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Compounding WORLD

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AGC plans US plant expansion

AGC Chemicals Americas is to add 50% more manufacturing, QC lab and office space at its site at Thorndale in Pennsylvania, US. Construction has already commenced and completion is scheduled for July 2023.

"The multi-use facility will be configured to meet the growing needs of current business and accommodate future production increases and new capabilities," the company said.

The Thorndale site is managed by the company's Global Compounds business unit. AGC said it was chosen for expansion because of its strong technical capabilities in compounding fluoropolymer resins and its significant presence in the transportation, aerospace and energy markets.

› **www.agcchem.com**

Avient ups medical focus

Avient Corporation's production site at Taoyuan in Taiwan has secured ISO13485:2016 certification, giving the company a fourth global manufacturing location for its Mevopur medical compounds and enhancing its ability to service the China and Asia-Pacific healthcare sector.

"China and other Asian countries not only have a rapidly growing domestic healthcare market, but they are also actively supporting Western countries for medical product manufacturing, where they need to meet strict medical and pharma-related standards for testing, traceability, and change control of the materials used in their products. This is where the Mevopur product line, and local availability from Taiwan, become extremely important," said Say-Eng Lee, Vice President and General Manager, Color & Additives Asia.

IMAGE: AVIENT/GETTY IMAGES

Above: Avient is now manufacturing its Mevopur medical grades in Taiwan

The company already produces Mevopur compounds at its ISO13485 compliant locations at Lewiston in Maine in the US, Malmö in Sweden, and in Singapore.

Avient reported a 27% growth in sales for 2021, reaching $4.8bn (adjusted to take account of the acquisition of the colour masterbatch activities of Clariant in July 2020). Full year adjusted EPS was up 58% to $3.05.

"We delivered record results this year against a backdrop of unprecedented challenges including the ongoing pandemic, substantial raw material inflation, supply chain disruptions, and labour shortages," said Chairman, President and CEO Robert M Patterson.

While expecting material and labour shortages to continue into 2022, and for inflation to rise, the company is forecasting a full year sales result of around $5.1bn.

› **www.avient.com**

Vertellus acquires Polyscope Polymers

Vertellus has acquired Polyscope Polymers, the Netherlands-based manufacturer of speciality additives for use in engineering polymers and other applications.

The company said that the addition of a "complementary product portfolio and advanced manufacturing capabilities" would expand its European production capabilities and extend its reach in to high-growth end markets.

Polyscope, which is based at Geleen, has sales and marketing opearations in Europe, North America and Asia, and claims more than 300 customers in over 35 countries. It focuses on production of styrene maleic anhydride (SMA), offering SMA and SMANPMI co and terpolymers and compounds for engineering plastic and speciality chemical applications, which it markets globally under the Xiran and Xiloy brand names.

IMAGE: POLYSCOPE

› **www.polyscope.eu**

› **www.vertellus.com**

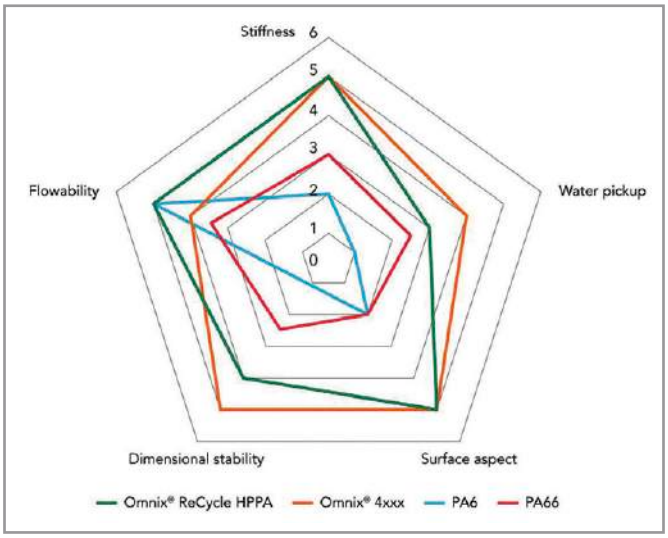
Left: Polyscope's Xiran IZ terpolymers can enhance heat resistance

Solvay launches recycled high performance PAs

Solvay has introduced the Omnix ReCycle family of high-performance PA (HPPA) compounds. The new products are based on a minimum of 33% recycled content, comprised of 70% post-industrial and 30% post-consumer sourced recycled resin.

Omnix ReCycle is claimed to be the first recycle-based HPPA available with a 50% glass fibre reinforcement.

According to Solvay, in addition to the advantage of recycled content and 30% lower global warming potential, it "combines the outstanding mechanical properties of virgin semi-aromatic HPPA with better flow, lower water pick-up and best-in-class surface aspect."



Omnix ReCycle is also said to offer greater durability than standard PA6 or PA66 polymers while having a good surface appearance that eliminates the need for painting, along with the tear resistance required for lightweight automotive interior components. Solvay says it can be processed on standard injection moulding equipment using water-regulated moulds.

› **www.solvay.com**

Domo goes global with Technyl

Domo Chemicals said it is now marketing the full Technyl range of PA6 and PA66 compounds globally, including the Technyl 4 Earth, Technyl Star and Technyl Protect product lines.

The company secured the rights to the Technyl brand in 2020 after acquiring Solvay's European Performance Polyamides business as part of the deal that saw BASF take over the Solvay PA business. BASF ceased to use the Technyl brand name from 1 September 2020 and all former Technyl grades that it retained are now sold under the Ultramid brand.

Domo Chemical described the ability to market the Technyl compounds globally as a key milestone in its growth strategy.

› **www.domochemicals.com**

IN BRIEF...

LyondellBasell's black masterbatch, Polybatch 73641 NIR, has obtained certification from COTREP (the French Technical Committee for the Recycling of Plastic Packaging) showing that plastics containing it can be separated using conventional near-infrared sorting equipment in recycling facilities.
www.lyondellbasell.com

DSM Engineering Materials is expanding its comparative tracking index (CTI) test laboratory to enable validation of tracking resistance up to 1,500V AC and 1,000V DC. The move is part of its plans to support manufacturers with materials for production of electric vehicle (EV) drive and charging systems.
www.dsm.com

Arkema is to increase its global capacity for Pebax elastomers by around 25% through an investment at its Serquigny plant in France. The investment will up capacity for Pebax Rnew range, made from castor seeds, as well as the company's traditional Pebax grades.
www.arkema.com

VinylPlus targets medical PVC recycling

VinylPlus has initiated a European collaborative project to recycle single-use PVC medical devices.

VinylPlus Med aims to develop a recycling scheme for single-use PVC medical devices used in hospitals in Belgium. Working in partnership with the Europe Hospitals group, it will focus on high-quality PVC waste.

"Most PVC medical waste is non infectious and can be recycled when properly sorted and collected," said Brigitte Dero, Managing Director of VinylPlus.

Other partners in the project include waste management company Renewi and recycler Raff Plastics.

VinylPlus said PVC medical devices are already being successfully recycled in eight countries, including Australia, New Zealand, UK, South Africa, Canada, Guatemala, Colombia and Thailand.

› **www.vinylplus.eu**

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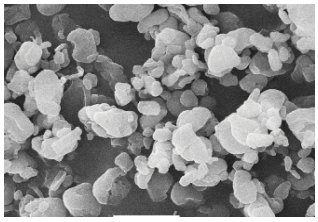
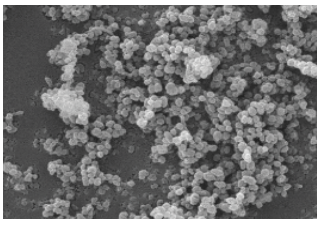
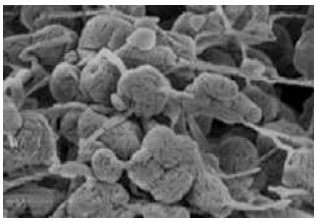
Shamrock offers Regulatory Compliant (RC) PTFE micropowder additives made from Recycled and Natural Prime feedstocks







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Shamrock Recycles

Covestro makes a circular call

Covestro said it is working with Fairphone, a Netherlands-based social enterprise aiming to build a market for sustainable and repairable smartphones, on the use of circular and recycled materials.

Fully and partly recycled TPUs from Covestro's Desmopan range are specified for the protective covers of the Fairphone 3 and new Fairphone 4, including Desmopan 3095AU RC100, which is sourced from post-industrial streams of recycled plastics. The materials are certified according to Recycled Claim Standard for traceability of recycled raw materials.

"The fully recycled material exhibits the typical advantages of TPU, for example, high chemical and abrasion resistance, but easier processability because it melts at lower temperatures and flows better than virgin material," Covestro said.

IMAGE: COVESTRO/FAIRPHONE

Above: Fairphone aims to make more sustainable smartphones

The new Fairphone 4 model also contains 30-50% post-consumer recycled Makrolon PC in the rear cover, middle frame and wireless charger. The PC grade used is said to offer physical properties comparable to virgin material in terms of impact strength, stiffness, flame retardancy and flow, while reducing CO_2 emissions by 30%.

Separately, Covestro and biotech firm Genomatica announced they have produced "significant volumes" of bio-based hexamethylenediamine (HMD) during their joint work to develop a commercial process technology.

HMD is a key raw material for the production of PA66 polymer.

The two companies now plan to proceed to full commercial scale manufacturing and Covestro has secured an option to license Genomatica's GENO HMD process technology for this purpose.

› **www.covestro.com**
› **www.fairphone.com**
› **www.genomatica.com**

LB Group invests $160m in TiO_2

Chinese chemicals and titanium dioxide (TiO_2) producer LB Group, formerly known as Lomon Billions, is to invest RMB1bn (around $160m) to build two 100,000 tonne/yr pigment finishing lines at its plant at Xiangyang.

The move is part of an RMB3.5bn ($560m) package of investments across its business in 2022, which also includes production of lithium battery raw material lithium iron phosphate.

With a total capacity of around 1m tonnes, LB Group claims to be the world's third largest TiO_2 pigment producer and the largest in Asia in capacity.

A spokesperson for LB Group said it has just received approval from the China Securities Regulatory Commission to move ahead with plans to list on the Hong Kong Stock Exchange.

› **www.lomonbillions.com**

MK connects with Ultradur PBT

MK-Elektronik developed its new C-Klic automotive connector system using Ultradur B 4300 G4, a glass reinforced grade of PBT from BASF. The new design is said to provide a space saving of up to 60% compared to standard USB ports while supporting data transfer rates of >10GB/s and providing a USB power delivery option. Ultradur is used to produce the CPA element, coding housing and internal overmoulding in the new design.

› **www.plastics.basf.com**

IN BRIEF...

SABIC has launched two new high flow glass fibre-reinforced PEI resins for electronic applications. Superflow Ultem SF2250EPR and SF2270 are said to provide the high flow required to mould thin-wall, high-precision, miniaturised connectors.
www.sabic.com

Evonik has launched a new isononanol-based cyclohexanoate plasticiser – Elatur DINCD – which will be made at its site in Marl, Germany. Elatur DINCD is said to offer excellent low-temperature flexibility and high UV resistance. Potential applications include roofing membranes and floor coverings.
www.evonik.com

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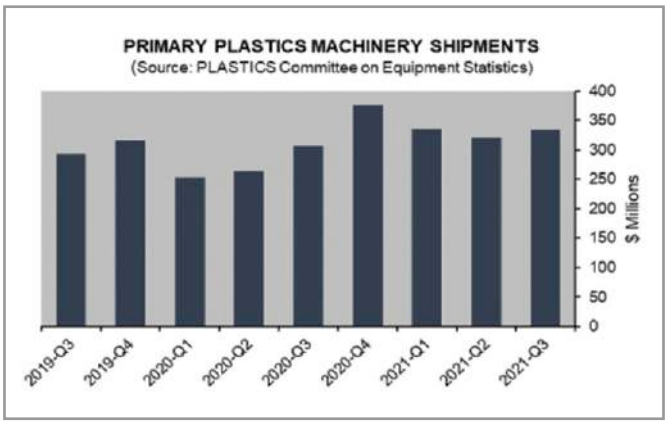
US machine shipments up in Q3

Shipments of primary plastics processing machinery in North America were up by near 9% year-on-year in Q3 2021, according to data from the Committee on Equipment Statistics (CES) at the US Plastics Industry Association.

Preliminary CES estimates put shipments at $334m for the quarter, up by 4.0% on Q2 and 8.8% on Q3 2020. Shipments of twin-screw extruders saw the biggest gains – up by 44.4% and 61.2% respectively. Single-screw extruders saw growth of 7.2% and 15.9%, while injection moulding machinery shipments grew by 1.6% and 5.7%.

The performance was in line with higher plastics production and the continued recovery in the US economy, said Plastics Industry Association Chief Economist Dr Perc Pineda.



According to CES, 76% of machinery executive respondents to its latest quarterly sentiment survey expected market conditions to either improve or hold steady in Q4, while 75% expected a similar outlook for the following 12 months.

"Data we're seeing confirm our prior projections that the outlook for plastics machinery in the second half of 2021 is positive albeit shipments will continue to fluctuate. The likelihood that supply chain issues will continue to be a headwind in 2022 remains high. The globe is still emerging from the pandemic," said Pineda.

› **http://plasticsindustry.org**

Italian machinery picks up

Italy's plastics and rubber machinery manufacturers saw a 14% increase in sales for the first nine months of last year, fuelled largely by healthy domestic demand, according to industry association Amaplast. Incoming orders rose by 41% over the period.

Amaplast said sales grew 17% in Q3 compared to the same period in 2020, and orders were up by 30%. Expectations for Q4 are positive, with revenues expected to come in some 60% up on Q4 2020.

› **www.amaplast.org**

Polygiene grows in biocides

Sweden's Polygiene, through its wholly-owned subsidiary Addmaster (UK), has acquired the SteriTouch antimicrobials business from UK-based Radical Materials for £3.5m.

The company said buying the SteriTouch business will increase its share in the market antimicrobial products for plastics.

SteriTouch sales amounted to £1.4m last year, according to Polygiene.

› **www.polygiene.com**

Piovan boosts global scale with acquisition of IPEG

Italian materials handling systems maker Piovan has continued its global expansion with the purchase of US-based IPEG – parent of Conair, Thermalcare, Pelletron and Republic Machine – for around $125m.

The move creates a global equipment business with 14 facilities and 1,800 employees worldwide and total sales of more €450m (based on pro forma results for the year to 30 September 2021).

"The acquisition of such an important American player and the merger of two of the largest companies in the world in the field of industrial automation for the processing of virgin and recycled polymers and bioresins will allow us to achieve important growth opportunities on a global scale," said Filippo Zuppichin, CEO of Piovan Group.

"It will also allow Piovan Group to access a formidable customer base in North America, with the possibility – thanks to the international set up of Piovan Group – to follow the investments of the main American multinational corporations in the world," he said.

Piovan said it also expected to benefit from acquired production capacity in India and the possibility to produce chillers in the US.

The move puts the newly acquired IPEG group companies alongside Piovan's existing US-based auxiliaries supplier Una-Dyn, and its European-based Aquatech, Doteco, Energys, FDM Penta and Progema subsidiaries.

› **www.piovan.com**

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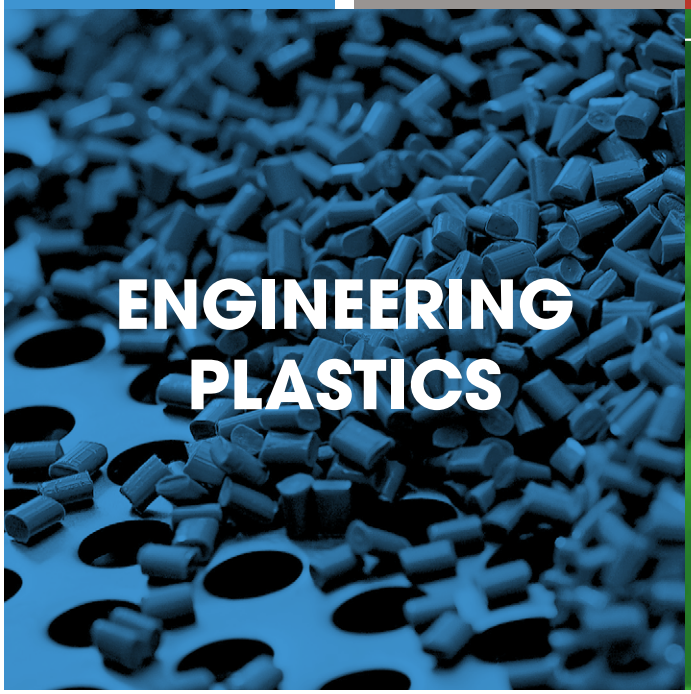

Plastics Engineer

www.tisan.com.tr

Study finds 78% of online sales in breach of EU chemical rules

Enforcement authorities acting for ECHA (the European Chemicals Agency) found that 78% of 6,000 products sold online and falling within the scope of REACH, the Classification, Labelling & Packaging (CLP) regulation, and/or the Biocidal Products Regulation (BPR) were non-compliant in at least one.

The enforcement programme included professional and consumer products and articles including textiles, leather, childcare articles, toys and jewellery. It resulted in around 5,000 enforcement actions.

Of 2,600 products checked against requirements for restricted substances, around 1,800 contained carcinogenic, mutagenic or reprotoxic substances (CMRs). Other non-compliances were found relating to phthalates in toys and cadmium in jewellery.

CLP non-compliances were mostly related to the lack of information on the hazards of the chemical product in the online advertisement; in 75% of cases this was missing and in others it was not clearly visible.

ECHA said 77% of inspected biocidal products were found to be non-compliant with at least one requirement under the BPR, with repellents and attractants the worst offenders and misleading statements the most common failing.

› **https://echa.europa.eu**

BASF reorganises research

IMAGE: BASF

Above: BASF Chief Technology Officer Dr Melanie Maas-Brunner

BASF is to reorganise its worldwide research activities over the coming year, embedding most business-related research units into its operating divisions to align them more closely to customers' needs. A centralised research division will take on activities relevant across multiple businesses.

"To overcome the challenges of the transformation towards sustainability at an even faster pace and be successful in the long term, we must further strengthen customer proximity and leverage the advantage of our know-how verbund," said Dr Melanie Maas-Brunner, Chief Technology Officer.

BASF has about 10,000 employees working in R&D worldwide and invested €2bn in R&D in 2020.

› **www.basf.com**

Styrolution adds ABS capacity in Europe; sells TPCs to Ensinger

Ineos Styrolution has started production of ABS at its site in Wingles, France, having completed conversion of an existing PS line. The new plant provides capacity of 50,000 tonnes/yr and is expected to supply the construction, compounding, household and automotive markets in Europe.

The new ABS line is the company's third European ABS site, joining those already in operation at Antwerp in Belgium and Cologne in Germany. In common with the Antwerp operation, the Wingles line will focus on production of standard Terluran and Lustran brands. Production of PS will continue at the location on other lines.

■ In a separate move, Styrolution has sold its StyLight SAN-based thermoplastic composite materials business, which was originally launched in 2016, to German compounds and semi-finished material firm Ensinger. The acquired materials will be rebranded as Tecatec, Ensinger's existing brand in this sector.

› **www.ineos.com**

› **www.ensingerplastics.com**

Ravago to work with Heartland

Bio-based materials group Heartland, which is building the first industrial hemp supply chain in the US, has concluded a joint development agreement with compounding and recycling firm Ravago Americas with the aim of creating plastic compounds incorporating the former's engineered hemp additives.

Heartland expects to be able to process over 45,000 tonnes of hemp additives for plastic compounding applications during the 2022 growing season.

The additives are claimed to reduce carbon footprint of virgin plastics by up to 44%. Heartland is now working on verifying the impact of hemp-filled recycled compounds.

› **www.ravago.com**

› **www.heartland.io**

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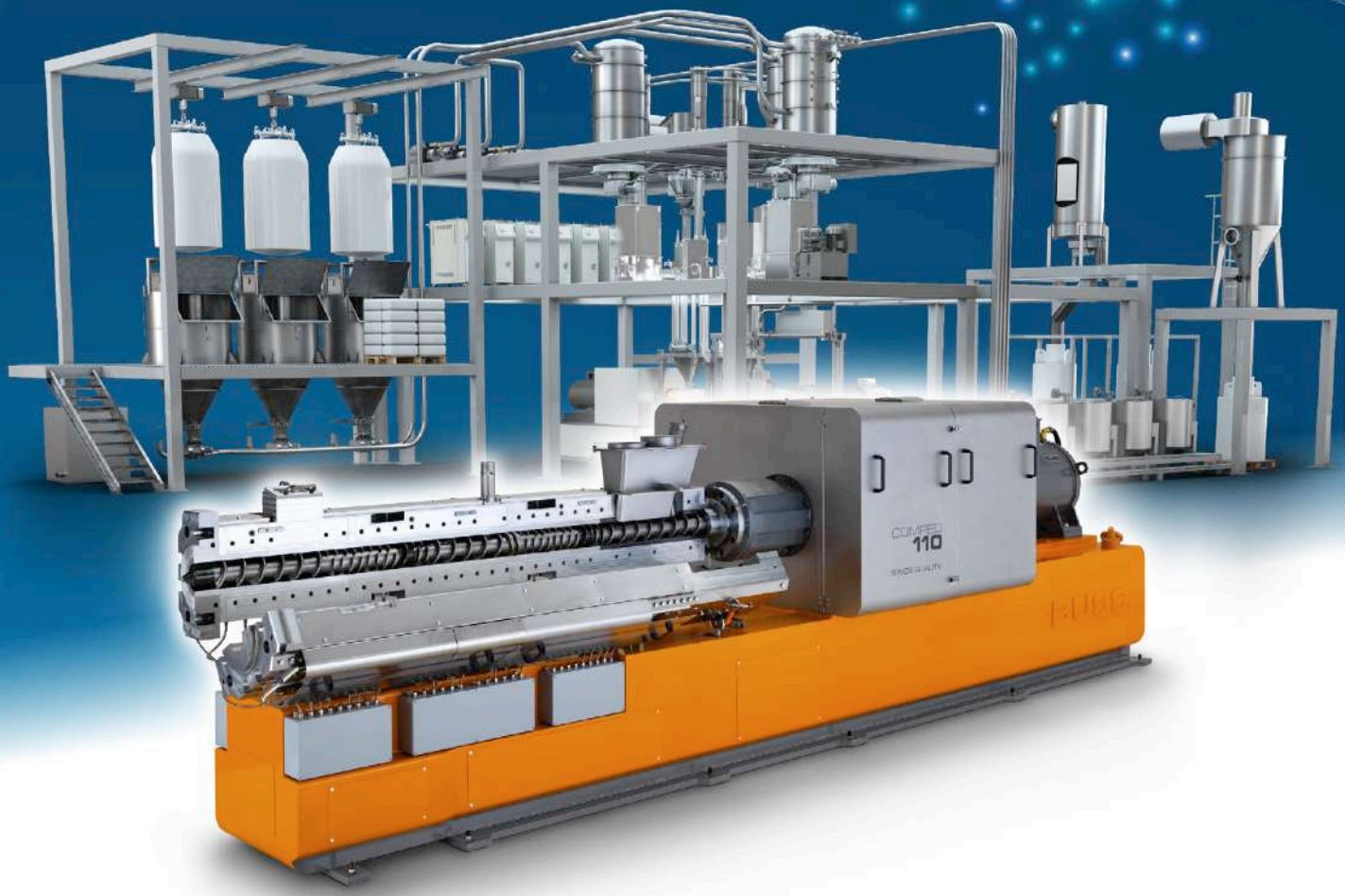

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IMAGE: SHUTTERSTOCK

Modifying surfaces for performance

*Surface modification of compounds can enhance the performance and durability of plastics while protecting or improving aesthetics. **Mark Holmes** learns more*

The ability to modify the surface properties or characteristics of a plastic compound can improve performance and broaden its field of application. In terms of aesthetics, scratch and mar resistance can be greatly enhanced while the general appearance of fibre reinforced polyamides can be significantly improved. And in high-performance applications requiring reduced wear or low coefficient of friction – such as bearings, bushings and housings – internal lubrication can eliminate the need for external lubricants and so reduce maintenance operations.

German chemical company **Wacker** has recently undertaken surface modification studies to determine whether additive combinations can be used to improve the properties and processability of biodegradable polymers. The investigation was conducted by Oliver Fuhrmann, Senior Technical Manager Plastics for the Genioplast Performance Additives product line within the Wacker Silicones business division and Karl Weber, Senior Technical Manager at Wacker Polymers; Dr Ingo Jeschke, Senior Business Development Manager at Wacker Polymers is technical contact for the company's Vinnex products.

The challenge of plastic waste is raising interest in biodegradable polymers, with biodegradation seen as an end-of-life option that could make a meaningful contribution to a circular economy for plastics. Industry association European Bioplastics expects global production capacity for these polymers, and especially biodegradable polyesters, to expand markedly over the next few years.

Unfortunately, biodegradable polyesters are still limited in their potential applications. They often fail to deliver the property profile that compounders, plastics converters and end-users have come to expect from conventional thermoplastics. In addition, they are difficult to process, and the surface properties are often not as good as expected.

Polymeric organic additives based on polyvinyl acetate have a proven track record when it comes to modifying biodegradable polyesters. Wacker supplies these under the Vinnex brand, with

Main image: Automotive OEMs are looking for enhanced polymer surfaces that provide long-lasting premium haptics


IMAGE: WACKER

Above: Bioplastics have been a target for bulk and surface property modification at Wacker

polarities tuned precisely to biodegradable polyesters. The resulting compatibility makes them highly effective. The company also supplies its Genioplast Pellet range of silicone-based additives for thermoplastics compounding. These act as processing aids by reducing friction, which enhances the polymer's properties.

Combined benefits

The company's researchers set out to study how a combination of both additive systems might affect the processing and material properties of biodegradable polyesters. The project focused on polylactic acid (PLA) and calcium carbonate-filled polybutylene succinate (PBS), which made it possible to look into the additives' effects on both filled and unfilled polymer systems.

Two standard commercial grades of polyester were used as polymer matrixes - Ingeo Biopolymer 4043 D (PLA) from Nature Works and BioPBS FZ 91 PM (PBS) from PTT MCC Biochem. Both are semi-crystalline, made from renewable raw materials and have been optimised by the manufacturers for the production of plastic film.

PLA is known as a rigid, high-tensile material, which is extremely brittle and fragile and has poor thermal stability. Its high melt viscosity and low melt strength make melt processing difficult. It also suffers from a low rate of crystallisation, with post-crystallisation being the reason that PLA articles typically become progressively more brittle.

By contrast, PBS has mechanical properties more similar to polyolefins. Unlike PLA, it is a flexible, tough material of high tensile strength. By virtue of its comparatively high degree of crystallinity, PBS has high heat resistance. However, it also tends to post-crystallise.

Four additives were studied - Vinnex 2504 and 2525, and Genioplast Pellet S and Pellet P Plus. Vinnex 2504, a vinyl acetate-ethylene copolymer, is a powder grade primarily used by compounders to incorporate soft segments into a polymer matrix. Vinnex 2525 is a pellet format polyvinyl acetate homopolymer. When used as a processing aid, it improves flow, increases the melt strength, and reduces post-crystallisation by semi crystalline polyesters. Genioplast Pellet P plus is a food contact approved grade, while the Pellet S grade is primarily aimed at technical applications. There are no other significant differences in the properties of these two grades.

The biopolyesters used in the screening were compounded on a ZE-25 co-rotating twin-screw extruder from KraussMaffei. The compounds were then pelletised and processed into test specimens – including injection-moulded test panels, flow spirals, blown film and compression moulded panels – which were tested and assessed in accordance with industry standards. The non-additive biodegradable polyesters served as references and were processed in the same way. The modified compounds were produced by incorporating either a Vinnex grade on its own or a combination of Vinnex and Genioplast Pellet into the polyesters. The PLA-based compounds were all unfilled, while the PBS based counterparts contained 15% calcium carbonate.

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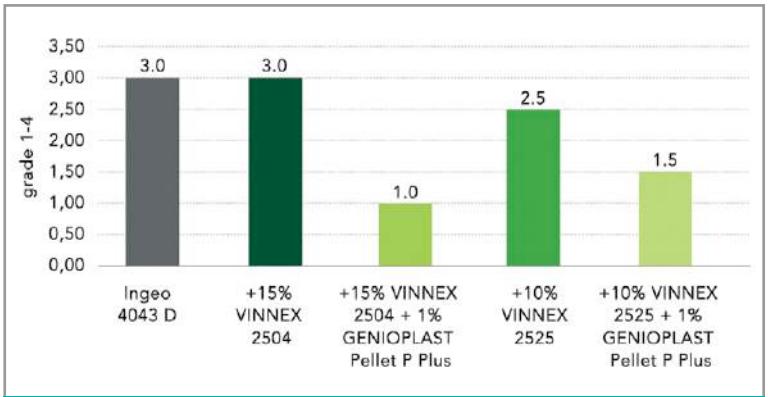

Figure 1: Crockmaster abrasion results for PLA with various Vinnex and Genioplast additive content
Source: Wacker

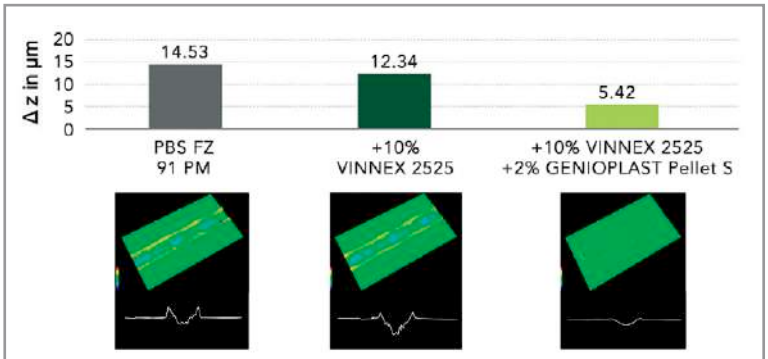

Figure 2: Erichsen scratch test results for PLA with Vinnex and Genioplast additives
Source: Wacker

The use of silicone additives resulted in lower energy cost in processing. In the compounding of filled PBS, addition of friction-lowering silicone pellets reduces the torque demand on the extruder during production of the compounds and leads to lower power consumption. The observed effects are small, but they can yield appreciable cost savings in large lines. The flow behaviour of the melted compounds was tested using the melt volume-flow rate specified in ISO 1133 and a spiral flow test. In the latter test, the combination of the additive systems results in a longer flow path. The additive combination generally leads to a substantial increase in the melt volume-flow rate, with combinations with Vinnex 2504 proving especially beneficial to the melt flow.

A superior surface finish was also achieved for the biodegradable polyesters. When used in combination with Vinnex, the the Genioplast Pellet exerts a particularly strong influence on the surface finish of the plastics. The surface roughness of the polyesters is not improved by the use of Vinnex on its own, because Genioplast needs to be added to lessen the effects of friction. As a result, a coefficient of sliding friction of less than 0.3 can be achieved in the case of both PLA and calcium carbonate-filled PBS – a level required by plastics converters for many applications. In the case of PLA, this level is achieved with a combination of Vinnex 2504 and Genioplast Pellet. In the case of filled PBS, it can be achieved with a blend of Vinnex 2525 and Genioplast Pellet.

The reduced surface friction provides the biopolyesters with greater scratch and abrasion resistance. This was confirmed by visual assessment of abrasion resistance using the Crockmeter test and gravimetric determination of abrasion by the abrasive disk method according to DIN 53754. The friction-reducing effect is especially clear from a confocal microscopic examination of scratch marks produced on smooth injection-moulded test panels using a scratch hardness tester (model 530 P-I from Erichsen). With Genioplast Pellet, the scratches are shallower, the scratch profile becomes flatter, and the surface inside the scratch is less rough. This effect is particularly pronounced at an additive application rate of 2% (Figure 1 and 2).

The Wacker researchers say that, with regard to mechanical properties, the study revealed a mixed picture. Combinations of the two additive types yielded improvements in some cases, but not in others. The effects depended on the grade of Vinnex employed and varied with the polyester matrix. For example, the combination of the two additives produced a higher elongation at break in the case of calcium carbonate-filled PBS but left unfilled PLA virtually unchanged.

As expected, Vinnex 2504 acted as an impact modifier for PLA, whereas Vinnex 2525 did not. A combination of Vinnex 2504 and Genioplast Pellet increased the tear strength of PLA blown film in both longitudinal and transverse directions. However, combination with Vinnex 2525 lead to a marked improvement in the transverse direction. The tear strength of the films was determined using the Graves angle test (DIN 53515). The mechanical properties also improved, without impairment of heat resistance. This was confirmed through determination of the Vicat softening points using ISO 306 (methods A and B).

The studies concluded that Vinnex and Genioplast Pellet are complementary in their effects and exert a greater influence when employed in combination than separately. Both the processing properties and the material properties of the biodegradable polyesters benefited substantially from the additive combination. Such a combination proves especially advantageous in the production of blown film; Vinnex enhancing the flowability and melt strength and Genioplast Pellet increasing the

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take-off and winding speed by lowering surface friction, according to the researchers.

Combining both additive systems could help unlock further applications for biodegradable polyesters, according to Wacker. The combination mitigates the processing and performance disadvantages – relative to conventional thermoplastics – that have limited the use of these polymers to date. In the usual application quantities and, depending on the system in question, the two additives do not lead to impairment of degradability in, for example, PBS, PLA or thermoplastic starch and combinations of these biodegradable polymers.

Enduring quality

Over the past two decades **Evonik** reports seeing high demand for surface modification additives for the plastic compound market. "These types of additives are primarily utilised to prevent scratches during transportation - shipping and handling - of plastic parts and their assembly and to ensure the quality of factory goods such as appliances and automotive parts after they reach the customer," says Dr Ido Offenbach, Americas Segments Manager – Specialty Additives.

"Lately, we have also seen an increase in interest for these type of additives for sustainability initiatives. As automotive companies are working to become more environmentally-friendly and reduce the need for animal-sourced materials in their products, we see them finding new ways to impart desired qualities in polymer materials to replace their organic counterparts. For example, several OEMs are looking for a surface additive that can modify the haptic feel of polymers to be more leather-like to the touch. While this initiative comes from a sustainable source, OEMs are discovering that surface modified polymers can improve both function and form – an aesthetically pleasing improvement that allows them to pursue the next evolutions of interior design more flexibility," Offenbach says.

"One place we see this focus is for manufacturers of prototype self-driving cars, where there is a greater emphasis on the vehicle being a place of comfort. Surface modification opens the door for OEMs to increasingly utilise recycled polymers, such as polypropylene, in places that had previously only allowed use of virgin materials or a

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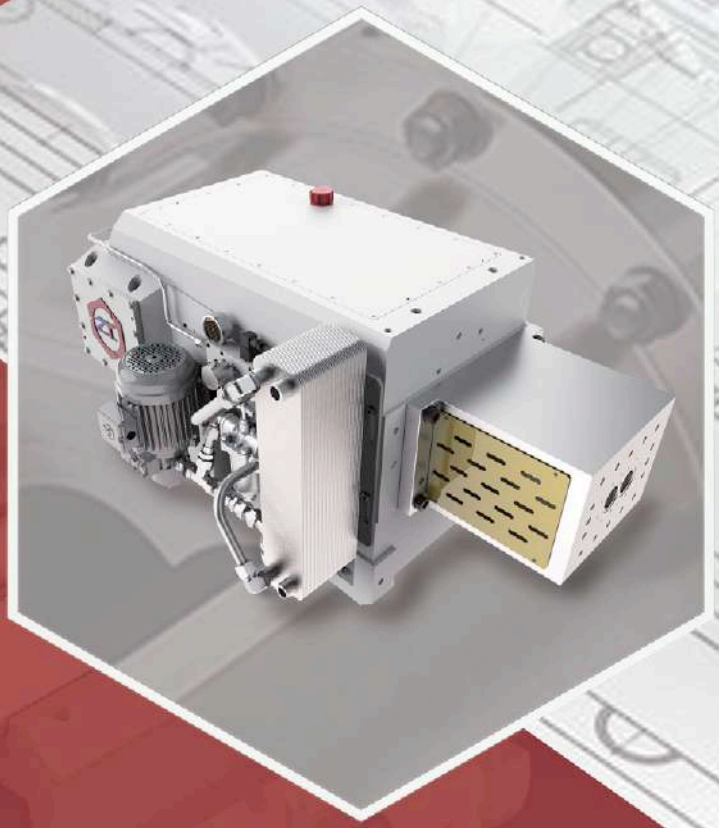

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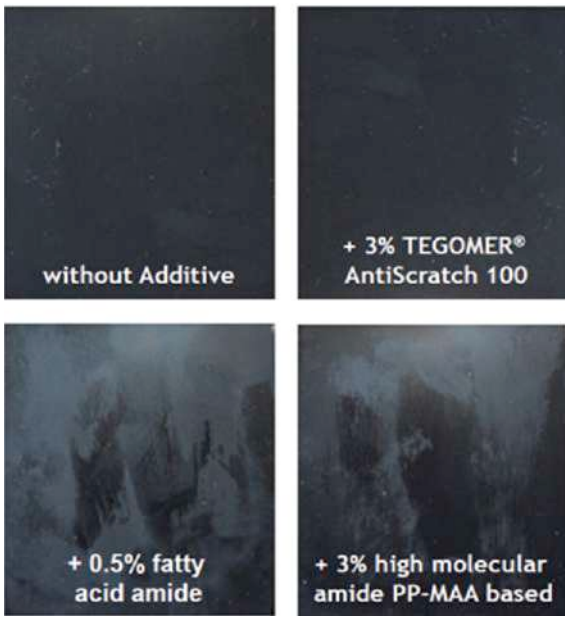

Migration/ blooming of Evonik's Tegomer AntiScratch 100 OMS additive in a PP compound compared with current alternatives (VW PV 1306 test – UV irradiation 5 J/ m² × 96 hours)

Source: Evonik

combination of recycled and virgin materials," he says. "Luxury cars, historically a very demanding environment, can increasingly utilise recycled material if properly modified, even in the most exposed applications such as interior door panels, for example."

Evonik says it offers organo-modifier siloxanes (OMS) in liquid and solid form that are designed to influence polymer surfaces without migration and bloom to the surface. Tegomer AntiScratch L, Tegomer AntiScratch 100 and Tegomer H-Si 6441 P are examples of additives that can provide long-term scratch resistance in polyolefins and engineering resins, while also preventing migration. Due to the OMS chemistry, the additives also reduce friction and wear of polymer parts. For example, TPE-S materials now have applications as air bags or sealants for automotive window glass. Evonik surface modification additives allow manufacturers to reduce the coefficient of friction, while preventing blooming for the lifetime of the materials, in a different way to other market solutions. As well as the control of haptics, this process can minimise the use of traditional waxes or oils that migrate over time.

Tegomer H-Si 6444 P is Evonik's latest development in this area. "This additive was designed to improve the scratch resistance of engineering resins such as PA, PC, PMMA and PBT, as well as TPEs and polyolefins," says Offenbach. "It also lowers the coefficient of friction of materials such as TPUs or TPEs, can maintain transparency in polymers such as PMMA, improve the appearance of polymer surfaces with glass fibres such as PP/GF or PA/GF, and improve dispersion of fillers and pigments.

Specialty compounder **RTP Company** has introduced a number of new Surface Protection Compounds, specifically formulated to improve the surface of plastic parts by resisting scratches, scuffs and mar. The company says that parts moulded using its Surface Protection compounds result in fewer quality rejections during manufacture, eliminate the need for costly protective coatings, and maintain good surface appearance throughout service life. Applications include consumer goods, electronics and automotive parts.

Long fibre gains

Meanwhile, **Avient** has introduced a new series of polyamide-based Complēt long fibre reinforced thermoplastic compounds with enhanced moisture resistance and smooth surface aesthetics. These formulations feature PA6 and PA66 base resins with delayed moisture absorption, which prolongs the effectiveness of their structural performance in moisture-rich environments. The materials also address the inconsistent surface appearance issues with long fibre polyamides that have affected quality perceptions in the past. Long glass fibre reinforced grades of Complēt moisture-resistant PA feature surfaces that are smooth and virtually free of visible fibre, making them suitable for a wide range of consumer applications.

The company says Complēt grades are globally available in several fibre loading levels (weight percentages) using long glass fibre, long carbon fibre, or hybrid combinations. This allows the materials to retain structural properties that fall between those of standard and speciality PAs when exposed to moisture. As a result, the materials are ideal for metal replacement and lightweighting initiatives in automotive and powersports applications that encounter varying climates or intermittent exposure to water.

"When manufacturers wanted to quell performance concerns by limiting moisture absorption for nylon 6 or 66, the only options were less hygroscopic and more costly speciality nylons," says Eric Wollan, General Manager of Avient's long fibre technologies. "Avient's new line of moisture-resistant nylon LFTs are modified to absorb moisture more slowly. This significantly prolongs the effectiveness of a part's structural capabilities in humid environments or during short-term water immersion, but at a more economical price point."

Additionally, Complēt PA grades provide lower shrink for applications that require high dimensional stability. In effect, they serve as a material solution to combat warp distortion from uneven cooling.

EMS-Grivory has developed Grivory G7V for a

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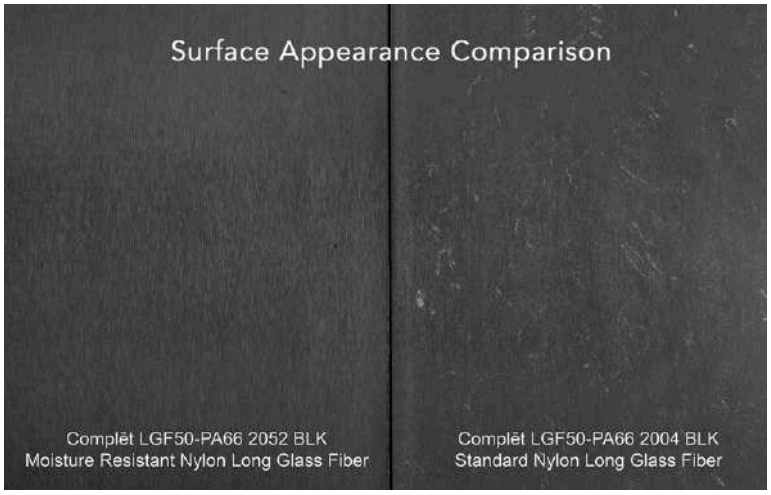

Above: Avient's new moisture resistant LFT provides a better surface finish

good surface finish in high gloss metal replacement applications. The company says that the high-performance polyamide gives visible components a decorative and stylish finish that is also resistant to scratching and chemicals. Grivory G7V also makes high-gloss surfaces possible for glass fibre-reinforced compounds.

According to EMS-Grivory, glass fibre-reinforced Grivory G7V combines properties such as increased stiffness and strength, even after moisture absorption, with the chemical resistance of a Grivory GV and the high-quality finish of a low or non-reinforced polyamide. In addition, the new Grivory G7V products exhibit better UV stability than other semi-aromatic polyamides. Grivory G7V was developed for metal replacement applications requiring an exceptional surface finish. The material is a new aliphatic high-performance polyamide with well-balanced properties, which enable cost-efficient production of lightweight components without any additional painting.

The surface sheen of glass fibre-reinforced polyamides often disappoints when it comes to visible parts because the surface is too rough or uneven, the company says. Partially crystalline polyamides contract during cooling, leaving sink marks on the surface and rough areas due to exposed glass fibres. Complex injection moulded parts, therefore, often have to be painted in a separate production step to cover critical areas.

Grivory G7V has a melting point of 215°C and offers all the advantages of a semi-crystalline aliphatic polyamide such as PA 6 or PA 6/6, including easy processing, high stiffness and strength as well as resistance to chemicals. How-

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Right: Witcom is working to produce PTFE-free versions of all of its lubricated compounds

ever, lower shrinkage and a reduced crystallisation rate compared to PA66 make for a glossy, smoother, more uniform, and easier-to-clean surface. In addition, the smooth surface minimises friction noise and wear. G7V also benefits from reduced moisture absorption and comparable stiffness and strength in a dry and conditioned state.

Surface replication

The company says the delayed freezing behaviour of Grivory G7V means it reproduces the mould surface very well without extending the cycle time. Another advantage of the aliphatic polyamide is its minimal shrinkage. This allows for the precise production of components, while the risk of ending up with a wavy surface ('orange peel') is significantly reduced. Even the basic grade, Grivory G7V-5H (GF 50), can produce low-distortion parts with a high-quality surface and an average roughness depth (Rz) of less than 1 micron. Special X-types reduce distortion even further.

Grivory G7V was developed for high-gloss component design and straightforward processing by injection moulding methods. The material is said to be easy to process due to its high flow and wide processing window. A good surface finish is achieved at melt temperatures of 270°C and above in combination with normal mould temperatures between 100°C and 120°C. Due to the low melt and mould temperatures, injection moulders can save energy and reduce costs.

The company says that Grivory G7V can be used in a wide variety of applications. The material is particularly well-suited for structural components in automotive interiors, such as air vents, indicator and gearstick levers, and handles, for example. Grivory G7V is just as suitable for functional components in mechanical engineering. Potential end products can also be found in the food and medical industries, where a crack and pore-free surface is particularly important to minimise the risk of pollution and, at worst, cross-contamination.

Witcom Engineering Plastics is a major supplier of speciality engineering compounds, including products with solid internal lubrication. "The main market driver for these materials remains weight reduction and the characteristics that can be achieved in mechanical, chemical and electrical properties resulting from the use of additives," says Ronald Pet, Global Business Development Manager. "There is still a focus on traditional materials and additives but due to environmental issues we are also seeing an increasing demand to move towards the use of more 'eco-friendly' additives. For our materials, growth is based on industrial

IMAGE: WITCOM

applications in different industries, for example, industrial robotics, e-mobility, medical and domestic appliances, and agricultural and industrial machinery."

Pet says new developments in surface modification are still being driven by the well-known advantages for the use of plastics in technical applications, however, the importance of recycled materials and additives, and sustainability in general, is increasing. For example, the forthcoming EU (and UK) approach on reducing PFOA/PFAS in plastics is likely to have a big impact on the way lubricated materials will be formulated in the future. This could result in a ban on use of PTFE as an additive in the most extreme cases. There could also be temporary issues regarding availability of certain materials and additives.

Targeting alternatives

Witcom develops compounds to customer specifications, but its main focus for lubricated materials is to develop non-PTFE filled materials for current and future applications. "Applications for these materials are in different industries," says Pet. "These include bushings and guiding strips for mechanical applications, parts and bushings in e-automotive, bushings and housings in water treatment systems, and parts and bushings for food industry machinery. All of these applications are driven by the need to reduce weight and the removal of external lubrication. We are currently involved in studies to replace PTFE in lubricated wear compounds, while maintaining a low coefficient of friction and good wear characteristics. One of the applications is a housing in a dosing system, revolving at a medium velocity."

Witcom says it aims to be able to offer PTFE-free solutions for all its compounds. "We are also focusing on helping customers to operate as sustainably as possible," adds Pet. "For example,

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IMAGE: WITCOM

Above: Lubricated compounds enable bushings to extend lifetimes and reduce maintenance

we are developing compounds that can help reduce energy consumption due to lower friction or wear, or by creating materials with a longer service life. When possible, we will also use recycled materials or additives in our compounds."

Specialty metal sulphides producer **Tribotecc** provides solutions for a wide range of applications including friction, lubrication, powder metallurgy, electronics and the polymer industries. "In polymers, these functional additives are used as solid lubricants in technical and high-engineered thermoplastic compounds such as PA, PPA, POM, PEEK and PTFE, as well as thermoplastic elastomers, to improve tribological properties such as wear and the coefficient of friction," says Ing Clemens Kappl, Head of Market & Technologies.

"We offer a wide range of customised synthetic solutions supported by reliable test data from our tribological competence centre in Austria…We are also listed as a lead registrant under REACH for various substances like tin, bismuth, tungsten and copper sulphides, for example," he says. "In addition, Tribotecc has developed several new synthetic, light-coloured and lightweight metal sulphide systems as alternatives to existing graphites, molybdenum disulphides and silicon oils, which offer better wear and micro-performance for modern polymer compounds. These solid lubricants can also be offered in granulated form as well for easy and dust-free handling."

Lightweight challenge

The company says that lightweighting with polymers is becoming increasingly challenging for the development of highly stressed components in motion, such as gear wheels, bearings, values and pumps. "To fulfil these requirements for the automotive industry, it is necessary to understand material science and functionality of polymer systems," according to Kappl. "We envisage using our expertise in this area to provide solutions in the future for plastics in sustainability, e-mobility and digitalisation, for example."

Italian compounder **Lati** has developed a POM-based compound that is formulated to offer good tribological and mechanical features, as well as excellent resistance to solar radiation. The compound is being supplied to GGB for its EP15

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IMAGE: LATI/GGB

Right: Bearing producer GGB is using a new lubricated POM from Lati for photovoltaic support applications

self-lubricating bearing solutions for outdoor applications. These include photovoltaic systems, a sector that has undergone a major expansion in recent years in terms of both the number and the size of the systems being installed.

Major photovoltaic power stations are often set up in highly aggressive environments where, in addition to constant exposure to ultraviolet radiation from the sun, they also have to contend with the effects of dust, sand, high temperatures, wind and zero humidity. Good operation of a photovoltaic power station depends on the functioning of its solar panels, whose efficiency is maximised through the use of a solar tracker which ensures their continuous alignment with the sun.

GGB provides solutions to reduce friction and optimise product design through tribological technologies. The EP15 solar bearing system solution does not need to be greased or require any other external lubricant, and consequently eliminates the need for maintenance interventions to deal with problems caused by drying or formation of abrasive sludge, which, in turn, cause wear of the metal parts.

The self-lubricating plastic material can withstand the wear caused by dust and sand. Furthermore, it is not weakened by solar radiation, and its typical properties remain stable over time. EP15 works at temperatures between −40°C and 125°C and at all levels of solar exposure and ambient humidity. GGB says bearing systems can be subjected to compression forces of up to 65 MPa without suffering structural damage. The EP15 material also complies with RoHS, ELV and WEEE standards.

LNP Lubriloy N2000, from **SABIC**, is a new internally lubricated compound that helps prevent buzz-squeak-rattle noise in automotive interiors. The company says that the new grade is based on an amorphous compatibilised olefinic blend and offers both moulded-in colour capability and paintability. It is free of silicone and PTFE and can replace PC/ABS in automotive applications, allowing OEMs to significantly reduce friction and stick-slip behaviour between moulded parts to limit or prevent unwanted noise.

"A quiet, smooth ride is a hallmark of automotive quality and luxury, but cabin sounds can be more noticeable in electric and hybrid vehicles due to the absence of source noise from their powertrains," says Ed Williams, Senior Product Manager, LNP Compounds. "Our new LNP Lubriloy N2000 compound is highly effective at limiting buzz-squeak-rattle noise and eliminates the need for secondary applications such as felts or tapes. This latest material innovation helps our customers provide a more enjoyable driving experience for consumers."

SABIC's lubricating technology enables the LNP Lubriloy N2000 compound to deliver a low coefficient of friction and good wear performance in plastic parts moving over metal and plastic surfaces. When evaluated using the BSR test VDA 230-206, the company claims that the new compound shows a risk priority number of less than 3 versus non-modified PC/ABS materials that typically have values greater than 5. In addition to automotive interior parts – such as mirror housings and trim, cupholders, button guides and heating-ventilation-air conditioning frames – the new material can potentially be used in consumer electronics applications where reduced friction or improved wear is required.

Below: LNP's Lubriloy N2000 compatibilised olefinic alloy reduces 'squeak' in auto interiors

IMAGE: SABIC/LNP

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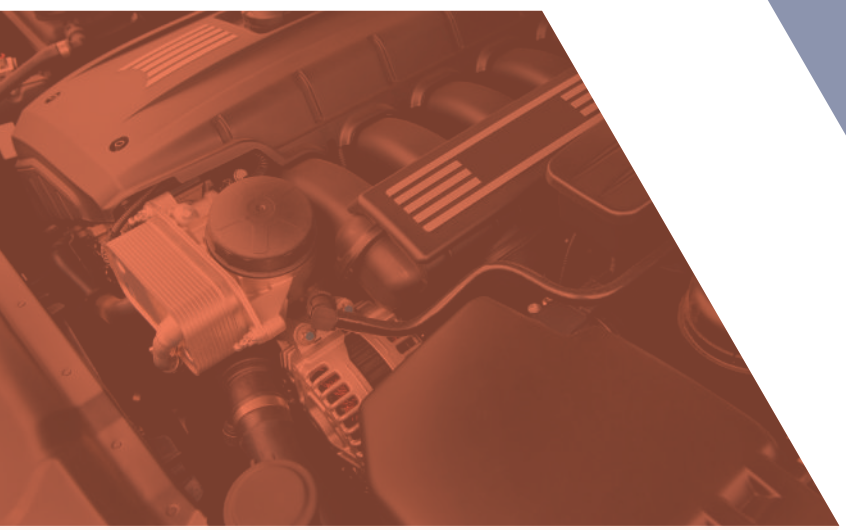

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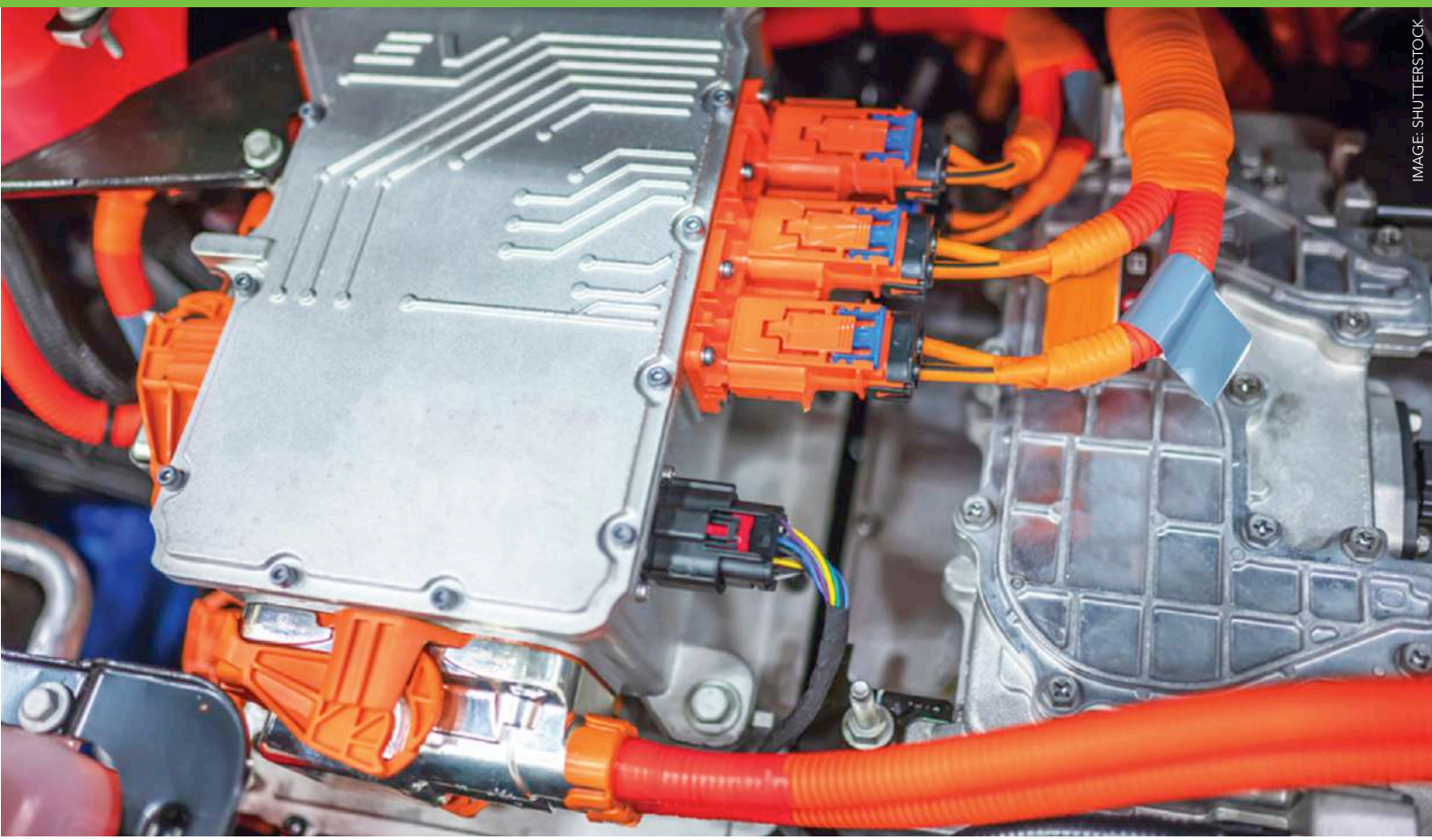


IMAGE: SHUTTERSTOCK

Powering up polyamides

*Today's polyamide additives must enhance performance while taking sustainability into account. **Jennifer Markarian** reviews the latest trends and introductions*

Polyamides are in high demand for engineering applications where their mechanical properties and temperature resistance are key, especially in metal-replacement uses. Their flexible polymer chemistry, together with an ever growing range of performance enhancing additives, also makes polyamides one of the most customisable and versatile of engineering resins.

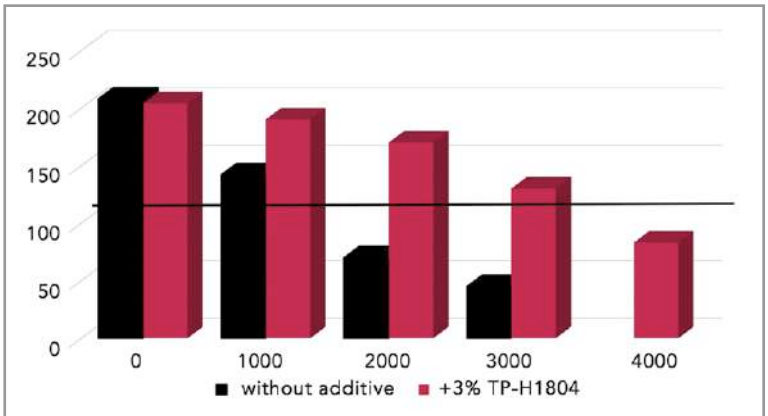
Additives for polyamide (PA) compounds include heat stabilisers, lubricants, flame retardants, thermal and electrical conductivity modifiers, glass reinforcement, colorants, and more. With such a broad range of performance-enhancing options available, it should be no surprise that PA plays such a key role in increasingly demanding markets such as transportation, communications, and electrical and electronics.

"E-mobility, unmanned vehicles (such as drones) and robotics will require higher temperature, higher modulus, lighter materials, which polyamide formulations/composites will likely address," says Roger Avakian, founder of **Avakian PolyChem Consulting**.

Avakian says another area driving the growing use of PA is in personal electronic devices – biobased PAs are already used in cell phones and their use is accelerating because of the improved eco-profile. Sustainability is also increasingly a concern for PA additives, he says, citing the example of flame retardants where manufacturers are looking for solutions that fit with their circular economy strategies.

In the area of PA stabilisation, there is an ongoing focus on halogen-free and copper-free heat stabilisers that will not negatively affect flame retardancy, according to Dr Klaus Bergmann, Business Unit Manager Polymer Additives at **Brüggemann**. The specialty additive maker recently introduced Bruggolen TP-H2062, a metal and halide-free heat stabiliser offering sustained protection in the temperature range of 120-170 °C. The stabiliser provides electrically neutral stabilisation to prevent

Main image: EVs present new challenges for PA compounds in meeting mechanical and electrical performance while maintaining colour stability



Tensile strength of 30% glass reinforced PA66 with and without Brüggemann's TP-H1804 stabiliser after ageing at 190°
Source: Brüggemann

corrosion of metal contacts – a potential problem in electronic applications – and maintains high mechanical properties of compounds even after long-term aging. Bergmann says the company is working on an improved version of this stabiliser that will allow better flame retardancy.

Brüggemann has also launched Bruggolen TP-H1804, a PA stabiliser suitable for a temperature range of 160-190 °C. It meets the need for applications at temperatures where classic copper-based stabilisers provide insufficient protection. The stabilisers are finding use in under-the-hood applications in down-sized internal combustion engines (ICEs).

Visible stability

High performance stabilisation is also a key criteria in electric vehicles (EVs). Brüggemann collaborated with masterbatch maker **Grafe** to develop and launch a heat-stabilised orange masterbatch, PA-Tekolen, designed for polyamide e-mobility uses that require the RAL2003 orange. "This combination ensures high visibility without discolouring in long-term high-heat applications, which is mandatory for components used in high voltage applications," says Bergmann. The masterbatch has been demonstrated to maintain colour after 1,000 service hours at 130 °C. It can be used for PA6, PA66 and glass fibre-filled and flame-retardant PA grades.

Macrolex Orange HT is a new soluble, halogen-free organic dye from **Lanxess** that is also intended for use in colouring polyamides (and other plastics) with the RAL2003 shade of orange. The company describes this as a "signal" colour that is used for live cables and other high-voltage components in electric and hybrid vehicles to reduce the risk of accidental injury to those maintaining electric motors. Lanxess says its new dye is heat-stable, light-fast, and weather resistant.

Cabot's new specialty carbon black – Black Pearls 1180HD – is a high jetness particle that exhibits strong colour and is easily dispersed, so it can provide good colour at lower loadings (lower carbon black levels enable better mechanical properties in PA compounds). High mechanical performance is crucial in metal-replacement applications, particularly in automotive applications where PA compounds are being considered to allow light-weighting, according to Dominique Strässler, Global Segment Manager for Plastics at Cabot.

Lower loadings of carbon black can also lead to reduced interaction with flame retardants and better overall flame retardant performance, while the optimised dispersibility and morphology can improve comparative tracking index (CTI) and dielectric performance, Strässler explained in a presentation given last year at AMI's Performance Polyamides conference in Munich in Germany.

Flow improvement

PA injection moulding compounds typically contain a small amount of lubricant to ensure good mould release. Higher levels of lubricant can also improve melt viscosity and flowability but careful formulation is required to avoid unwanted negative side effects, says Henrik Eriksson, Technical Product Manager of Special Additives at **Baerlocher**. The company offers a range of lubricants for PAs, including metal soaps (stearates), EBS-wax, and specialty soaps (behenates).

"When working with metal soaps, this includes choosing the proper metal cation and a suitable chain length for the organic part, as well as considering a suitable wax partner for the metal soap to balance solubility constraints," says Eriksson. "Some compounders have traditionally shunned working with aluminium stearate, although it contributes to very good surface appearance in glass fibre reinforced compounds. This reluctance is due to the tendency of the very fluid powder to separate from other additives and

IMAGE: LANXESS

Right: Macrolex Orange HT is a soluble halogen-free dye from Lanxess for PA EV parts

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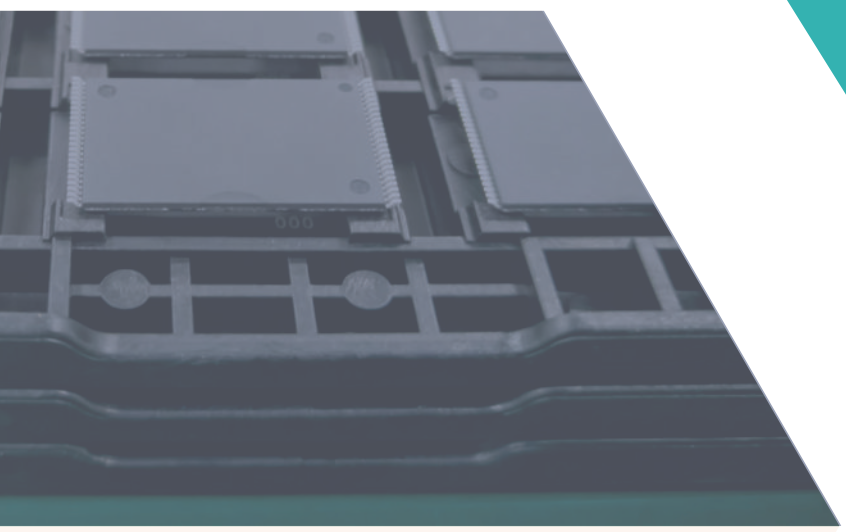

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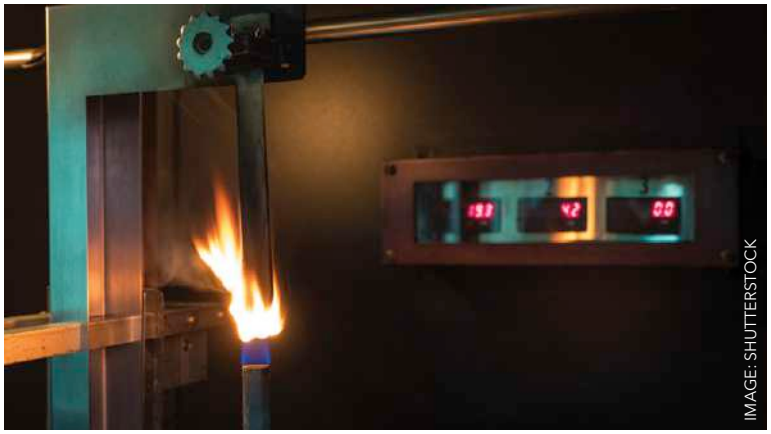

IMAGE: SHUTTERSTOCK

Above: The need to comply with different flame testing standards is a challenge for PA compound developers

create inhomogeneous premixes."

Baerlocher offers aluminium stearate compacted to a convenient granular format that eliminates these problems. The lubricant can also be compacted with other additives into a granule to create a "one-pack" option that reduces handling, minimises dust generation, and increases dosing accuracy, according to Eriksson.

Baerlocher also offers a calcium behenate, which contains renewable carabon, as a replacement for more expensive fossil-carbon-based calcium montanate lubricants in PA. "The long carbon chain of the behenate allows for higher addition levels [without] risking the migration issues associated with high amounts of the lower molecular weight calcium stearate," says Eriksson.

Multiple standards

Achieving flame retardancy standards is important in many of the applications where PA compounds are used. One of the big flame retardant challenges is to develop systems with the ability to pass flammability tests from both the US (UL 94, for example) and Europe (glow wire), according to industry consultant Roger Avakian. "Many formulations can pass either one or the other, but not both," he says.

Other key properties include ease of processing and avoiding corrosion and mould deposits as well, of course, as sustainability—both in terms of environmental profile and recyclability. The ability to retain flame retardant properties during recycling is a cost advantage that is being looked at more often, according to Avakian. "Most studies have been on halogenated FRs, showing they retain FR characteristics during mechanical recycling. Studies of phosphorous-based HFFRs have shown they are also robust, but there is some

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question about whether some phosphorous-nitrogen FRs would break down," he says.

Some low-molecular weight halogenated flame retardants present toxicity concerns and have the potential to produce corrosive fumes; as a result, most of these were phased out of E&E applications in Europe nearly 20 years ago. Polymeric brominated flame retardants, however, are said to be an option; they are effective and are lower cost than halogen-free flame retardants, and suppliers say they are sustainable.

"Some newer polymeric halogenated flame retardants are being adopted (such as the Emerald technology in polystyrene), but some older polymeric halogenated flame retardants used in nylons successfully for many years are being scrutinised," says Avakian. Melamine cyanurate is also under scrutiny in Europe, he adds.

One to watch

There is an ongoing push for moving to halogen-free flame retardants, especially in Europe. New halogen-free technologies continue to be developed. For example, organophosphorus FRs based on DOPO [9,10-dihydro-9-oxa-10-phosphaphenanthrene-10-oxide] are nonvolatile and can be derivatised to fit into different polymers. While these chemicals have not yet been adopted broadly, because of limitations in supply and in obtaining commercial registrations, the technology is one to watch, Avakian suggests.

Christian Panofen, Global Marketing Director for **Huber Engineered Materials**' Fire Retardant Additives business, points to the EU's Green Deal and the subsequent Chemicals Strategy for Sustainability, which was introduced in October 2020, as driving support for halogen-free flame retardants (HFFRs) and smoke suppressants.

"Increased regulatory compliance for use of fire retardants will continue to play a major role in the future. The strong, positive momentum for use of environmentally friendly, halogen-free fire retardants will increase," says Panofen. "The trend of combining and blending non-halogenated fire retardants will most likely increase to optimise flame retardancy and smoke suppression and enhance material performance," he adds.

Phosphate option

Huber's Safire 400 nitrogen-phosphorus (N-P) fire retardant technology is a new melamine poly (zinc phosphate) intended for use in PA. Panofen says that, compared with melamine polyphosphate at the same loading levels, Safire 400 offers equivalent fire retardant and process performance as well as having some additional advantages. These include a dual fire-retardant mechanism of intumescence and strong smoke suppression via char formation in most polymers, improved smoke opacity and toxicity performance, reduced blooming, higher comparative tracking index (CTI) performance, and a lighter colour. It can also act as a synergist with phosphinates and other HFFRs.

Huber offers other HFFR technologies, including alumina trihydrate (ATH) and magnesium hydroxide (MDH). At the end of 2021, Huber Engineered Materials (HEM) completed the acquisition of RHI Magnesita's 50% ownership stake in Magnifin Magnesiaprodukte, which had been a 50/50 joint venture with Martinswerk (Martinswerk has been part of Huber since 2016).

The synthetically produced, fine particle-size of Magnifin MDH is said to allow processors to produce flame retarded PAs without halogen or phosphorous containing compounds. "Today's existing products contain approximately 10 to 20% glass fibre, with about 30 to 55% of Magnifin," says Panofen. He says the product ensures very low levels of smoke density and allows users to achieve a UL94 V-0 compound with CTI of 600V in a glass fibre-reinforced formulation that can be made in any colour.

In electric vehicles (EVs), both flame retardancy

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IMAGE: SHUTTERSTOCK

Right: E-mobility is one of the drivers of growth for HFFR PA compounds, according to Clariant

and heat management are important. Thermally conductive additives, such as Huber's alumina-based Martoxid TM-4000 series, provide balanced properties of thermal conductivity up to 2.5 W/m.K, improved mechanical properties, flame retardance and processability, according to Panofen.

FRX Polymers, the manufacturer of Nofia polyphosphonate flame retardants, is also actively working on flame retardants for polyamides. The company says that its flame retardant has been successfully used in a high-performance PA targeted at electric vehicles. Separately, FRX reports that a Nofia FR is soon to be commercialised in a PA masterbatch for a high-performance blended-textile application. In this application, the Nofia FR offers improved melt processability and the sustainability benefits of a non-halogen polymeric FR, the company claims.

Adding capacity

Increasing use of HFFRs is also predicted by **Clariant**, which announced at the end of last year that it is building new capacity for its Exolit OP FRs at its chemical production site at Daya Bay, Huizhou, Guangdong Province, China. The company says the local production capacity will allow it to more quickly supply customers in China in the fast-growing areas of E&E, e-mobility, 5G communications technology and transportation. Clariant plans to invest around €57m in the project and expects the facility to be completed in 2023.

Clariant says that the Exolit OP range is based on aluminum diethyl-phosphinate (DEPAL) and carries its EcoTain sustainability label, which recognises its good environmental and health profile. In PA, Exolit can achieve a UL94 V-0 rating down to 0.4 mm, together with good electrical properties (a CTI of 600V), thermal stability, and good mechanical properties, reports the company. Exolit grades tailored for improved glow wire ignition test performance for use in unattended household appliances are being developed and are expected to be launched this year.

Below: Budenheim's Budit HFFR's are well matched to glass reinforced PAs for E&E applications

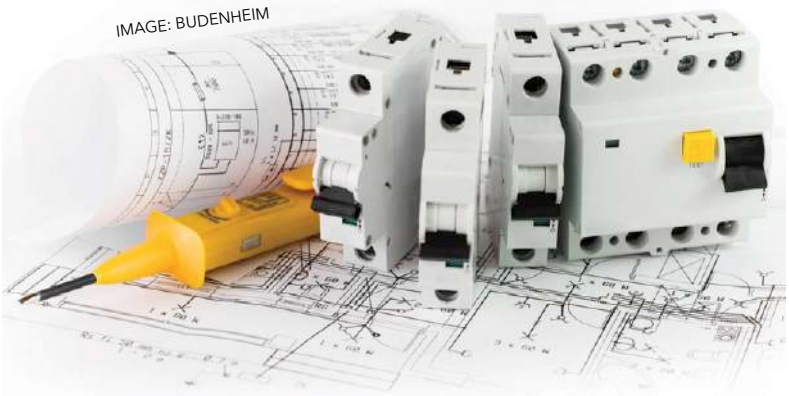

IMAGE: BUDENHEIM

Clariant also sees increased demand for its reduced carbon footprint Exolit OP Terra FRs. These grades contain up to 100% renewable carbon content and are said to be "drop ins" for the company's standard Exolit OP grades.

Budit 617, recently introduced by **Budenheim**, is an HFFR system based on melamine polyphosphate and synergists. The additive is said to be suitable for use in glass fibre reinforced PA compounds, particularly for E&E use. It says that compounds using the additive achieve a value greater than 800°C in the glow wire ignition temperature test and UL94 V-0 classification for thicknesses above 0.8mm. It is also said to offer low corrosion, low smoke toxicity, and low smoke density.

Another PA additive from Budenheim is the Budit F Series of phosphate-chemistry based endothermic chemical foaming agent concentrates, which can offer an alternative to physical foaming. Budit F24, for example, is an anhydrous foaming agent suitable for PAs that are susceptible to hydrolysis. Advantages over physical foaming include more controlled cell formation, better surfaces (due to fewer sink marks), improved melt flow, and shorter injection moulding cycle times, according to Tobias Moss, Innovation and Application Development Manager for Budenheim's Business Unit Material Ingredients (speaking at AMI's Performance Polyamides conference).

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VISCOSPEED by innospec

VISCOSPEED in semi-conductive compounds

The inexorable growth of renewable energy to replace fossil-based energy is highly important to meet European climate goals of cutting greenhouse emissions by 40% compared to 1990. Most of this renewable energy is produced by solar panels or off and on-shore wind turbines, presenting the challenge of transporting it from the place of creation to the final user.

For this purpose — and to support the charging infrastructure required for the move to electric vehicles — demand for medium (MV) and high voltage (HV) cables is expected to increase strongly in upcoming years.

These types of cables are typically composed of copper wires, two concentric semi-conducting layers (conductor and insulation shield) with an insulation layer in between, bedding materials, and protective and semi-conductive jacketing. The semi-conducting layers contain high levels of conductive materials such as carbon black or graphite and are required to homogenise the electrical field in the insulation material to prevent failure.

Innospec's new VISCOSPEED products are excellent low-dosage, organic processing aids for high filler content compounds and have proved to be beneficial in semi-conductive compounds. Initial trials have yielded improved processing and less breakdown of the

primary carbon black aggregates, which is important for good conductivity.

Additionally, VISCOSPEED and VISCOSPEED HP-X address nicely the problem of increasing EVA-copolymer prices, allowing for the use of simple LDPE polymer in so-called bonded semi-conductive compounds.

VISCOSPEED, polar by nature, allows for a quick wetting and dispersion of the conductive carbon black, yielding better conductivity (see table) and in principle shorter mixing cycles.

Another important specialty, especially for the French and US markets (due to regulation), is the 'easy strippable' insulation shield. When using VISCOSPEED or VISCOSPEED HP-X, the stripping force on the XLPE or EPR insulation can be decreased to a level far below the critical value of 20 N*cm. Besides the optimised processing, this is a highly relevant finding making VISCOSPEED a new and exciting addition to the toolbox of R&D engineers for these cable compounds.

VISCOSPEED can be applied in semi-conductive compounds as a processing aid, and to improve conductivity and flowability. Furthermore, VISCOSPEED helps avoid the use of frequently requested high vinyl acetate content EVA-co-polymers, allowing formulators to use more abundant low vinyl acetate content base polymers or even non-polar polyethylene as a base material.

Click **HERE** to learn more about formulating semi-conductive compounds with VISCOSPEED. More insights will be presented at this year's Cables conference in Cologne, Germany.

VISCOSPEED products in strippable semi-conductive formulations

Components	PE-Wax	VISCOSPEED	VISCOSPEED HP-X
EVA 33 MFI 43	53	53	53
Carbon Black	38.5	38.5	38.5
PE-wax	5	-	-
VISCOSPEED	-	5	-
VISCOSPEED HP-X	-	-	5
Additives	3.5	3.5	3.5
Peroxide	0.75	0.75	0.75
Properties	**PE-Wax**	**VISCOSPEED**	**VISCOSPEED HP-X**
MFI (21.6kg @ 120°C)	12	10	13
Stripping force [N*cm]	28	18	15
Vol. resistivity (Ohm*cm)	55	50	45

IMAGE: SHUTTERSTOCK

Carbon additives key to low-carbon future

*For polymer compounders, the route to a low-carbon future is likely to mean a greater use of carbon additives of all types. **Peter Mapleston** learns more*

It seems that carbon additives are set to play a key role in society's move to a low carbon future. Electrically conductive additives based on carbon in various forms are enabling the development of compounds for use in sustainable applications such as electric vehicles, where they bring weight down and improve safety through shielding from interference. And the growing use of some of these additives – such as recycled carbon fibres – also fits well into the circular economy concept.

Other macro-economic trends – such as light weighting, electrification and miniaturisation – are also supporting the growth of conductive plastics solutions across sectors as varied as automotive, electronics and packaging, according to **Cabot Corporation**.

The company has developed several new solutions that are intended to help its customers address these emerging trends. Cabelec XS6624B conductive concentrate, introduced last October, is designed for polystyrene carrier tapes used in chip packaging where it can solve customer challenges such as dye-build up, uniform conductivity and miniaturisation of parts. Cabelec XS6627A conductive concentrate, commercialised in December, is designed for injection moulding of PP where it is said to enable customers to achieve a balance of conductivity and mechanical performance. And Cabelec XS6325A conductive concentrate, which was launched earlier last year and is based on PA6, is designed to help compounders develop conductive formulations that combine conductivity with other features such as fire retardancy or glass fibre reinforcement.

The rapid electrification of cars, together with the continuing growth in the amount of electronic

Main image: Electric vehicles, autonomous transportation, 5G communications, and smart appliances and infrastructure are driving demand for electrically conductive plastics

equipment on board each, has led to the requirement for EMI shielding in electronic parts to ensure that neighboring systems do not interfere with one another when sending and receiving electronic signals. EMI shielding requires not only high conductivity but also the ability to miniaturise components, which calls for superior mechanicals.

"Cabelec XS6325A conductive concentrate allows nylon compounders to tailor the electrical performance of compounds for ESD or EMI applications," says Santiague Pierre, Global Application Lead Masterbatch and Conductives, at Cabot Corporation. "This conductive concentrate is so versatile that customers can add glass fibre, plasticiser, flame retardant or impact modifier to create more functionality to their material."

At **Imerys Graphite and Carbon**, Anna Ellett, Field Application Engineer Polymers, sees a growing interest in EMI shielding compounds for applications such as 5G technology and automotive driving assistance systems, where factors such as their low weight and high corrosion resistance compared to metal-based systems play an important role.

For such applications, the company offers its Ensaco conductive carbon blacks, Timrex synthetic graphites, and specialty high aspect ratio Timrex C-Therm graphites as ways of achieving the required combination of high electromagnetic signal attenuation, high thermal conductivity and easy processability.

Ellett highlights Ensaco's combination of high purity, high structure and low surface area, which guarantees low moisture pick-up as well as easy dispersion. She says this makes it possible to reach high levels of electrical conductivity at low loadings. Meanwhile, Timrex C-Therm graphites, with their extremely high aspect ratios, are designed for applications requiring high electrical and thermal conductivity at low carbon contents.

She says a synergistic effect on electrical conductivity can be obtained when blending Timrex C-Therm graphites and Ensaco conductive carbon blacks. "For example, a 50% Ensaco 250G/ 50% C-Therm blend enables reducing volume resistivity by a factor of four compared to a formulation with Ensaco as single additive," she says (Figure 1). This is reflected in superior levels of EMI shielding (Figure 2).

At **Orion Engineered Carbons**, Kevin Milks, Market Manager for Polymers and Batteries in North America, reflects on the effects of consumers' concerns about fuel prices and climate change on increased demand for electric vehicles (EVs), and the role of conductive polymers to enable aspects of EV technology.

Milks says that last year, in his region, there were indications that more than 50% of car buyers would consider purchasing an EV. The trend has been assisted not only by fuel, climate, and sustainability concerns, but also by the growing availability of EVs, including versions of extremely popular models such as the Ford F-150 truck (the electric F-150 Lightning is set to go on sale this spring).

Conductive thermoplastic compounds play a role in improving EV performance but compounders face some new challenges. "Thermoplastics polymer compounders are very familiar with converting carbon black and relevant polymers into conductive compounds," says Vasanth Narayanan, Orion Polymers Technical Market Manager, "but these EV applications require higher black dosages or higher surface-area blacks to impart electromagnetic interference (EMI) shielding properties."

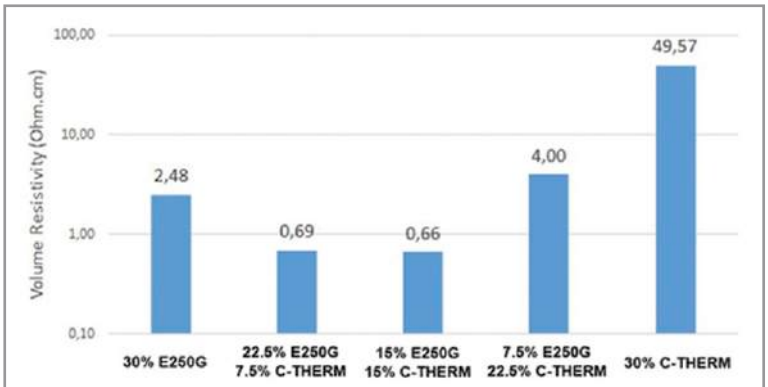

Figure1: Volume resistivity of PP compounds containing different carbon black blends
Source: Imerys Graphite & Carbon

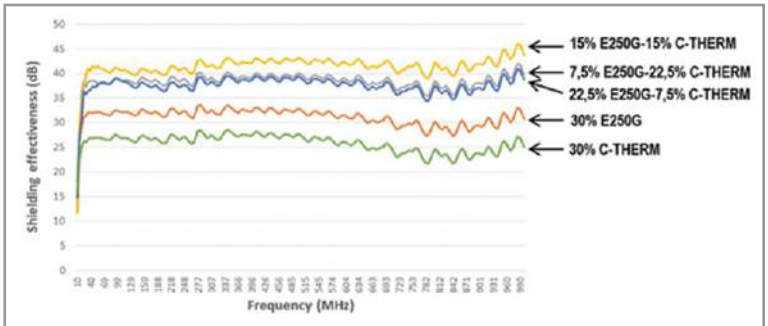

Figure 2: Shielding effectiveness of PP compounds containing different carbon black blends
Source: Imerys Graphite & Carbon

Shielding solutions

Shielding to prevent interference with neighbouring electronic devices during operation and charging, requires a resistivity of 1 to 500 ohms/ square in plastics covers, Narayanan says. Higher surface area blacks yield lower resistivity at a lower dosage, but higher surface area blacks are more

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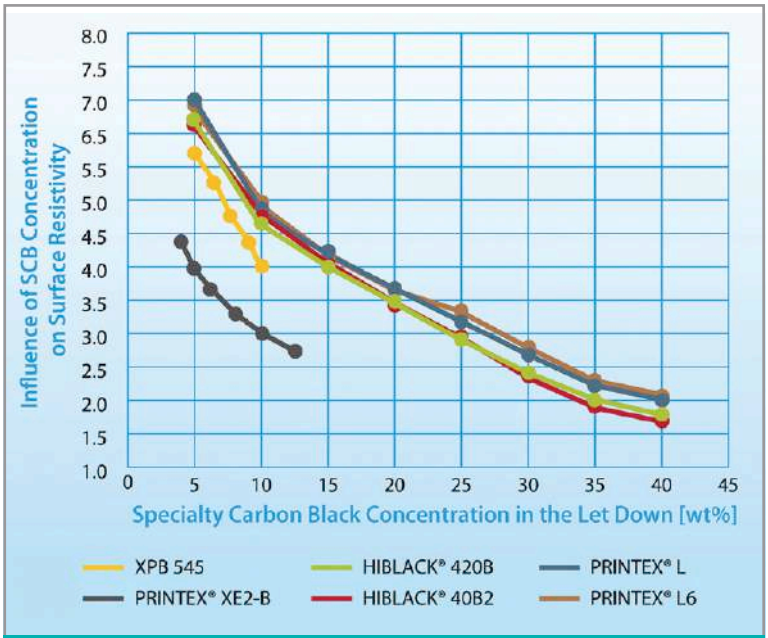

Figure 3: The effect of carbon black surface area and dosage on compound resistivity. The black curve represents super conductive black performance; the other curves depict more conventional conductive black performance.
Source: Orion Engineered Carbons

difficult to disperse than conventional conductive blacks.

"Conventional conductive blacks are not well suited for EMI applications. Super conductive blacks, such as Orion's Printex XE2B, can enable EMI applications, and we are actively working with compounders to optimise black dosage, compounding conditions, and mechanical properties," Narayanan says.

The Pre-Elec line of electrically conductive plastic compounds from Finland's **Premix** incorporate carbon black, which the company says is the most reliable and cost-efficient choice for producing conductive plastics. As an example of how they can be applied, it cites flexible conduit and tubes that retain strength and flexibility. "Using our conductive compounds you guarantee conductivity, high abrasion resistance, high flex-life, durability, easy processability, and flexibility even at low temperatures," says Senior Product Manager Anssi Aarnio.


IMAGE: PREMIX

Right: Premix's electrically conductive Pre-Elec plastics compounds incorporate carbon black and offer good mechanicals and flexibilty

Uncontrolled electrostatic discharge (ESD) can destroy electronic components or cause explosions in flammable environments. For such applications, **Tisan Engineering Plastics** has developed a range of conductive polymer compounds that either prevent generation of high electrical charge or that dissipate them before they accumulate to dangerous levels.

Generally thermoplastic polymers have a surface resistivity of 10^{12}-10^{16} ohms/sq, the company says. It has developed a range of compounds offering surface resistivity in the range 10^{3}-10^{12} that are suitable for extrusion or injection moulding.

The highest conductivities are achieved using combinations of carbon additives, including carbon blacks and carbon fibres of various sizes. Tisoplen D UNR K17 R02 (an unreinforced antistatic PP), Tisapet L 30D11 K07 R02 (a 30% carbon fibre reinforced anti-static PET), and Tisren K UNR K17 R02 (an unreinforced anti-static PS) all offer resistivity between 10^{3} and 10^{4} ohms/sq. Where colour is a priority, it can offer a number of carbon-free formulations. Tisetilen N UNR K17 R10, for example, is an anti-static unreinforced PE with a resistivity of 10^{8}-10^{10} ohms/sq suitable for dissipative applications.

Nano-opportunities

Conductivity in plastics can also serve to improve paintability in the automotive industry. Non-conductive plastics parts cannot be painted using the electrostatic spray painting systems used for metal elements of cars, and so have to be painted offline. This adds to costs and slows down the whole painting process. "To overcome this, manufacturers of automotive parts should wisely choose temperature-stable thermoplastic grades and modify these systems with electrically conductive additives. Carbon black is frequently used, but high addition rates may be required, negatively affecting mechanical properties and processability," according to single wall carbon nanotube producer **OCSiAl**.

The company has launched a new single-wall carbon nanotube (it uses the term graphene nanotube) concentrate for use with PA, filled PPS, ABS, TPU, and PC. It says the new product provides targeted conductivity in thermoplastics produced by injection molding at working loadings starting from 0.1 wt% of nanotubes in the final system.

"This approach allows makers to optimise the painting process and reduce the final production cost," the company says.

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For more information about Makroplus CC products and Chezacarb AC carbon black visit our website

www.chezacarbcarbonblack.com

ORLEN Unipetrol

IMAGE: GRAPHMATECH

Right: HDPE-graphene masterbatch from Graphmatech

tivity without "hot spots" in the range of 10^5–10^9 ohm·cm, while retaining the original key mechanical properties, such as durability and strength, and minimally impacting the host polymer matrix, according to OCSiAl. "Furthermore, a low working dosage of 0.1-0.3 wt.% of graphene nanotubes demonstrates only a limited effect on rheological properties and processability," it claims.

"The working loading of graphene nanotubes is significantly lower than the dosage required for multi walled carbon nanotubes: typically 0.1–0.3 wt.% compared to 1–5 wt.% ," says Christian Maus, Development and Support Leader for Thermoplastics, OCSiAl Group. "This gives a number of benefits. Feedback from our customers shows that Tuball graphene nanotubes can be used to prepare compounds with overall high mechanical performance and allow easier moulding of complex parts compared to products with MWCNTs."

OCSiAl's carbon nanotubes are already being used commercially in automotive body parts. Russian compounder R&P PolyPlastic developed its Armamid conductive glass-filled PA66, which offers conductivity in the range of 10^6 to 10^8 Ω cm, using the company's Tuball Matrix 826 grade. Since last year, a conductive Armamid compound been used to produce on-line painted fenders for the GAZ Gazelle NN light commercial truck.

Graphene developments

Sweden's **Graphmatech**, based in Upsalla, is building up a range of conductive masterbatches and compounds containing graphenes for injection moulding, extrusion and FFF 3D printing applications. Torkel Nord Bjärneman, Business Development Manager for its Polymer Division, says the company dates back to 2017 at Uppsala University where researcher Mamoun Taher invented Aros Graphene, which he describes as a unique graphene hybrid material.

According to the company, when produced on a large scale, the individual one-molecule-thick layers in pure graphene have a tendency to stick together, making the material more like a graphite. Aros Graphene is said to have been designed to prevent this by incorporating specially designed "separator" molecules.

Graphmatech performs some of its graphene production in-house and outsources other grades. "We utilise a robust supply-chain of graphene suppliers, as there are many different forms of graphene with different end-applications," says Bjärneman. "We normally functionalise the flakes in-house using a patented process, to make the graphene flakes compatible with the polymer and to avoid re-agglomeration of the flakes."

Bjärneman says that for polymer-graphene formulations it uses a "few-layer graphene flakes with a certain average thickness, lateral size, and layer count." These are produced using graphite as the feedstock material.

"We usually speak of multifunctionality when we talk about added benefit, because graphene can enable applications where for example the mechanical, thermal properties and processability are just as critical as the electrical properties," he says.

"We can see that graphene reaches percolation at lower concentrations than carbon black. That means that a lot less graphene is required to achieve the dissipative properties of carbon black. At the concentration where carbon black shows dissipative properties, graphene is already entering the conductive region. This unlocks more possibilities beyond static charge dissipation," Bjärneman claims.

Cost is, of course, a concern for compound developers. "We analyse the added cost per kilo of compound," he says. "Today, we sell solutions with an added cost similar to solutions using carbon nanotubes. Once demand increases, and production volumes increases, we expect a similar added cost as high-conductive carbon black, which will open up more applications."

Graphene and other nanoparticles are used in the AvanShield range of EMI/RFI shielding compounds from **Avanzare Innova-**

IMAGE: AVANZARE INNOVACION TECNOLOGICA

This "dark box" is produced in an AvanShield graphene-filled compound from Avanzare to protect sensitive electronics

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cion Tecnologica. The Spanish company says the compounds contain a variety of functional additives enhanced by graphene and other nano -additives and offer electrical conductivity in the range of 1S/m. They also absorb electromagnetic waves in a frequency range from 100Hz to 8GHz.

Belgium-based **Nanocyl**, which has been making multi-wall carbon nanotubes (MWCNTs) for around 20 years, claims its NC7000 is the market benchmark in the ESD plastics industry. It proposes a wide range of dispersions in various media, among them the Plasticyl range of polymer-based products, including masterbatches.

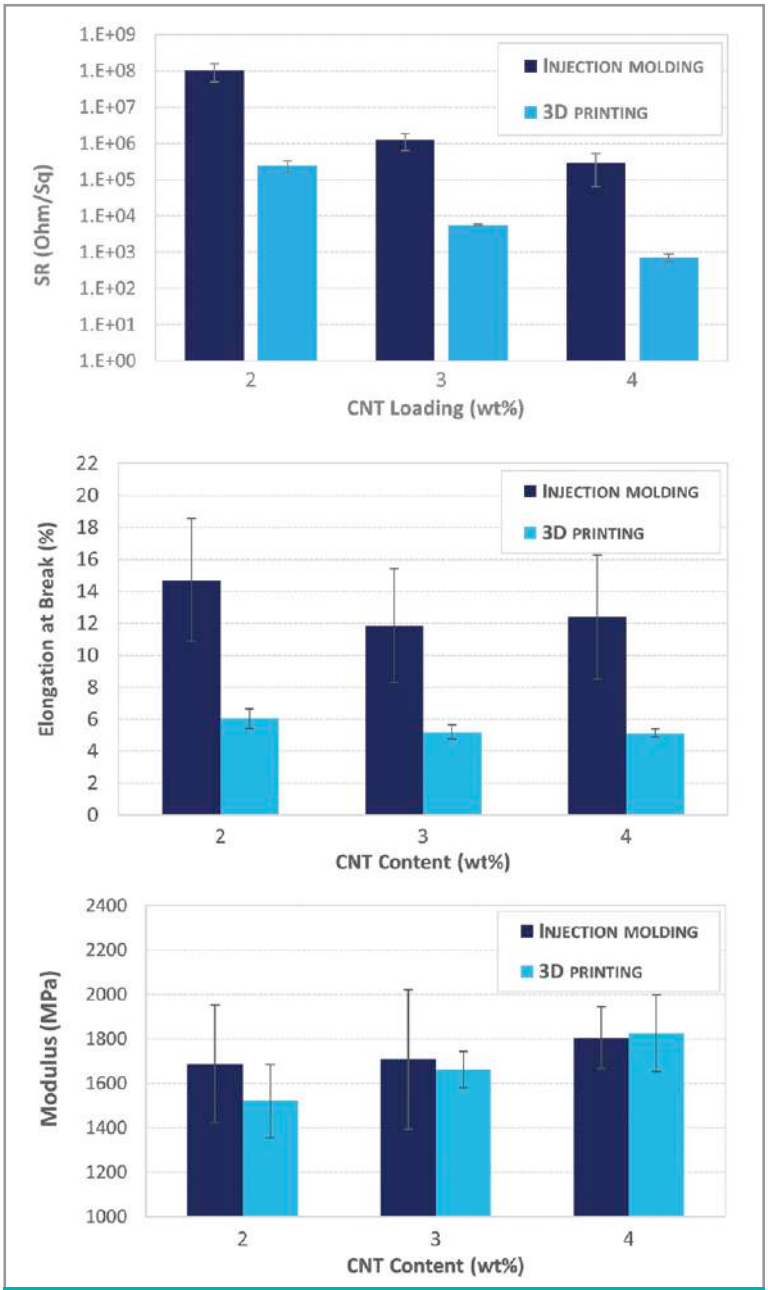

Figure 4: Electrical conductivity, elongation at break and modulus of Plasticyl NC7000 dispersion in ABS fused deposition moulding compound versus injection moulded ABS at addition levels of 2, 3 and 4 wt%.
Source, Nanocyl

Focusing on 3Dprint

The company has recently been placing considerable emphasis on the development of materials based on various polymers for 3D printing filament extrusion. It now has several dedicated Plasticyl products that are adapted to the processing specifications of FFF technology. Electrical resistivity can be adjusted in the range of 10 to around 10^9ohm.cm.

Alicia Rul, Technical Sales Manager Americas at the company, cites upgraded Plasticyl ABS compounds as an illustration of current developments. "Performances are better than the injection moulding 'standard' grade," she says. "Electrical conductivity and mechanical performance of printed parts by fused deposition moulding are better than the parts done via injection moulding." Results are shown in Figure 4.

Netherlands-based **CarbonX** says it has new data showing that its product, also called CarbonX, could provide performance-enhanced plastics with the recyclability that manufacturers need to implement real circularity and comply with upcoming EU regulations.

CarbonX is composed of nano-sized carbon filaments that are chemically connected to form a three-dimensional micron-sized network. The company describes the the additive as the "missing link between the performance of a nano-structure and the processability of a micron-sized material."

The company says the novel CarbonX structure makes it possible to combine properties in plastics compounds in new ways that could provide "the key to unlocking new design possibilities that can deliver both high performance and greater sustainability."

While pressure to mandate compulsory use of post-consumer recycled plastics in new products is strongest in the packaging sector, CarbonX says the focus of future legislation "will inevitably be extended to all plastic applications."

The CarbonX additive was recently tested to determine how well compounds containing it could retain initial properties after being recycled. A PP compound containing 45% CarbonX was re-processed 10 times to simulate the recycling process and its properties measured after each cycle. "High loading was used to test the limits of CarbonX because high loading increases shear during processing and makes it tougher to keep properties intact," says Daniela Sordi, CTO at CarbonX.

It was found that volume resistivity was largely preserved in the compound. The stability of the E-modulus and yield stress indicate that strength

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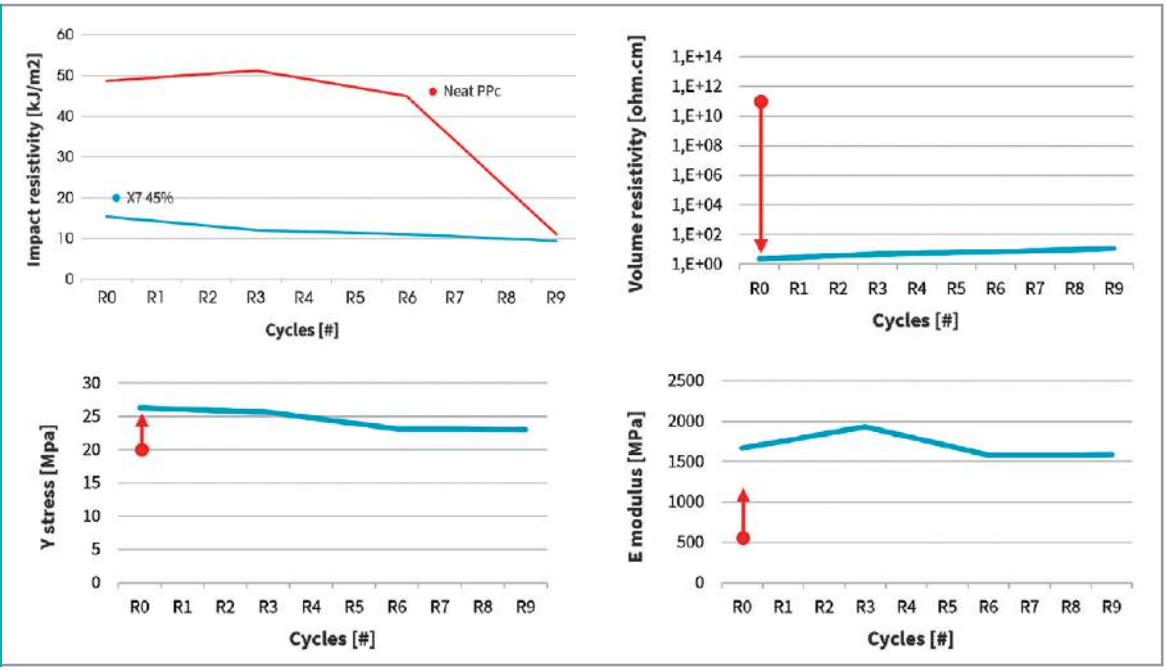

Figure 5: Effect of multiple recycling cycles on electrical and mechanical properties of a PP compound containing 45% CarbonX (blue line) compared with a 100% virgin PP sample (in orange)

Source: CarbonX

was also retained, even after 10 cycles (Figure 5).

An 80% decline in the impact resistance of the neat polymer indicates just how much the recycling process damages the polymer itself. However, the CarbonX compound showed a much higher retention of impact resistance.

"The combination of higher impact resistance and strength provided by CarbonX translates into greater durability, which improves the overall sustainability of the product by improving processability as well as recyclability," says Sordi. "Substituting conventional fillers with CarbonX would allow the introduction of larger quantities of recycled compounds back into the production process – making it more cost-effective to invest in closed-loop recycling, achieve real circularity, and vastly improve the sustainability of products starting now, not just in the future."

Sustainable thinking

Hans Miltner provides technical market and business development services for **Apply Carbon** (a divison of Procotex), which produces recycled carbon fibre. In a report he wrote this January, he discusses the growing demand for sustainable raw materials, and the effects of the COVID-19 pandemic.

He highlights the recent rapid climb in raw material prices, record-high container freight costs, increased lead times for key strategic products, among the factors that have created new opportunities for high-quality recycled products that can relieve the supply bottlenecks that have appeared for virgin materials. In addition, he flags massive ongoing investments in the development of low-carbon energy and travel, alongside shifts to circular economy models.

Miltner says this has had a considerable impact on the carbon fibre industry. After witnessing an abrupt drop in demand as air traffic fell to near zero in the early days of the pandemic, demand for carbon fibre today stands at record-high levels. He says this is not only due to aviation picking up, but also to the emergence of new end markets in need of lightweight and strong (wind energy) as well as electrically conductive (electric vehicles) materials.

"As a result, prices for virgin carbon fibre are high, lead times long, current capacity stretched, and opportunities for valorising growing volumes of post-industrial and end-of-life carbon fibre waste higher than ever," Miltner says.

Properties in demand for Apply Carbon products are robust mechanical performance (strength and stiffness) as well as tailored electrical characteristics (anti-static, conductive, electromagnetic interference (EMI) shielding) – and generally the combination of both, he says.

In anticipation of this growing market traction, and to reinforce its position in recycled carbon fibre products, the company made a series of strategic investments in 2021. These included the acquisition of the UK-based short carbon fibre business of ELG Carbon Fibre (now Gen 2 Carbon). It also now has a new 15,600m^2 facility in Plouay, France, with an extra 90,000m^2 available for future expansion. For compounding, a full range of pyrolysed and non-pyrolysed, sized, cut, milled and granulated recycled fibres is now available under the brand name Carbiso.

Miltner says Apply Carbon sees growing

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Right: Example of a plastic part that leverages the high mechanical performance and tunable electrical properties offered by high-quality recycled carbon fibers

demand, especially in automotive and in general electronics, for new sustainable and cost-effective material solutions that impart various levels of electrical conductivity to plastics. The company now offers a range of recycled carbon fibre products based on 'intermediate modulus' carbon fibre, milled, cut or granulated, with an appropriate sizing to impart the necessary compatibility with the matrix polymer.

The company says these intermediate modulus carbon fibres are stiffer than their standard modulus counterparts, but also inherently more conductive and generally faster at forming a conductive 'percolating' network at low fibre content within the polymer matrix (percolation occurs when the conducting fibres or fillers in the matrix make direct contact and is characterised by a sharp increase in conductivity).

"With these, customers can now achieve the desired electrical conductivity levels at as low as 10 wt% fibre content, where regular 'standard modulus' fibres may require as much as 30 wt% fibre content," says Miltner (Figure 6).

Apply Carbon also sees a growing demand for 3D printing materials (especially for FFF production technology) offering improved performance. It says that one problem with FFF 3Dprint technology is that longer fibres result in higher viscosity during fabrication, which is not desirable, and higher risk of nozzle clogging. "The key is therefore to use carbon fibre grades that offer the best compromise in terms of inherent performance, fibre length distribution and dispersibility in the matrix polymer," the company says. It now offers a range of grades with moderate fibre lengths and narrow fibre length distributions for this sector.

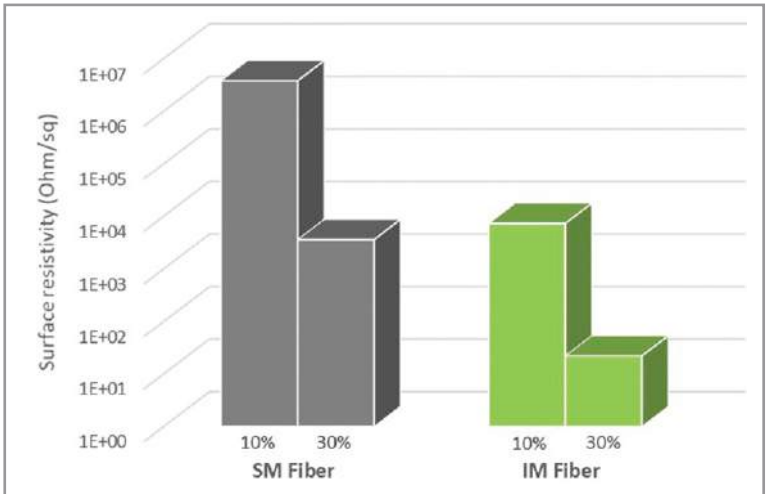

Figure 6: Surface resistivity of PA66 reinforced with 300 micron recycled carbon fibre granulates. Data obtained at 10 and 30 wt% fibre content for standard modulus (SM) and intermediate modulus (IM) grades
Source: Apply Carbon

Conductive devices

Italian compounding company **Lati** recently created a spin-off called Lati 3DLab dedicated to engineering and manufacturing of special thermoplastic compounds suitable for FDM 3D printing. Among recently developed grades, electrically conductive materials have proved successful in printing of conductive devices used in medical, electronics, robotics and sensors.

The use of a combination of carbon nanotubes and structured carbon black has allowed the company to reduce the electric resistivity of PLA-based plastic compounds below 10Ω while providing good homogeneity and isotropy of electrical properties. Physical properties have been maintained through the development of a multiphase matrix that incorporates a non-melting elastomeric component.

The resulting filament, sold by Filoalfa as Alfaohm, has been used by the Tecnologico de Monterrey University in Mexico to 3D print a conductive sensor for point-of-care medical applications. After surface etching and carbon activation, this sensor was able to transport electrical signals from an electroanalytical sensing device used to detect the presence of specific chemical substances.

"Exciting performances of conductive 3D printable compounds come together with fast fabrication time, quick switching to tailor made solutions and a very competitive bottom-line cost, specially when disposable parts are concerned," says Luca Posca, Group Technical Assistance & Marketing Director at Lati. "These advantages may offer a winning step forward to innovative applications as supercapacitors for hybrid or electric vehicles, lithium-ion batteries, electrokinetically-driven microfluidics and solar cells."

Within its Luvocom ESD product line, the **LehVoss** group now offers what it says are highly innovative non-carbon-modified high-temperature resistant thermoplastic ESD compounds, based on such polymers as PEI, PPS, and PAEKs. Additives, reinforcements and compounding technology can be varied to adjust mechanical and electrical

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IMAGE: APPLY CARBON

Above: Several suppliers of conductive additives are targeting applications in FFF 3D printing filaments

properties for each application (the company does not disclose which additives it uses). The range of conductivity typically is 10^6 to 10^9 Ohm and even conductivity is claimed in all three planes, allowing predictable end-use part performance. Materials are also said to offer high impact strength, allowing use for housings in harsh environments.

Further products offering high-strength and stiffness are available based on the use of CNTs and selected carbon fibres in combination with additives such as minerals, according to Thomas Collet, Director Marketing, Business Unit Customised Polymer Materials. "By using these technologies in combination with special fibres (steel and carbon), a portfolio of EMI shielding compounds has been developed," he says.

Production of electrically conductive compounds based on polymers ranging from polyolefins up to high end engineering plastics, and using various conductive additives, is a key strength of specialty custom compounder **Witcom**, which is a member of the Wittenburg Group. "We are very much accustomed to compound with conductive carbon blacks in our plants in the Netherlands and in China but can also select permanent anti-static additives to produce coloured conductive compounds," says Christine Van Bellingen, Business Development Manager, Conductive Compounds.

"Over the last year, we fulfilled several requests to meet stringent ATEX requirements (black or coloured materials), coupled for instance with high impact, good flame retardancy and UV stability properties, mainly for personal protective equipment and safe handling of compressed gas," she says.

Witcom expects EMI shielding plastics to gain momentum due to the growth in e-mobility and lightweighting megatrends, according to Van Bellingen. "However, the market indicators tell that the older, traditional EMI shielding plastics solutions are not attractive enough to replace metal because they are too expensive or based on non-environmentally friendly additives," she says.

"We have developed cost-effective, non-toxic EMI shielding compounds that can match high attenuation at high frequency (up to 100 dB between 4 to 40 GHz) and medium attenuation at lower frequency (up to 30 dB between 1 kHz and 2 MHz)," she says, adding that those figures are based on PA6 compounds and a sample thickness of 2mm. Compounds can be used to produce lightweight housings that match new e-mobility targets, with shielding effectiveness of 40 to 60 dB.

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Fraunhofer composites aim at metals

Fraunhofer ICT is developing electrically conductive polymer composites that it hopes could displace metals in some applications where relatively low currents are used. The institute says that the technology could be used to eliminate the use of polymer-metal combinations, which can cause problems in recycling due to the need for disassembly, and avoid the need for cabling in some applications.

Two-component injection moulding and additive manufacturing methods have been used to produce conductive paths within parts. For each technology, special conductive composites have been developed and appropriate processing parameters determined.

Several demonstration parts have been produced. One example is a pre-assembled ABS insert with an LED that is mechanically and electrically connected using a printed conductive material (a PC/ABS compound containing carbon nanotubes). A resistivity of 1 ohm.cm was measured in a single conductive layer 200 microns thick. A stack of three layers was printed for connecting the LED with a USB power supply.

Another potential area of application for conductive composites is redox-flow battery bipolar plates, which separate the electrolyte flow in the individual electrochemical cells and enable the flow of electrical current from one to the next. The electrolytes in redox-flow batteries are highly acidic, so the conductive component is carbon rather than metal-based. Composite parts combine relatively low filler levels, and therefore a relatively low melt viscosity, with a 4-7 S/cm through-plane conductivity said to be well suited to the application.

- **www.ict.fraunhofer.de**

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INJECTION MOLDING & DESIGN EXPO

The free-to-attend conference theatres at the Injection Molding and Design Expo will host leading players from throughout the supply chain discussing key business and technology developments. We look ahead to some of the highlights

Speakers announced for Detroit moulding expo

AMI, publisher of *Compounding World*, and *Plastics News* have published the programmes for the two free-to-attend conference theatres at the Injection Molding and Design Expo, which takes place in Detroit, Michigan, USA on May 25-26, 2022.

The speaker line-up boasts senior representatives from OEMs, tier one suppliers, packaging producers and leading moulders. These include Ford Motor Company, Berry Global, Faurecia, Amcor, Westfall Technik, Yanfeng Automotive Interiors, Teel Plastics, Cascade Engineering and many more.

Located alongside the exhibition, the two conference theatres are focused on "Moulding The Future" and "Designing The Future". They each feature busy two-day programmes of keynote talks, panel discussions and technology presentations. Admission to the conference theatres and the expo is free of charge – attendees can register **here**.

"We have worked with the industry to compile programmes that cover a wide range of important issues for the designers and manufacturers of injection moulded plastic parts and products," says Joe Pryweller, Director of Conference and Event Content at Crain Global Polymer Group.

Sean Manson, Senior Conference Producer at AMI, says: "Our selected speakers are covering a variety of critical themes and hot topics, such as digital manufacturing, tackling the skills shortage, strategies for business growth, factory automation, supply chain concerns, improving sustainability, design trends, cybersecurity, 3D printing and much more."

Industry leaders

The opening keynote presenters on the first day include Troy Nix, Executive Director of the Manufacturers Association for Plastics Processors (MAPP), whose talk is on "Working together to build a stronger moulding industry in the USA". In the other theatre, Alper Kiziltas, Technical Expert for Sustainability and Emerging Materials at Ford Motor Company, is giving the keynote presentation on "Selecting materials for more sustainable vehicles".

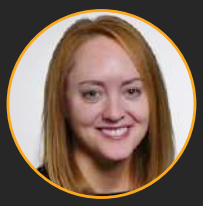
On the second day of the expo, the keynote speakers include Mark Gomulka, CEO of Westfall Technik, one of the world's most dynamic and fastest growing injection moulding groups. He's covering "Growth and expansion in opportunistic times". The other opening presentation is on "Transforming product design with innovative design thinking". It will be given by Grey Parker,

The conference at Injection Molding and Design Expo in May features key speakers including:

Troy Nix
Manufacturers Association for Plastic Processors

Carla Bailo
Center for Automotive Research

Alper Kiziltas
Ford Motor Company



Diane Marret
Berry Global

Jeff Stout
Yanfeng Automotive Interiors

Katie Roco
Faurecia Interiors

David Clark
Amcor

Laurie Harbour
Harbour Results

Gene Altonen
iMFLUX

Megan Tsanoukakis
Sussex IM

Mark Gomulka
Westfall Technik

Patricia Miller
Matrix 4

Principal and CEO at Sundberg-Ferar, a leading industrial design consultancy working across markets, including automotive, home appliances, consumer electronics, medical and packaging.

Both of the conference theatres will host a series of panel discussions featuring industry leaders debating key issues facing the moulding supply chain. For example, the discussion on "What makes a successful moulding operation?" will feature: Patricia Miller, CEO of Matrix 4; Gary Hulecki, Executive VP of MTD Micro Molding; and Mike Ruggieri, President of Comar. It will be followed by a separate discussion on the future of mould making that will include: Laurie Harbour, President and CEO of Harbour Results; Camille Sackett, VP of Sales and Project Management at Accede Mold & Tool; plus Brian Bendig, President of Cavalier Tool & Manufacturing. Other hot topics being debated in the "Moulding The Future Theatre" include how the industry can tackle skills shortages and how it can respond to supply chain issues.

Design debates

The "Designing The Future Theatre" will host separate debates focused on trends in automotive, rigid packaging and medical applications, plus a discussion on designing for sustainability. Speakers on these topics will include: Katie Roco, Customer Engineering Director at Faurecia; Jeff Stout, Executive Director at Yanfeng Automotive Interiors; and Carla Bailo, President and CEO of the Center for Automotive Research; David Clark, VP, Sustainability at Amcor: Diane Marret, Sustainability Manager for consumer packaging at Berry Global; Jeff Totten, Chief Engineer at Cascade Engineering; Thierry Fabozzi, President and CEO of Plastic Technologies Inc (PTI); Megan Tsanoukakis, VP Supply Chain at Sussex IM; and Christian Herrild, Director of Growth Strategies at Teel Plastics.

In between the panel discussions, there will be a series of technology talks from leading suppliers. These will cover topics such as: specifying hot runners; harnessing factory data; microcellular foam moulding; lights-out automation; Industry 4.0; advanced control systems; innovations in process simulation; and selecting materials to minimise a product's carbon footprint.

There will also be talks on specific applications and new technologies. Gene Altonen, Chief Technology Officer at iMFLUX, will discuss his company's innovations in adaptive processing. Steve Beasley, Regional Sales Manager at Krauss-Maffei will discuss the injection moulding of lightweight door modules incorporating natural fibre prepreg sheets.

The two conference theatres at the Injection Molding and Design Expo 2022 are sponsored by CAE Services and Bristlecone. The current programmes and timings can be viewed **here**. There will be an additional Training Theatre at the expo hosting a series of practical seminars from some of the industry's leading trainers and educators. The programme for this will be published next month.

For more information on the Injection Molding and Design Expo, including free registration, please visit: **www.injectionmoldingexpo.com**

Download these new product brochures

COPERION: PELLETISING SYSTEMS

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

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MIXACO: MIXING TECHNOLOGY

Mixaco has been driving innovation in PVC mixing technology for more than 50 years and has 7,500+ machines installed worldwide. This brochure explains some of the details that make its HM and KMH heating cooling mixers stand out.

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BUSS: COMPEO KNEADER

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

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CHEMOURS: PROCESSING AIDS

In this brochure, Improving the Efficiency and Quality of Polyolefin Extrusion, Chemours explains how issues including melt fracture and extrusion instabilities can be addressed with its Viton FreeFlow products, the next generation of polymer processing aids.

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KLK OLEO: GREEN ADDITIVES

KLK OLEO provides a series of products for industrial applications. PALMOWAX and PALMESTER provide green lubricant solutions for polymer processing; PALMERE and PALMERA are green ingredients for PVC additives/ plasticisers.

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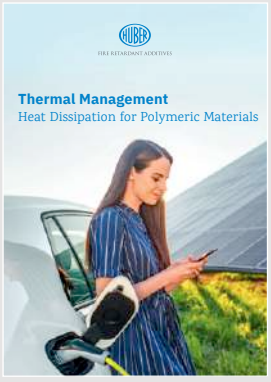
HUBER: THERMAL MANAGEMENT



Heat dissipation has become an important consideration in many plastics applications. Find out how the thermal properties of Huber's Martoxid, Magnifin and Martinal fillers can be used to create thermally conductive polymer compounds.

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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

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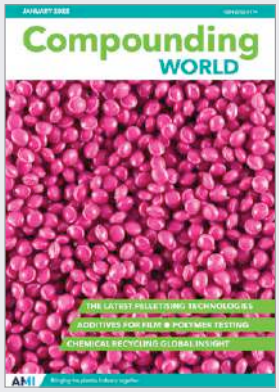

Compounding World January 2022
The January 2022 edition of Compounding World looks at the latest developments in pelletising technology. It also explores some of the recent additions to the film additive option list and learns how new demands on compounders and end users are changing polymer testing strategies.

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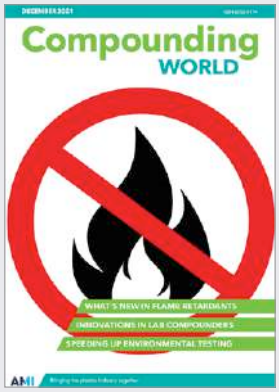

Compounding World December 2021
The final edition of Compounding World in 2021 took a detailed look at the latest developments in the flame retardants sector. This edition also explored innovations in laboratory-scale compounding equipment and explored the area of accelerated testing.

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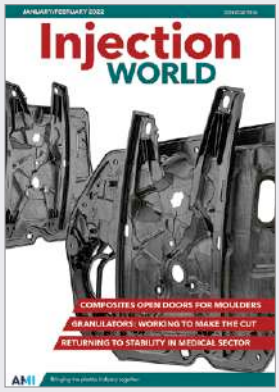

Injection World January/February 2022
The January/February edition of Injection World magazine takes a look at some of the latest developments in thermoplastic composite part production. This first edition of 2022 also reviews recent innovations in the area of medical moulding.

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Plastics Recycling World November/December 2021
The November-December edition of Plastics Recycling World has a lead feature on progress in chemical recycling projects around the world. Other features cover PET depolymerisation and quality measurement in mechanical plastics recycling.

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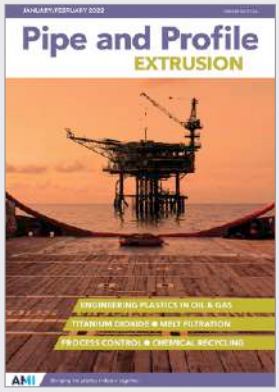

Pipe and Profile January/February 2022
The Pipe and Profile Extrusion January-February edition looks at the success of engineering plastics and composites being used in oil and gas applications. Other features cover regulatory issues around titanium dioxide, controls and melt filtration.

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Film and Sheet January/February 2022
The first edition of Film and Sheet Extrusion magazine in 2022 explores innovations in the agricultural film industry. It also looks at how enzymes may be used as plastics additives, and reviews developments in bioplastics, quality testing, and medical applications.

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Compounding WORLD

Film and Sheet EXTRUSION

Pipe and Profile EXTRUSION

Injection WORLD

Plastics Recycling WORLD

GLOBAL EXHIBITION GUIDE

2022	**8-11 March**	Plastimagen, Mexico City	www.plastimagen.com.mx
	5-8 April	FIP, Lyon, France	www.f-i-p.com
	25-28 April	Chinaplas, Shanghai, China	www.chinaplasonline.com
	3-5 May	JEC 2022, Paris France **NEW DATE**	www.jec-world.events
	3-6 May	GreenPlast, Milan, Italy	www.greenplast.org
	18-19 May	PlastExpo Nordic, Helsinki, Finland **NEW DATE**	https://pfsptec.messukeskus.com/
	25-26 May	Injection Moulding & Design, Detroit, MI, USA	https://injectionmoldingexpo.com/
	26-30 September	Colombiaplast, Bogota, Colombia	www.colombiaplast.org
	27-29 September	Fachpack 2022, Nuremburg, Germany	www.fachpack.de
	3-7 October	Plastex, Brno, Czech Republic	www.bvv.cz/en/plastex/
	19-26 October	K2022, Dusseldorf, Germany	www.k-online.com
	9-10 November	Compounding World Expo USA, Cleveland, USA	www.compoundingworldexpo.com/na/
	1-3 December	Plast Print Pack West Africa, Accra, Ghana	www.ppp-westafrica.com
2023	**1-5 February**	PlastIndia, New Delhi, India	www.plastindia.org
	14-15 June	Compounding World Expo Europe, Essen, Germany	www.compoundingworldexpo.com/eu/
	5-8 September	Plast 2023, Milan, Italy	www.plastonline.org/en
	26-28 September	Interplas, Birmingham, UK	www.interplasuk.com
	17-21 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de

AMI CONFERENCES

1-2 March	PVC Formulation USA, Cleveland, OH, USA
14-16 March	Cables Europe 2022, Cologne, Germany
29-30 March	Chemical Recycling North America, Houston, TX, USA
26-27 April	Fire Retardants in Plastics 2022, Houston, TX, USA
10-12 May	Masterbatch Europe, Frankfurt, Germany
7-8 June	Compounding World Congress Europe, Cologne, Germany
14-15 June	Chemical Recycling Europe, Cologne, 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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