, Chief Technology Officer at **CarbonX** in the Netherlands, will detail use of its porous carbon nanostructures in films and 3D print applications.

Day Two opens with a review of the processing of electrically conductive polymers by additive manufacturing techniques, presented by **Dr Christof Hübner**, Group Leader Nanocomposites at **Fraunhofer ICT** in Germany. This forward-looking presentation will be followed with an end user panel session including DSM's Tamim P Sadiki plus **Urszula Kosidlo**, Materials Research Manager at **Motherson Innovations Deutschland** in Germany, **Miloslav Smutny**, Material Engineer and Technical Professional Polymeric Materials at **Varroc Lighting Systems** in the Czech Republic, and **Andreas Brunner**, Materials Engineer at **Georg Fischer Piping Systems** in Germany.

The conference then looks at some application challenges. **Jean-Michel Poncelet**, Business Development Manager at **Cabot Performance Materials** in Belgium, will detail how advanced carbons can be used in electrically conductive applications. **Christine Van Bellingen**, Business Development Manager at compounder **Witcom Engineering Plastics** in the Netherlands, will explain how overall compound properties can be optimised while achieving electrical performance. And **Yves Trolez**, Manager of Polymer Material Department at **Total Research and Technology** in Belgium, will detail application of CNTs in industrial ATEX applications.



Expert speakers and panellists include (top row from left) Bekaert Market Manager Conductive Plastics Tom Daniels, 3M Technical Ceramics Senior Specialist Product and Application Development Dr Stefanie Wildhack, Nabaltec Head of Department R&D Dr Carsten Ihmels, Conalign VP Business Development & Sales Morten Lindberget, (bottom row from left) Fraunhofer ICT Group Leader Nanocomposites Dr Christof Hübner, Georg Fischer Piping Systems Materials Engineer Andreas Brunner, Witcom Engineering Plastics Business Development Manager Christine Van Bellingen and Dr Andreas Kaiser, Technical Marketing Manager at Arlanxco

The final session of the conference focuses on thermally conductive applications. **Luca Posca**, Technical Service & Marketing Director at **Lati Industria Termoplastici** in Italy, will speak about development of heat sinks for high power LED lamps. **Marco Grundler**, Group Leader Materials and Compounding Technology at the **ZBT** fuel cell research centre in Germany, will detail its work with graphite filled heat sinks. **Michael Schäfer**, Product Specialist at **Celanese Services** in Germany, will explain the influence of molecular orientation on thermal conductivity of polymer compounds. And **Dr Andreas Kaiser**, Technical Marketing Manager at **Arlanxco** in Germany, will review developments in thermally conductive synthetic rubbers.

About Conductive Plastics Europe 2018

Taking place in Vienna in Austria on 6-7 November, Conductive Plastics 2018 is AMI's third conference covering this topic in Europe and its sixth globally. It is now firmly established as a high level learning point for OEMs, engineering designers, processors, compounders and additive producers to learn about the latest developments in the use and formulation of electrically and/or thermally conductive plastic materials.

Expert speakers will cover the opportunities and challenges in the development and application of these materials in sectors ranging from LED lighting and electric vehicles through to wireless communication systems and ATEX-compliant equipment. Presentations will focus on compound formulation as well as product design and processing. This year's event also includes an end user panel session where attendees can learn how some leading technology providers see applications developing in their markets.

To find out more about Conductive Plastics 2018, visit the [conference website](#) or contact Conference Organiser Grace Midgley. Tel: +44 117 314 8111; Email: grace.midgley@ami.international



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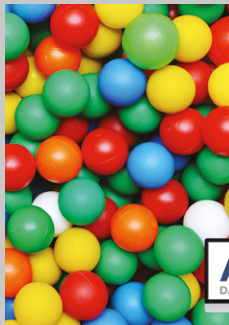
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Farrel Pomini's CPeX Laboratory Compact Processor is ideally sized for compound testing and development applications. Offering production capacities of 10-30 kg/h, it accepts full size pellets and all standard feed materials. Find out more in this brochure.

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

Learn more about AMI's upcoming conferences

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

PLASTIC PIPE FITTINGS & JOINTS 2018



Taking place in Berlin, Germany on 24-25 October 2018, the Plastic Pipe Fittings & Joints conference covers the polymers, production technologies and design innovations, as well as testing and certification, of these system critical components.

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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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PIPELINE COATING USA 2018



The third edition of AMI's North American Pipeline Coating conference takes place on 13-14 November 2018 in Houston, Texas, bringing together leading pipeline contractors and operators, pipe producers and coaters with specifiers and materials and machinery suppliers.

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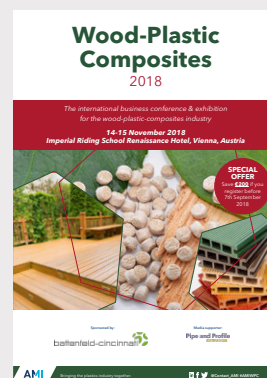
PERFORMANCE POLYAMIDES USA



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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WOOD-PLASTIC COMPOSITES 2018



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

Learn more about AMI's upcoming conferences

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

POLYMER FOAM 2018



Taking place in Hamburg in Germany on 28-29 November 2018, AMI's sixth Polymer Foam conference brings together international experts to learn about the latest developments in blowing agents and physical foaming of polymers.

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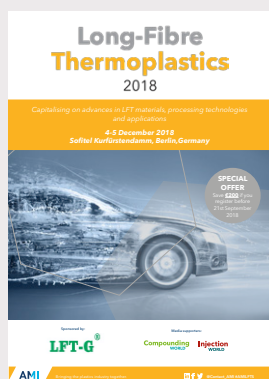
COMPOUNDING WORLD FORUM 2018



The 6th Compounding World Forum takes place on 4-6 December 2018 in Coral Springs, Florida, USA. This annual meeting point for US technical compounders covers business strategies and new materials and processing technologies.

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LONG-FIBRE THERMOPLASTICS 2018



On 4-5 December 2018, the 2nd edition of Long-Fibre Thermoplastics in Berlin, Germany will see LFT experts discuss the latest developments in materials, production techniques and end-use applications which are driving growth in LFT composites.

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FIRE RESISTANCE IN PLASTICS 2018



AMI's Fire Resistance in Plastics conference takes place on 10-12 December 2018 in Cologne, Germany. Now in its 13th year, the event provides a forum to debate fire safety requirements and regulatory and technical developments.

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PLASTICS REGULATIONS USA 2018



Following two successful events in Europe, AMI's first North American Plastics Regulations conference takes place in Pittsburgh, PA, USA, on 11-12 December and will examine the evolving nature of US and global chemical, plastics and food contact regulation.

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POLYMERS FOR 3D PRINTING



Polymers for 3D Printing is a new conference from AMI exploring the development, production and application of polymers for 3D printing and other rapid manufacturing technologies. The event will be held in Düsseldorf, Germany on 11-12 December 2018.

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

Plastics Recyclers in Europe 2018

Access verified contact, source
and reprocessed product data
for 877 plastics recycling sites:

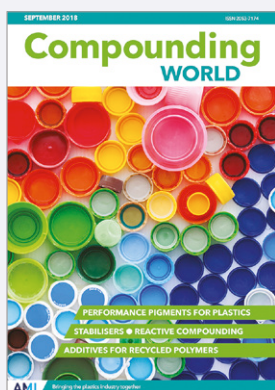
- ✓ *Identify* suppliers of recycled polymers
- ✓ *Find recyclers* of production waste
- ✓ *Analyse* each recycler's potential for your business
- ✓ *Contact* managerial decision makers
- ✓ *Research* the industry



Find out more **HERE** or email evren.akfirat@ami.international
for a free sample excel file of this database

Keep informed: read our latest editions

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



Compounding World September 2018

The September edition of Compounding World looks at developments in the world of colours, where pigment price rises are causing pressure. The issue also covers reactive compounding, new stabilisers and additives for recycling.

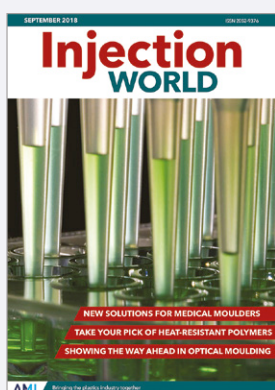
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Compounding World August 2018

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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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 September/October 2018

The September/October edition of Plastics Recycling World looks at the equipment on offer for direct recycling to sheet. Plus, exclusive analysis of Europe's recycling capacity needs and a review of the latest optical sorting technologies.

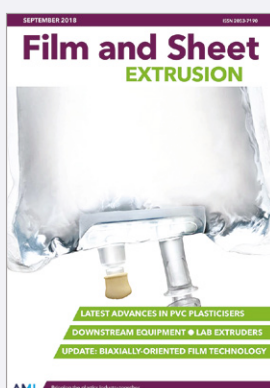
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Pipe and Profile October 2018

The October edition of Pipe and Profile Extrusion magazine has features taking an in-depth look at pipe inspection, oriented PVC, advances in materials handling and new methods for in situ pipe production. The edition also previews AMI's Conductive Plastics conference.

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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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Injection
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Plastics Recycling
WORLD

GLOBAL EXHIBITION GUIDE

Year	Event Dates	Event Name & Location	Website
2018	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
	14-16 November	JEC Asia, Seoul, South Korea	www.jeccomposites.com
	26-29 November	All4Pack, Paris, France	www.all4pack.com
	5-7 December	Plastic Japan, Chiba, Japan	www.plas.jp/en
2019	5-8 January	ArabPlast, Dubai	https://arabplast.info
	12-15 March	Pro-Pack Africa, Johannesburg, South Africa	www.propakafrica.co.za
	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/na
	21-24 May	Chinaplas 2019, 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	K 2019, Dusseldorf, Germany	www.k-online.com
2020	16-20 January	Plastivision India, Mumbai, India	www.plastivision.org
	21-23 January	Swiss Plastics, Lucerne, Switzerland	www.swissplastics-expo.ch
	7-13 May	Interpack, Dusseldorf, Germany	www.interpack.com


AMI CONFERENCES

6-7 November	Conductive Plastics Europe 20-18, Vienna, Austria
6-7 November	Performance Polyamides USA, Pittsburgh, PA, USA
14-15 November	Wood-Plastic Composites 2018, Vienna, Austria
28-29 November	Polymer Foam 2018, Hamburg, Germany
4-6 December	Compounding World Forum 2018, Coral Springs, FL, USA
4-5 December	Long-Fibre Thermoplastics 2018, Berlin, Germany

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

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