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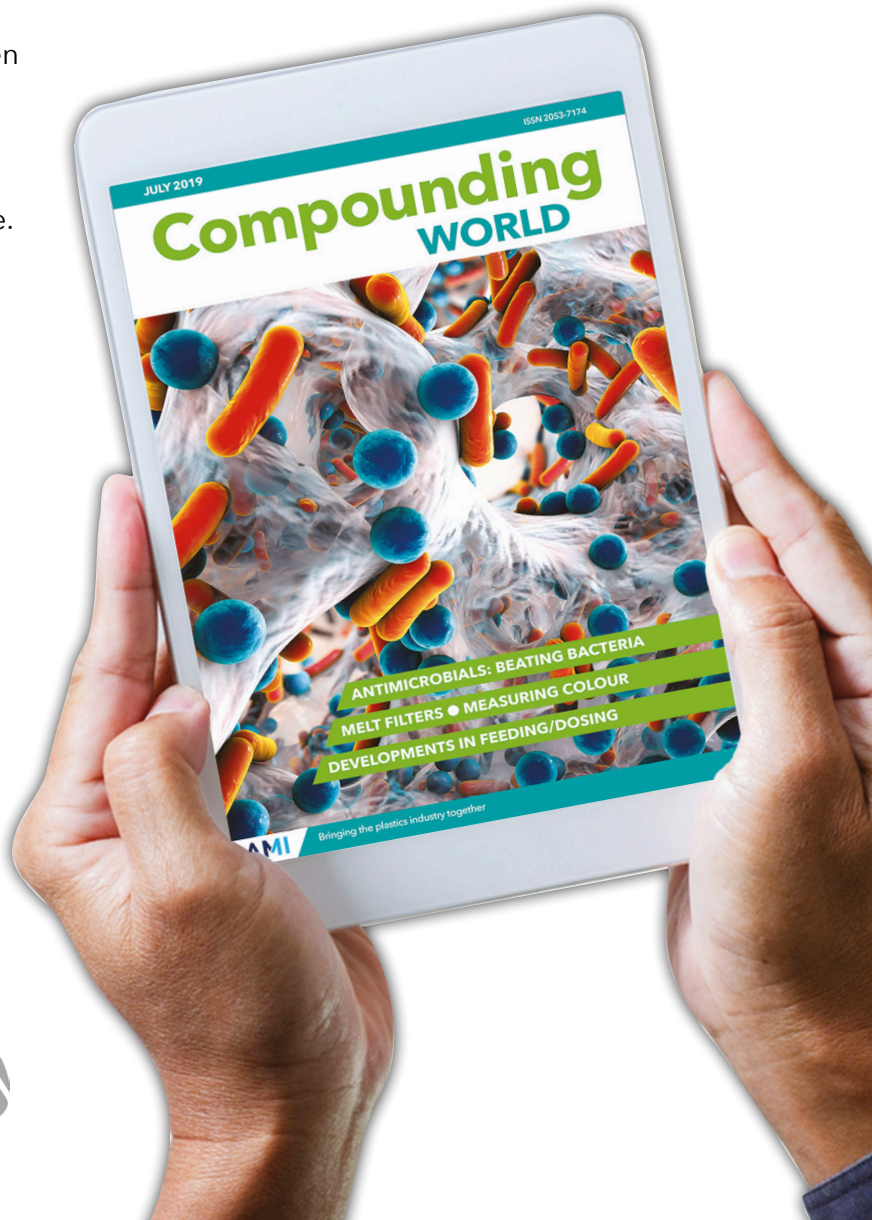

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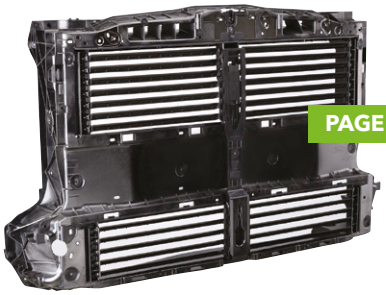
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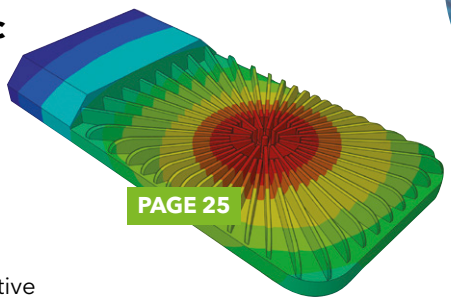
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Celanese to consolidate European compounding

Celanese is to establish a 'European compounding centre of excellence' for its Engineered Materials business at its site in Forli, Italy. As part of the plan, the company said compounding operations at its sites at Kaiserslautern and Wehr in Germany and Ferrara Marconi in Italy will transfer to the Forli location over the next 12 to 24 months.

The company said the move will align the structure of its European operations with the models already in place in the Americas and Asia. Celanese said Forli is the viable choice as the location has the largest existing infrastructure and capabilities for speciality compounding, a physical layout that allows for future expansion, and expertise in engineering polymers.

Forli was formerly the headquarters of the So.F.Ter compounding business that Celanese acquired in 2016. The company produced a range of TPE and engineering thermoplastic compounds. Celanese said inventory build, customer requalification and transfer of compounding assets will take place over the next two years.

In an unrelated move, Celanese has agreed to sell its 45% stake in its Polyplastics joint venture to Japan's Daicel for $1.575bn. Polyplastics is headquartered in Japan and makes engineered polymers including POM, LCP and PPS. The two companies co-founded it as a 45/55 joint venture in 1964.

Lori Ryerkerk, Celanese chair and CEO said it will "use this opportunity to monetise a historically passive investment and allocate significant capital to higher growth businesses within Celanese". These include its Engineered Materials business, which will now compete with Polyplastics in markets and regions where there are overlapping product lines.

› **www.celanese.com**

BASF explores traceability

BASF Plastic Additives and Australian firm Security Matters, a blockchain and coding specialist, have signed a joint development agreement "to develop solutions for plastics traceability and circularity". The aim of the deal is to develop techniques for tracking and validation of closed loop recycling systems. BASF will apply its plastics knowledge; Security Matters will contribute its track and trace technology

› **www.plasticadditives.basf.com**

› **www.securitymattersltd.com**

Biesterfeld invests in innovation

Plastics and additives distributor Biesterfeld has opened an 800m² 'Lab & Innovation Centre' at its headquarters site at Hamburg in Germany. The centre houses a laboratory as well as a conference room and meeting areas.

The new facility will be used mainly for application-related laboratory activities, including development of new formulations, product tests and customer-specific projects.

"Alongside individual project work in accordance with customer requirements, the laboratory will be used to screen new raw materials from our partners and to conduct comparative studies," said Laboratory Manager Dr Lisa Nahrwold.

In addition to the new centre, Biesterfeld has other regional laboratories in Norway, Turkey and Poland.

› **www.biesterfeld.com**

Lanxess fills out Ford Kuga front end module

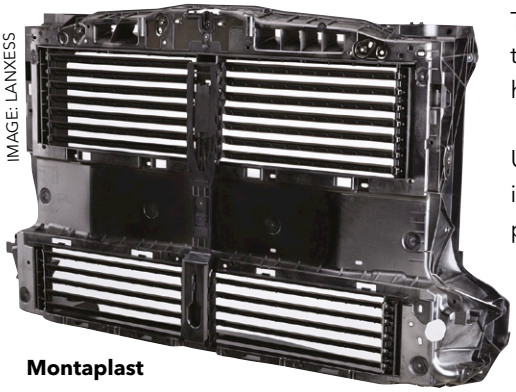

IMAGE: LANXESS

Montaplast is producing this FEM for Ford using a high-flow Durethan PA from Lanxess

The highly integrated plastic-metal composite bolster developed and manufactured by Montaplast for the latest Ford Kuga SUV uses fibreglass-reinforced high-flow Durethan BKV30H2.0EF PA6 from Lanxess.

"Our easy-flowing PA6 can be processed at lower injection pressures," said Ulrich Dajek, a hybrid design expert at Lanxess. "For this reason, smaller injection moulding machines with lower clamping forces can be used in the production of the hybrid bolster."

According to Lanxess, PA6 offers two key advantages over PP in this application – the threaded connections are more reliable and the bolster can better withstand the thermal load that arises when the grille shutters are closed. Furthermore, Dajek said component areas with filigree geometries can be designed with around 20% thinner walls due to the improved flow.

› **www.lanxess.com**

AMI postpones Essen exhibitions

Compounding World publisher AMI has announced the postponement of its four focused plastics industry exhibitions, which were scheduled to take place at Messe Essen in Germany on 7-8 October 2020. The shows will now take place on 1-2 June 2021.

The decision to delay the Compounding World Expo, Plastics Recycling World Expo, Plastics Extrusion World Expo and Polymer Testing World Expo has been taken due to the on-going uncertainty created by the Coronavirus pandemic.

"We have been reviewing the fast-changing situation daily, and we have been consulting with exhibitors, Messe Essen, local government and health authorities. Our primary concerns are for the health and safety of all attendees at our events and delivering the very best audience for our exhibitors. With these factors in mind, we have taken the decision to postpone the expos to 1-2 June 2021," said Rita Andrews, Head of Exhibitions at AMI.

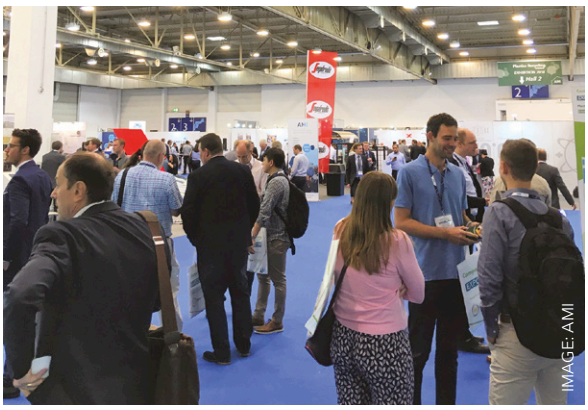
IMAGE: AMI

Above: This year's Compounding World Expo has been postponed to 2021

"Exhibitor numbers are up by more than 80% compared to our launch event in 2018, and we want to ensure visitors can feel confident and comfortable in attending the expanded exhibitions," she added.

The decision to reschedule the event was made on 4 August. "We felt it was important to make and announce this decision now, in order to end the current uncertainty and to allow exhibitors, speakers and attendees to plan effectively for the new dates," said Andy Beevers, Events Director at the company. "We have had tremendous support and understanding from the industry during this process and are now all looking to forward to a successful return to Essen next year".

Admission to the four expos and their five conference theatres will continue to be free of charge and registration will re-open later this year. Visitors who have already registered for the 2020 event will be able to simply renew their free tickets for the 2021 exhibitions.

› **www.ami.international/exhibitions**

NEWS IN BRIEF...

SABIC said its PC facility at Cartagena in Spain is set to become the first large-scale chemical operation to run entirely on renewable energy. Deal with Spanish utility firm Iberdrola will see construction of a €70m 100MW solar energy unit by 2024.
www.sabic.com

Sweden's RenCom has selected Coperion's ZSK twin screw extrusion system to produce its Renol lignin-based bio compounds. It plans to produce up to 1,000 tonnes/yr by late 2020.
www.lignin.se
www.coperion.com

Radici launches Mixloy blends

RadiciGroup's High Performance Polymers business has launched a new speciality range of PA blends. The Radilon Mixloy products are based on PA6, PA66 and long chain PA resins and manufactured using a proprietary compatibilisation technology, according to the company.

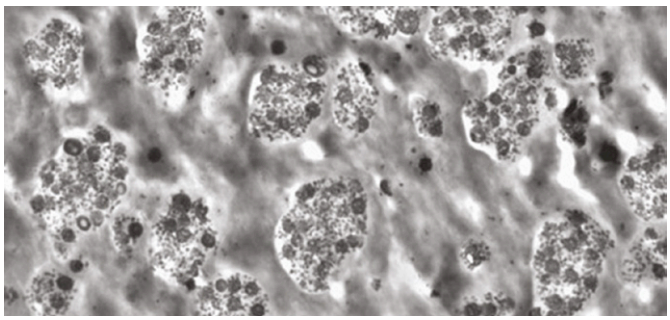
IMAGE: RADICI GROUP

Nicolangelo Peduto, R&D Manager at the business, said that development is currently focused on certain types of alloys "but, in the future, we plan to add other products, with the goal of achieving properties that are simply not attainable with individual polymers". The key commercial aim is to "be able to meet the demand coming from market niches".

PA is RadiciGroup's main material and it claims to be the only industrial group in Europe able to control its entire production process, including recycling. "Thanks to our upstream vertically integrated PA production, we have at our disposal a number of different types of polymers that give us design freedom in formulating the new Radilon Mixloys," Peduto added.

■ Separately, RadiciGroup announced its 2019 results, which it described as "positive" and in line with budgets. Consolidated sales were 10% down on 2018 at €1.1bn and EBITDA was €165m. It said Q1 2020 results had held up but "the rest of the year will feel the consequences of pandemic-induced uncertainty and difficulties".

› **www.radicigroup.com**

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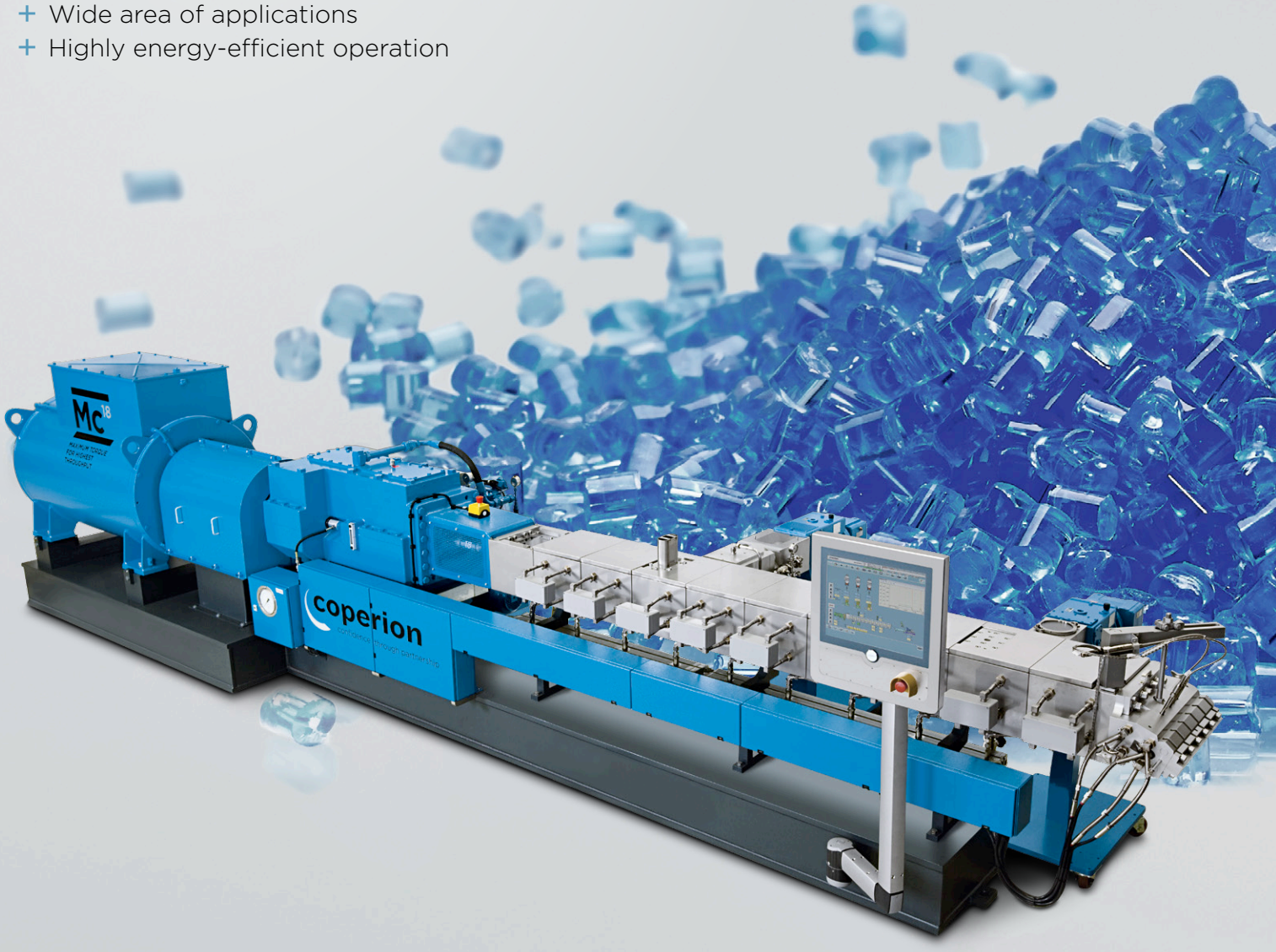

Coperion's ZSK Mc^{18} high performance twin screw extruder is a superlative product. It has a proven track record on the market as a throughput champion for products with high torque requirements such as engineering plastics. For further information please visit **www.coperion.com/zskmc18**

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SK Capital invests in Techmer PM

New York-based private investment firm SK Capital Partners has acquired a majority stake in Techmer PM. Founder, chairman and CEO, John Manuck, who previously owned it outright will retain "a significant ownership stake." Further terms of the deal were not disclosed.

"Techmer is taking this step with SK to satisfy growing demands from brand owners and international clients who want to see the company expand its footprint to allow it to better serve customers no matter where they are in the world," said Manuck.

Headquartered at Clinton in Tennessee, US, Techmer PM produces engineered compounds and colour and additive concentrates for plastics and fibres. The company has seven manufacturing plants in North America, employing more than 600 people. It opened its first non-US plant in Querétaro, Mexico, in late 2017.

SK Capital focuses on the speciality materials, chemicals and pharmaceuticals sectors. Last year it acquired PolyOne's Performance Products and Solutions business and in 2018 it bought SI Group, which it combined with portfolio company Addivant. It currently has some $4.8bn of assets under management.

› **www.techmerpm.com**
› **www.skcapitalpartners.com**

IMAGE: TECHMER PM

Above: Techmer PM founder and CEO John Manuck

Sukano makes an impact

Sukano has launched a transparent impact modifier masterbatch for cold, flash frozen and room temperature thermoformed tray applications. Part of its rPET product portfolio, the company said it can replace specialised copolyester resins and GAG film structures to allow the end product to be both mono-material and recyclable.

Alessandra Funcia, Head of Marketing at Sukano, said the new material offers improved durability and toughness and enhanced impact resistance without a loss in transparency. It also generates fewer sharp edges and shards during die cutting, which can help speed up production lines and avoid cross-contamination.

› **www.sukano.com**

Collin finds partners in Asia

Germany-based Collin, which develops modular pilot and laboratory lines for plastics processing companies and research institutes, has established two new representatives in China and one in Vietnam.

Techwin Medical Science is now representing Collin for presses, extruders, blown film lines, roll mills and other products in the medical arena in China; Team Testing Equipment (TTE) is representing it in the petrochemical and plastics industry. Both companies are based in Shanghai.

Song Song has been appointed to represent Collin in Vietnam. It is based in Ho Chi Minh City.

› **www.collin-solutions.com**

Rehook cycling multi-tool uses Silvergate blue masterbatch

Rehook is using a custom-developed 'ultra blue' masterbatch from Silvergate to colour its latest Rehook Plus cycling multi-tool, which incorporates tyre levers, wrenches, spoke keys, a screwdriver and hex heads together with the company's original chain replacement aid.

Most of the injection-moulded PA tool is black but entrepreneur Wayne Taylor, who developed it, wanted a splash of colour on this new version to make it stand out at the point of sale. "The classic Rehook was originally produced in a variety of colours but I wasn't 100% happy with the final aesthetics. Our packaging also needed a revamp, as it featured pastel shades that lacked visual appeal," he said.

IMAGE: REHOOK

Silvergate developed the blue masterbatch for Rehook's cycling multi-tool

› **www.silvergate.co.uk**
› **www.rehook.bike**

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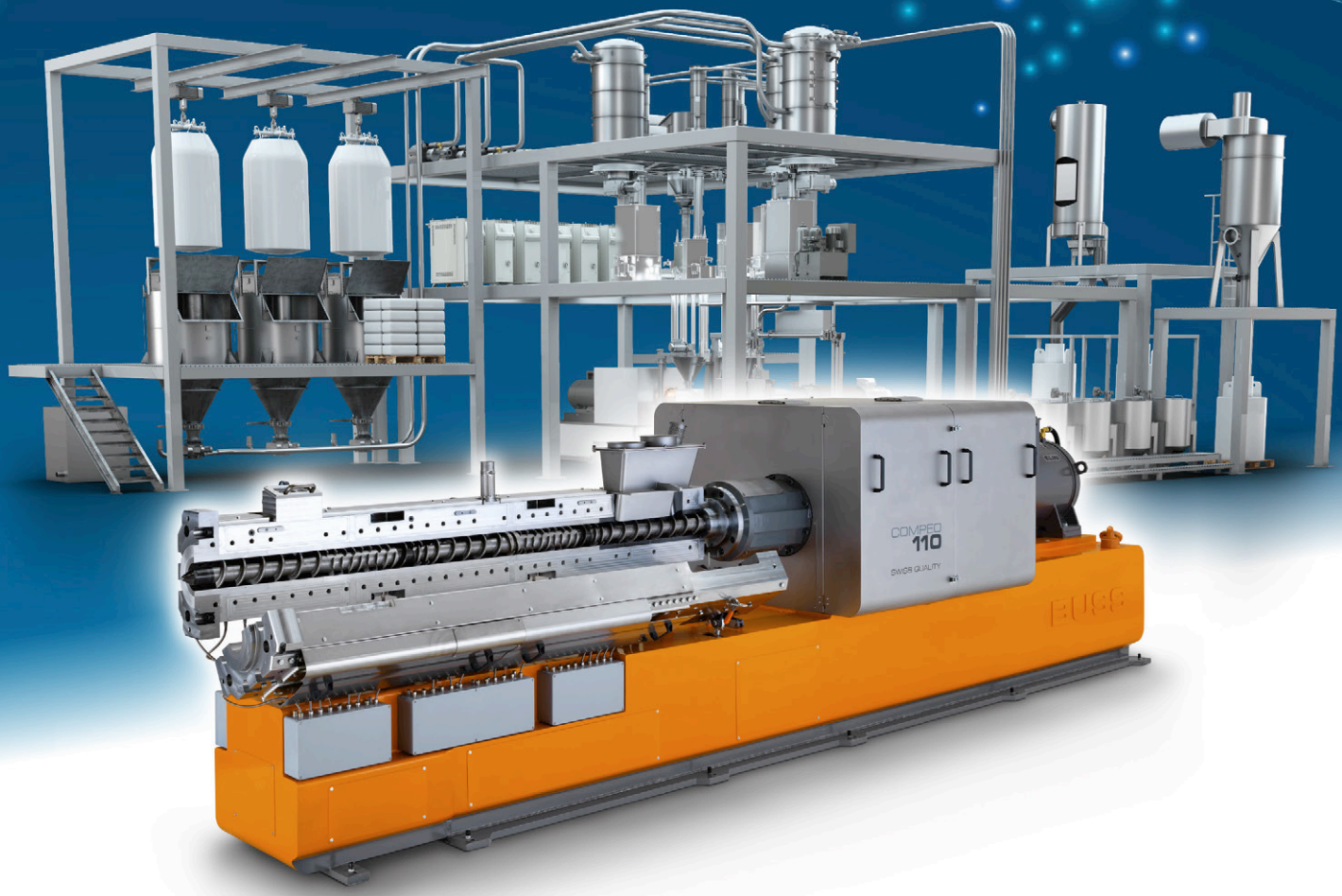

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www.busscorp.com

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Heroplas starts up in Germany

German technical compounder Sitraplas Group and plastics recycler Spenger KRS Kunststoff Recycling and Service have started production at their recently formed joint venture compounding company, Heroplas.

Around €3m has been invested in the new business at Spenge in Germany, which will produce custom polyolefin-based compounds with a focus on fast turnaround, small batches. "Heroplas will set its focus on customer-specific special compounds, which are mostly small lots, but the set-up is flexible for large lots as well," said a company spokesperson.

Heroplas product lines will include PP and PE compounds, TPEs and TPVs, complementing the PC, PMMA, ABS, PBT and engineering resin blend products produced by Sitraplas.

The plant commenced operation in June and will be in full production by September. It is equipped with two Coperion compounding lines – ZSK 26 and ZSK 45 variants – with options of underwater and wet or dry strand pelletising. Total capacity is around 2,000 tonnes/yr, according to the company.

› **www.heroplas.com**

Asahi Kasei targets haptics

Asahi Kasei Plastics North America (APNA) has introduced SoForm, a new addition to its Thermylene family of chemically-coupled, glass fibre reinforced PPs described as a cost and process optimised material for automotive interior surfaces and industrial durable goods.

Key features claimed for SoForm include excellent scratch resistance with a pleasant haptic surface and improved durability, plus low gloss, low emissions, chemical resistance and structural performance. It is said to eliminate the need to paint, over-mould or foam-in-place.

Above: SoForm is a new enhanced-haptic reinforced PP from Asahi Kasei

The material is offered in 10, 15, 20 and 25% glass fibre reinforced grades. All are available either natural or pre-coloured and are suitable for injection moulding.

Potential applications include instrument panels, door panels and associated touch points in the automotive sector, as well as furniture armrests and durable wear surfaces.

› **www.asahi-kasei.com**

Victrex sets sights on 3D

Victrex has launched Victrex AM 200, a PAEK-based filament that has been designed and optimised specifically for use in 3D printing of parts requiring resistance to wear, high temperatures, fatigue and corrosion.

It said the AM 200 filament has been developed to address the problems associated from repurposing injection moulding PEEK for filament fusion additive manufacturing, notably poor interlayer bonding.

› **www.victrex.com**

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Fakuma shifts to 2021

Fakuma organiser PE Schall has called off its 2020 show, which was due to take place in October in Friedrichshafen in Germany. The next event will take place on 12-16 October 2021.

"Together with all involved parties, we struggled for a long time to amend the general conditions demanded by the corona pandemic in such a way that Fakuma 2020 could have been promoted successfully," said Bettina Schall, Managing Director of PE Schall.

The 2018 event attracted 47,560 visitors. Schall said a hygiene and security concept that met all the prerequisites was developed for the show but "current uncertainties amongst exhibitors and visitors…with regard to travel and sending employees to events" had convinced it not to go ahead with a 2020 event.

The next Fakuma fair will take place at the Friedrichshafen fairground in 2021

Over the past few weeks a number of major long-time Fakuma exhibitors had indicated they would not "actively participate" in the 2020 show, which was generally interpreted to mean no machinery exhibits and few, if any, staff.

› **www.fakuma-messe.de**

Archman picks Domo PA6

Italian horticultural tool manufacturer Archman selected Domo's Econamid Air carbon fibre reinforced PA6 compound for the cutting body of its new Helium electric tree pruner.

Domo worked with Archman and its Italian distribution partner Guberti throughout the design phase for the Helium tool, which weighs just 1.6kg.

Econamid Air, which uses recycled carbon fibre, was chosen for its combination of light weight, strength, electrical conductivity and sustainability (its carbon footprint is said to be 90% lower than virgin equivalents). It also offers improved tribological properties.

› **www.domochemicals.com**

BASF to invest in pigments

BASF Colors & Effects is to set up a new global distribution centre at Ladenburg in Germany. Work is already underway on the 20,000m² building, with completion expected in the first half of 2021.

"This site, about 20km away from our largest production site in Ludwigshafen and in an ideal location to our other European production sites, allows us to combine our centralised distribution structure in Europe with a distribution network geared to small quantities," said Dr Florian Hofer, globally responsible for customer service and logistics management.

The new facility will mean shorter delivery times and improved certainty of delivery schedules, the company said.

■ BASF announced the planned sale of its pigments business to Japan's DIC in August last year. The company said the €1.15bn deal, which requires regulatory approval, is still moving ahead and is expected to complete towards the end of this year.

› **www.colors-effects.eu**

Twin screw simulation software update

Sciences Computers Consultants (SCC) has launched Ludovic v7.0, the latest version of its simulation software for co-rotating twin screw extruders.

The new version incorporates a number of improvements to address user-friendliness, extruder design capability and material issues, the company said. These include a refreshed interface, new dashboard for greater readability, and changes to the simulation batch mode.

Other additions to Ludovic v7.0 include: integration of new turbine mixing elements and blister/ring elements and an expanded standard database of simulations.

› **www.scconsultants.com**

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Mocom emerges from Albis

Otto Krahn Group has completed the split of its distribution and compounding operations, which was first announced back in October 2019, with compounding now operating under the new Mocom name and distribution continuing under Albis.

As previously announced, the compounding business is headed by CEO Ian Mills, formerly Chief Sales Officer within Albis. "We are an innovative thermoplastic compounder delivering high quality, sustainable solutions at competitive prices in close cooperation with our customers, able to offer our product portfolio to a high quality level worldwide," he said. "Mocom will build on our strong history of customer collaboration utilising the experience gained over 50 years."

IMAGE: OTTO KRAHN GROUP

Above: pictured from left, Albis CEO Horst Klink, Otto Krahn Group CEO Philip O Krahn, and Mocom CEO Ian Mills

Mocom has three manufacturing operations in Germany and production sites at Duncan in South Carolina in the US and Changsu in China. It employs some 700 staff.

The Albis distribution business will be headed by CEO Horst Klink, former Vice-President of Distribution at Albis. It has 24 locations worldwide, most are in Europe but it also has a distribution presence in North Africa, Asia-Pacific and the Americas. It employs around 450 people.

Separating the two businesses was announced as a strategic move. "The new structure is good for our customers, good for our distribution partners and good for us as a group," said Philip O Krahn, CEO of the family-run Otto Krahn Group. The group also includes Krahn Chemie and plastics recycler Wipag.

› **www.albis.com**
› **www.mocom.eu**

Burgsmüller completes move to Einbeck

IMAGE: BURGSMÜLLER

Twin screw extruder screw element producer Burgsmüller has completed the move to its new production facility at Einbeck in Lower Saxony, Germany.

The company, part of KraussMaffei, made the move to increase capacity and to streamline its production processes. "The significantly enlarged production area of our new site also allows us to further extend our team," said Jens Biel, Managing Director of Burgsmüller.

The 7,200m² building was constructed on the two hectare site by developer VGP in just nine months.

› **www.burgsmueller.de**

The new meeting place for the Asian compounding and masterbatch industry

The event brings together the well established Compounding World and Masterbatch Asia conferences to create a wider industry meeting place for the whole supply chain.

The expanded programme will cover the key market and technologies trends for compounders involved in formulating and manufacturing all types of thermoplastics compounds and masterbatches.

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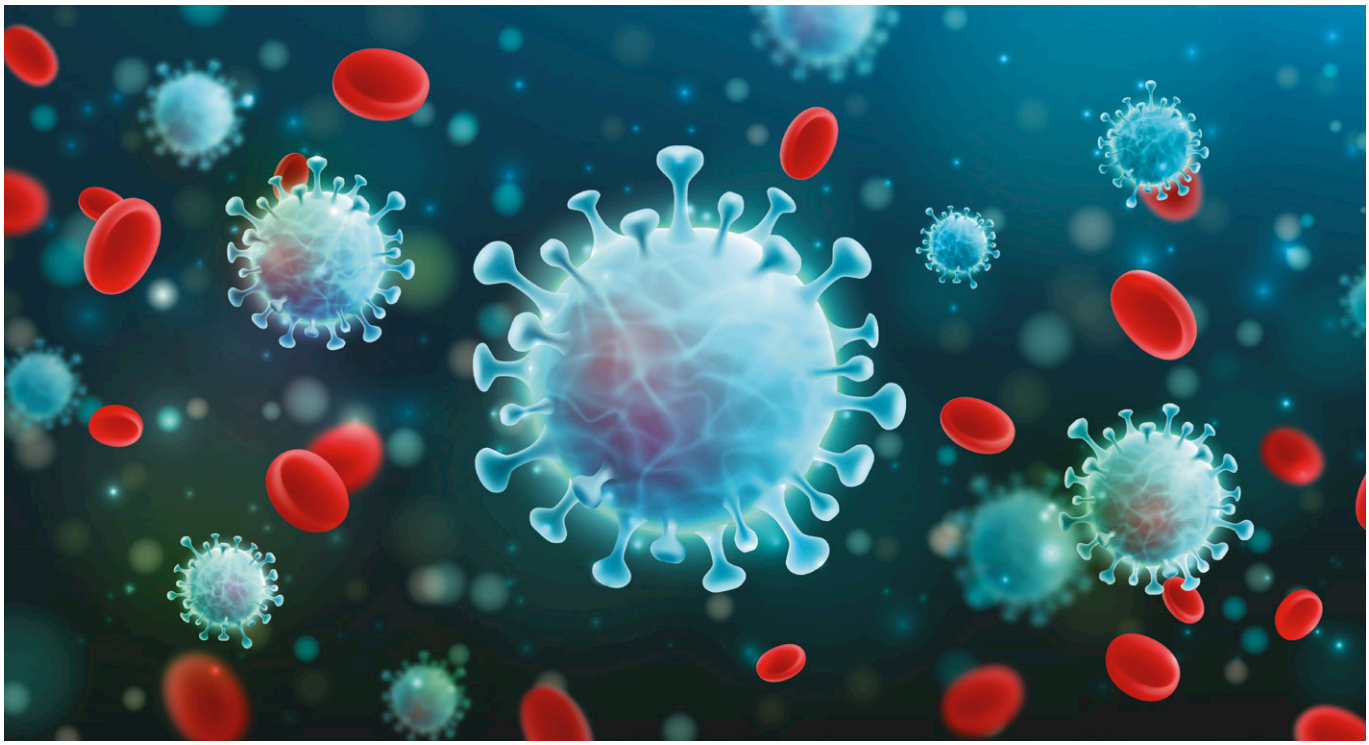


IMAGE: SHUTTERSTOCK

Gauging the business impact of the Covid-19 pandemic

The Covid-19 pandemic has hit the global economy hard. A new survey by *Compounding World* publisher AMI measures the impact on the plastics industry and expectations for recovery

The global plastics industry has certainly not escaped the impact of the Covid-19 pandemic with more than 60% of businesses experiencing a reduction in activity of 10% or more over the first half of the year, according to the findings of a global survey of plastics industry business sentiment carried out by *Compounding World* publisher AMI in the second half of June. However, the survey also reveals a high level of optimism among plastics industry players – more than 60% of respondents expect their business to have returned to per-Covid-19 levels by the end of 2021.

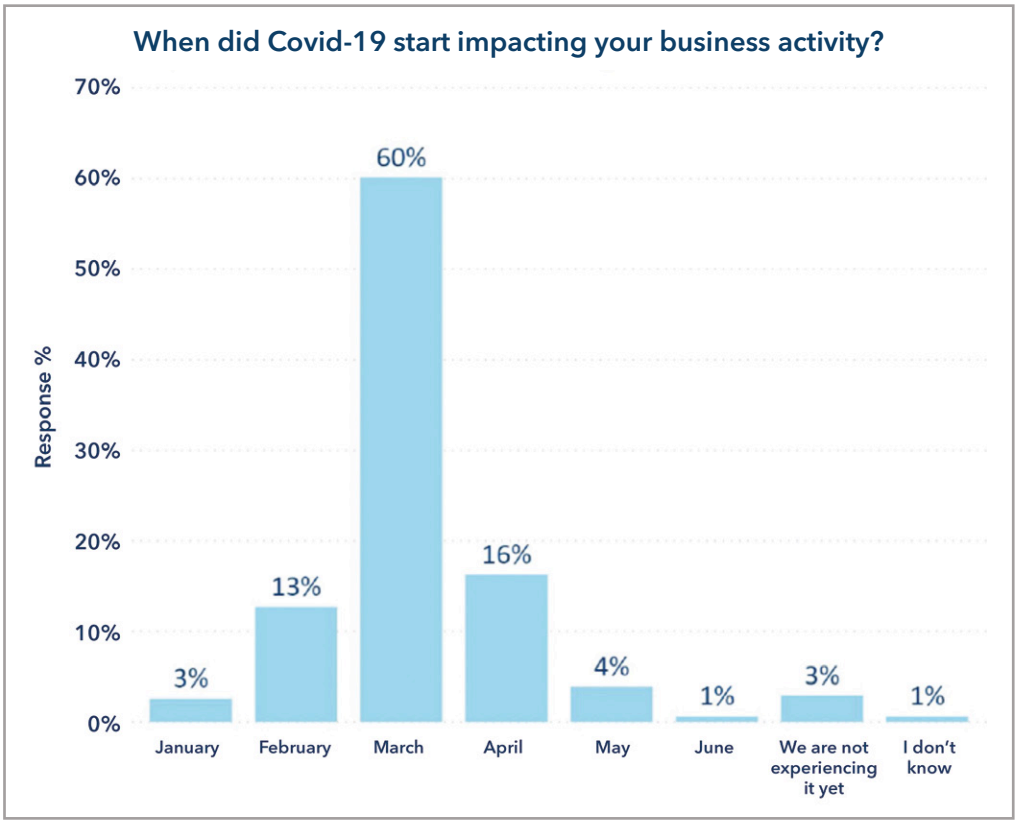
Unsurprisingly, the AMI survey confirms that the impact of the Covid-19 pandemic on the plastics industry was both sudden and significant. Most respondents experienced a negative impact on business activity during the first half of the year with a significant minority seeing their activity decline by 20% or more. It was also clear from responses that the impact of Covid-19 was felt at different points in time around the world – China in the first quarter, the rest of Asia together with Europe and North America around March, and South America and the Middle East and Africa through Q2. Aside from the timing, however, the business impact appears very similar in each region.

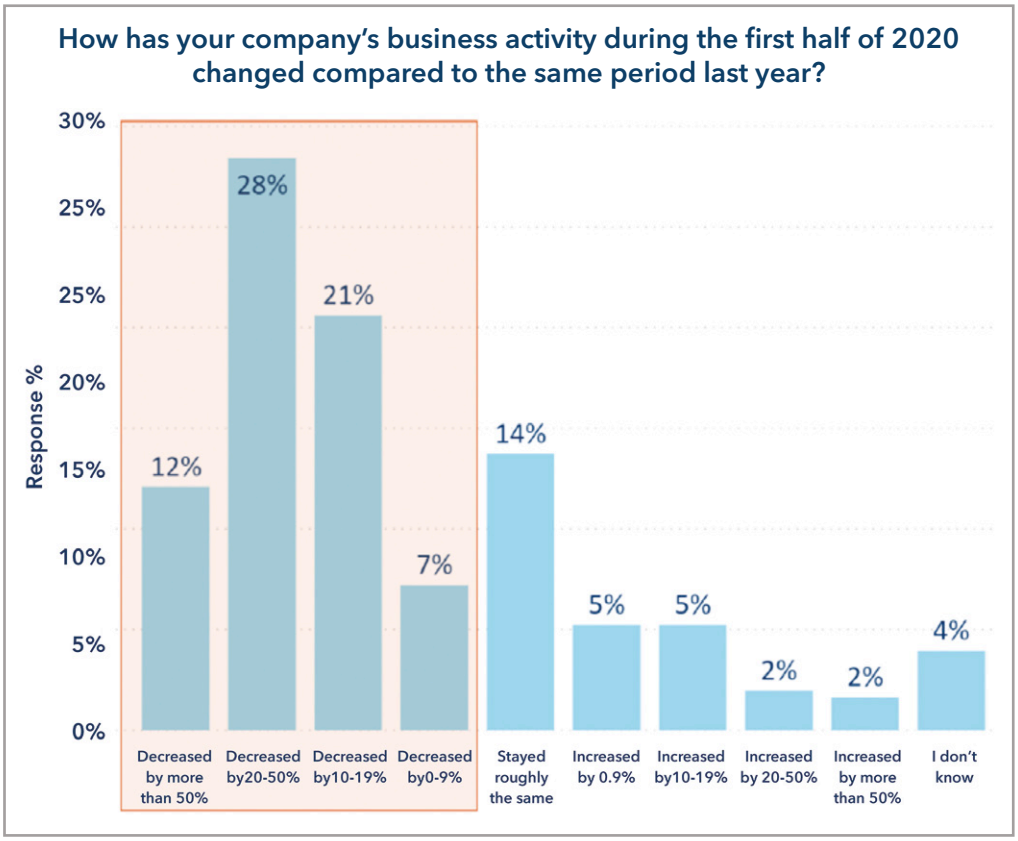
For the majority of the participating businesses – some 70% - the impact on their business was negative in H1, with 40% seeing a reduction in activity of 20% or more. The data shows that resin producers and masterbatch makers experienced some of the biggest immediate hits, most likely as a result of processors taking the opportunity to de-stock and use up inventory (which may correspondingly mean they see a faster pick-up). Companies active in automotive and transport were also hit hard, with 91% reporting a negative impact and more than 60% seeing a decline of 20% or more on H1 2019.

However, 14% of respondents reported no significant impact on their business, and 14% identified better than expected levels of activity. Businesses involved in flexible food packaging markets were the most bullish, with 30% of those experiencing an increase in business activity in the first half of the year compared to an industry average of 10%.

In terms of the challenges the pandemic presented to plastics businesses around

the world, the biggest by some margin was the sudden drop in demand, which was identified by 66% of respondents. Other key challenges included staff working from home (cited by 49%), implementing Covid-19 workplace safety measures (44%), logistical difficulties (31%) and material shortages (28%). For a minority of firms – 20% – the need to meet sudden demand spikes was a significant challenge.





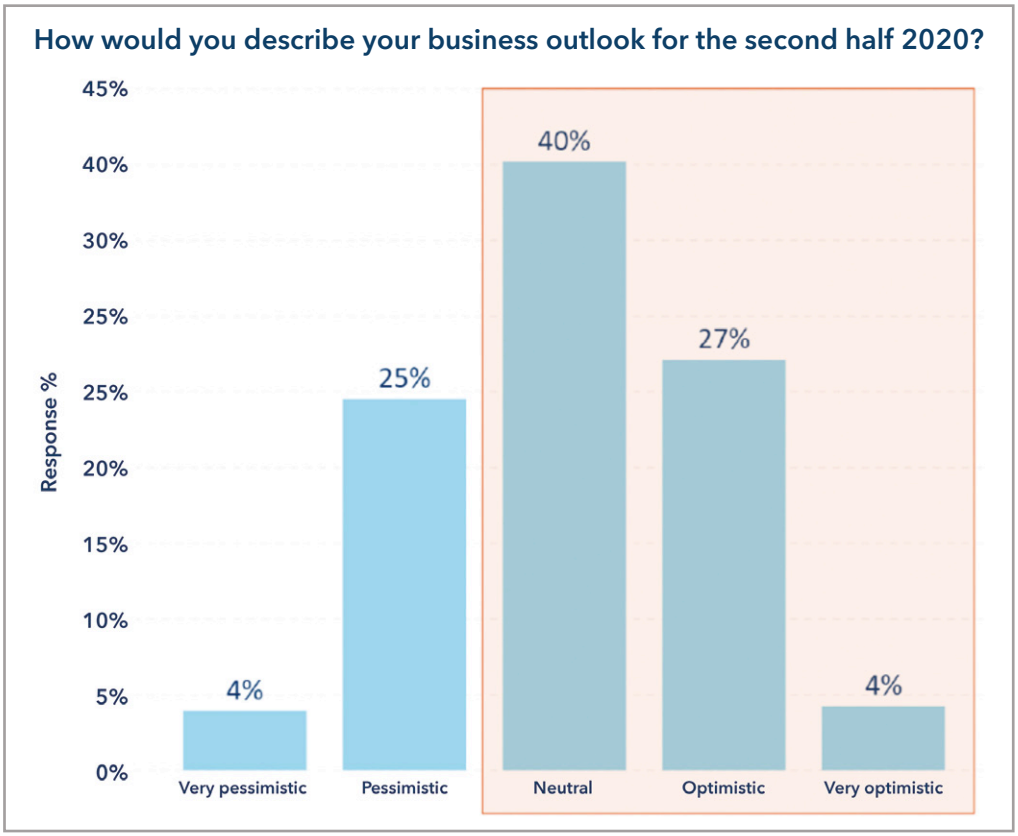
Production impact

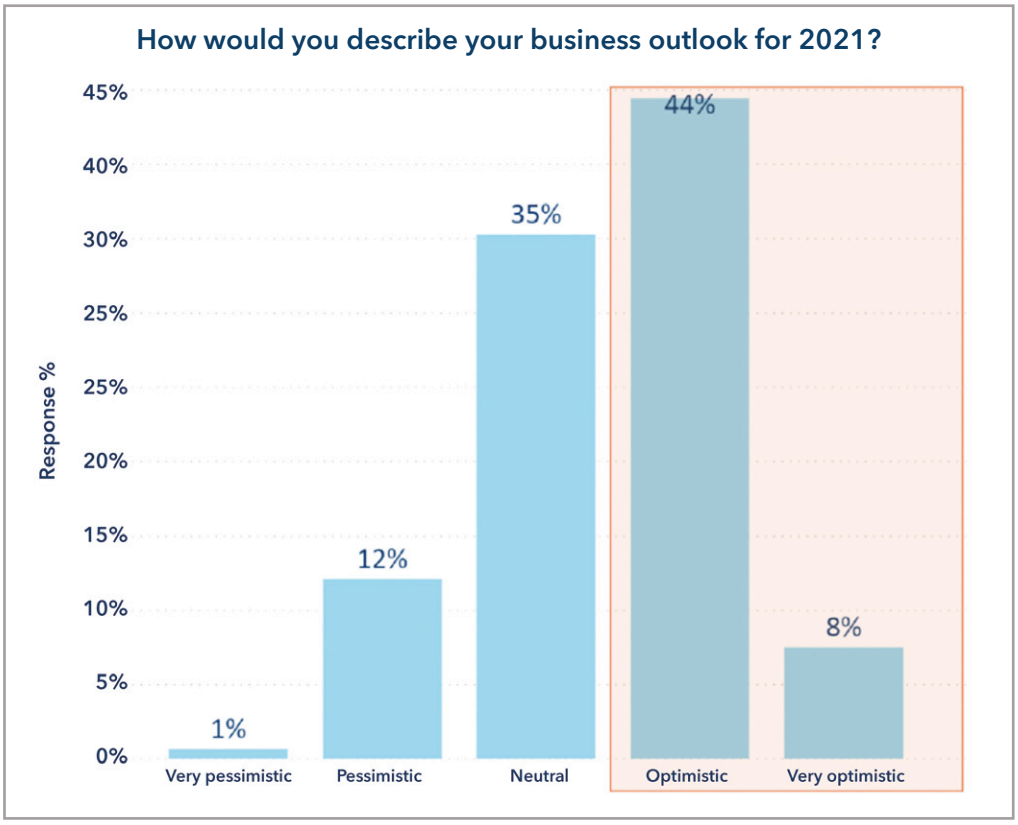
Given that the majority of these and other less commonly identified business challenges were negative, it is no surprise to see that production capacity was impacted. Almost half of respondents (48%) said production was reduced against just 8% that recorded increases. Capital investment plans have also been negatively impacted with more than 40% flagging an immediate or significant reduction. Spending on new product development and sales and marketing remain neutral across the surveyed companies (meaning any intended reductions are balanced by planned increases).

In terms of the response to the Covid-19 challenges, the most intense focus is identifying and targeting new market opportunities. This was cited as a priority by 49% of respondents. Other common actions mentioned by respondents included renegotiating supplier contracts (23%), reducing sales prices (22%), identifying alternative materials and components (20%), and collaborating more closely with local companies (19%).

Other responses include reducing staff training (16%), streamlining product lines (15%), extending maintenance schedules (14%), and delaying supplier payments (13%). Despite the disruption the pandemic caused to global supply chains, only 3% of respondents said reshoring of production was a priority.

The number of respondents was too small to be certain on any sectorial trends, but companies involved in flexible non-food packaging and rigid packaging showed a slightly higher interest in localisation of production.





Optimism evident

The survey confirms that many plastics companies experienced business conditions and impacts on an unprecedented scale and with no forewarning. However, optimism remains intact across much of the sector. More than 30% of respondents said they were optimistic or very optimistic for their business in the second half of the year, rising to more than 70% when including those with a neutral (no better, no worse) view. Less than 30% held a pessimistic view while 21% expect their business activity to return to pre-Covid-19 levels during this year.

Extending that timeframe to 2021 reveals an even brighter outlook, with 52% of respondents holding an optimistic view against just 13% pessimistic. In fact, the survey reveals 64% of respondents expect their business activity to be back to pre-Covid-19 levels by the end of 2021. Of those expecting a slower return to pre-pandemic activity levels, 30% are forecasting 2022 and just 6% beyond that.

In terms of the strategic actions plastics business are planning over the next two years to realise this recovery to pre-Covid-19 levels, the majority of companies said they will maintain or increase their activity in research and development (88%), sales and marketing (89%), and new product development (89%).

More than 60% of respondents said they would also increase their efforts to develop new markets. In terms of market focus, the survey revealed a 5% swing among respondents to medical and 2% swings to non-food flexible food packaging and to construction/infrastructure. Automotive and transport,

Photo : the first reactor pot used in 1917 (exhibited in the headquarter showroom)

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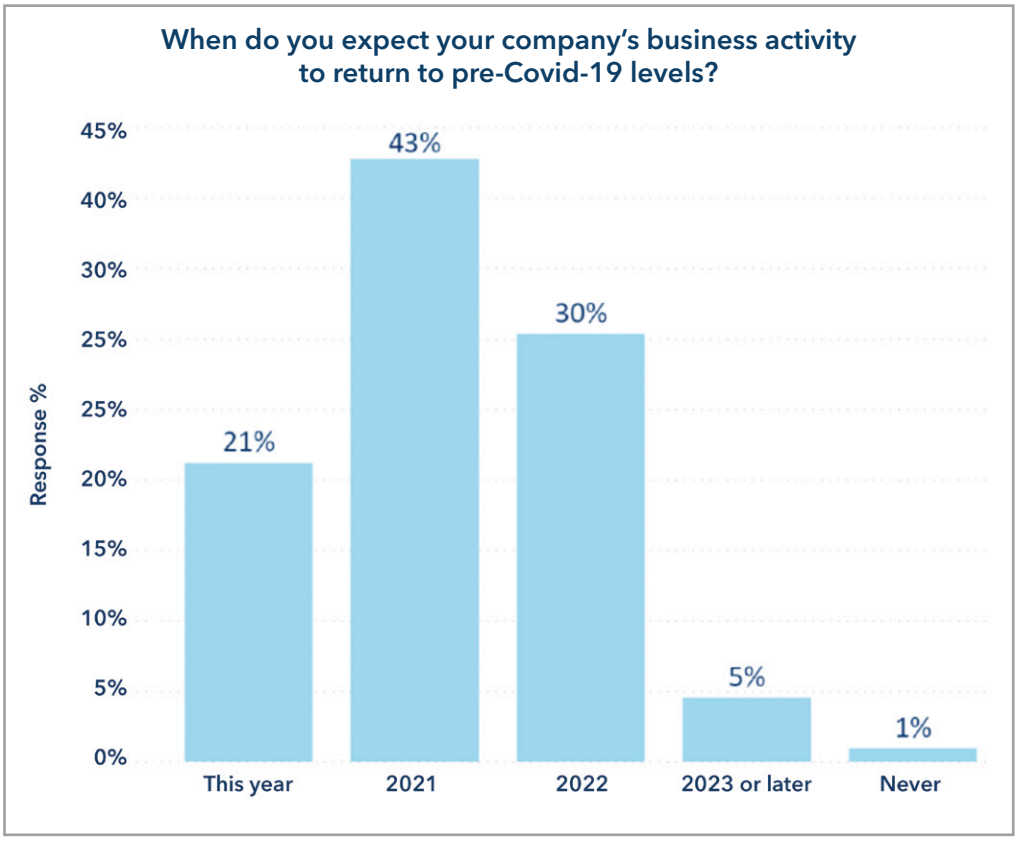
however, saw a -4% swing. That suggestion of the waning appeal of automotive is, perhaps, unsurprising given the stress the sector has experienced during the pandemic, with many car plants at a complete standstill.

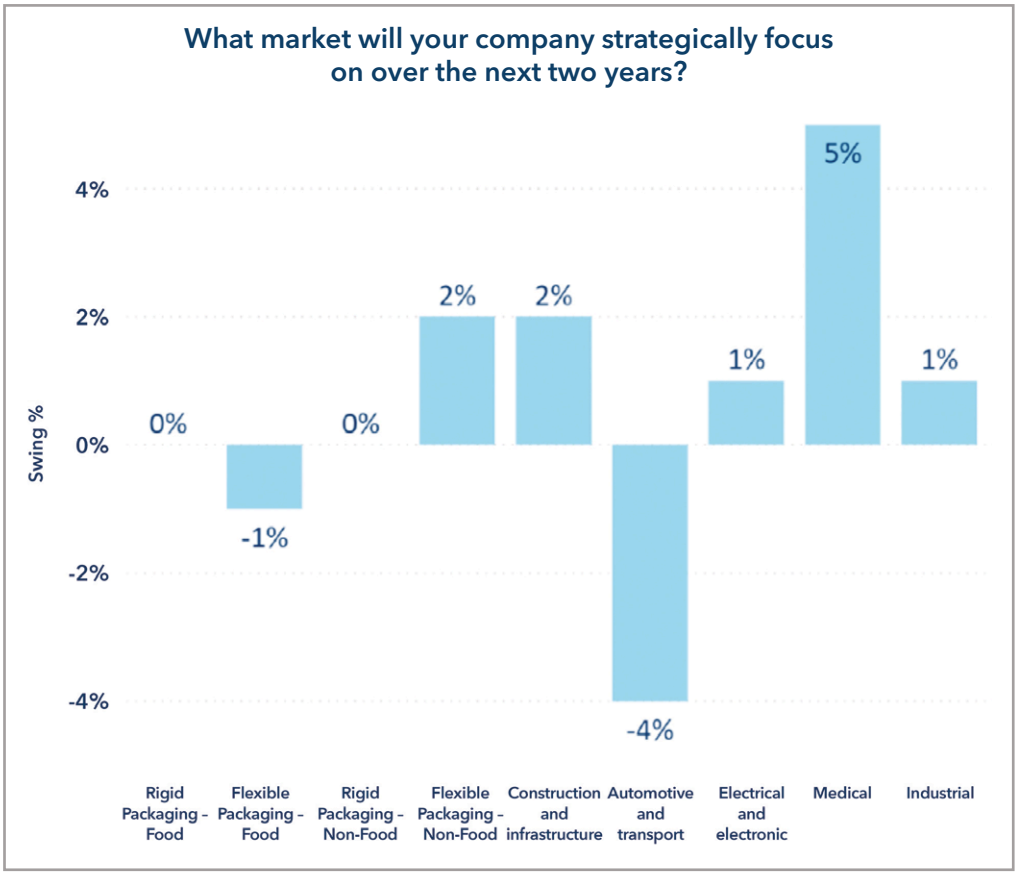
About the study

This article is based on a survey of the business sentiment, experiences and plans of 306 plastics companies around the world carried out by *Compounding World* publisher AMI over the period from 24 June to 5 July 2020. Responding companies were located in all five regions of the world and covered the entire plastics industry supply chain.

Classified by geography, 57% of survey respondents were based in Europe, 21% in North America and 15% in Asia. Analysed by position in the plastics industry value chain, 27% were processors, 16% resin suppliers, 15% machinery suppliers, 12% additive suppliers and 12% compounders. Plastics end users accounted for 3% of the survey respondents and recyclers 4%.

In terms of principal plastics markets, 21% of survey participants were involved in flexible food packaging, 13% in automotive and transport, 12% in construction and infrastructure, 8% in rigid food packaging and 5% in electrical and electronic. Non-food rigid and flexible packaging accounted for a further 7%.





The data was reported and discussed online in AMI's Plastics and the Pandemic Virtual Forum on 21 July 2020. That can be viewed on demand HERE.

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Managing the heat

Whether in smart devices or electric vehicles, thermal management is a growing challenge. Thermally conductive additives enable plastics compounders to develop cost effective solutions, writes Peter Mapleston

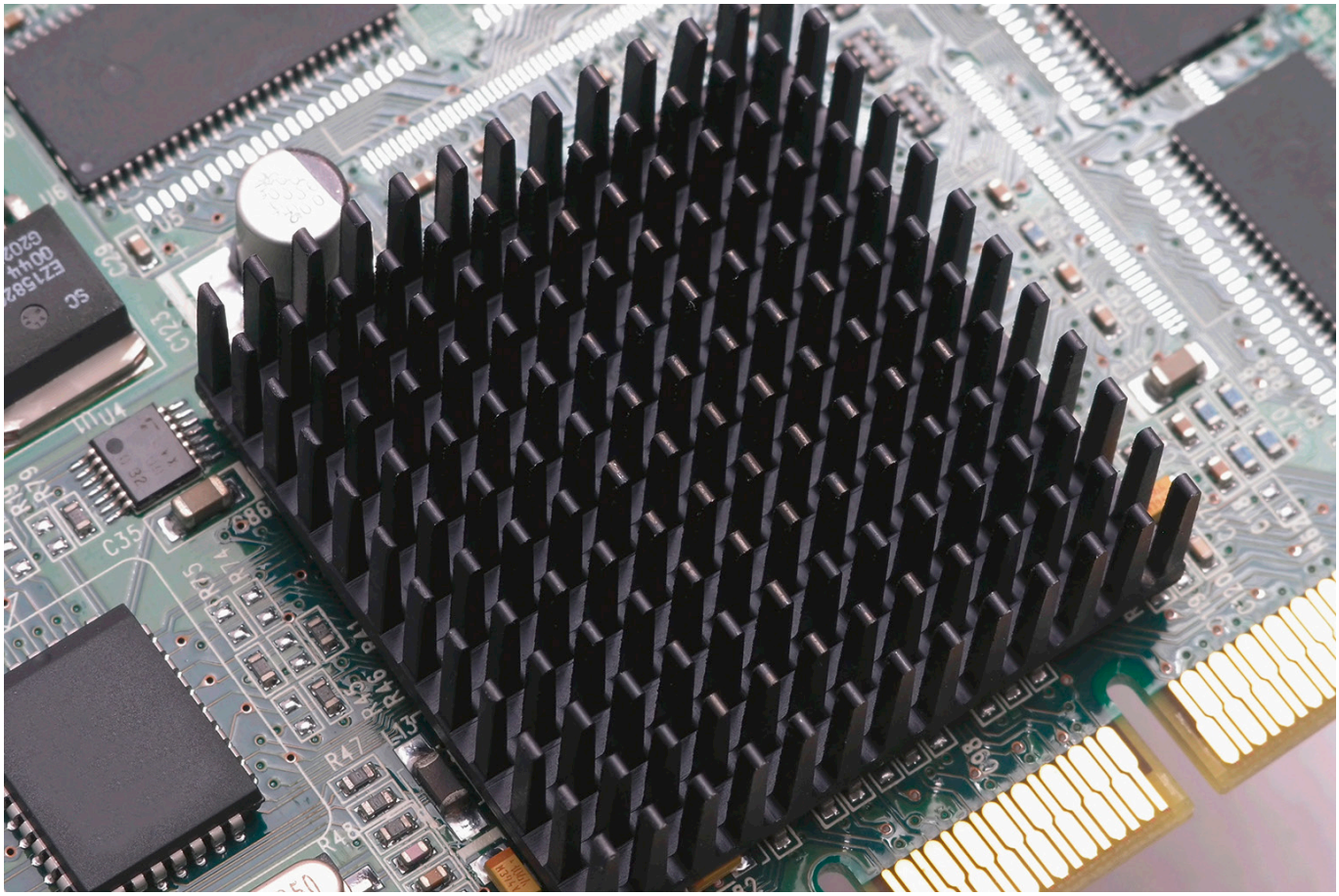

IMAGE: IMERYS

Main image: Electronic heat sinks are a typical potential application for graphite-filled thermally conductive compounds

Thermally conductive additives provide compounders with the means to create novel polymer solutions that dissipate heat in a growing number of applications ranging from automotive to lighting. Growth is, perhaps, not be as fast as some would hope for, but there is strong potential in many sectors of industry where removal of heat is essential for ensuring long-term functionality. Plastics cannot match the conductivity of metals but in many cases what plastics can provide is more than enough. And, of course, they bring benefits such as simplified manufacturing and design flexibility that have seen them displace metals in so many projects.

Dr Elisabeth Gau, a Durethan product development expert at **Lanxess**, which produces a range of thermally conductive PA compounds, sees growth driven by the trend toward electromobility, the increasing digitalisation of everyday life through smart home systems and the miniaturisation of electrical and electronic components.

Meanwhile, Christine Van Bellingen, Business Development Manager at compounder **Witcom Engineering Plastics**, which is a specialist in this area, says heat exchangers and LED lights are the major markets of interest but sees e-mobility developments encouraging more thermally conductive plastics developments. "It is a good development ground for the involved players, from

IMAGE: IMERYS GRAPHITE AND CARBON

Right: Automotive LED lighting is a potential application area for thermally conductive compounds

additive and polymer suppliers, to compounders and OEMs," says Van Bellingen. "Obviously, partnerships are necessary to innovate."

A good deal of development activity among additive suppliers is in carbon-based thermally conductive products, most notably graphite but also graphene. Graphite is widely used to provide thermal conductivity to polymer compounds due to its good cost/performance ratio, says Anna Ellett, Field Application Engineer, Polymers, at **Imerys Graphite & Carbon**. Typical final parts range from heat sinks for LEDs to geothermal pipes.

The company supplies a wide range of both natural and synthetic graphite powders, which Ellett says enables customers to fine-tune thermal conductivity and mechanical performance of compounds through selection of a grade with the most appropriate morphology and particle size distribution for the application. "With Imerys graphite additives, it is possible to achieve an in-plane thermal conductivity level higher than 20W/m.K or a through-plane level of 4W/m.K while maintaining good processability of the final compound," she says. Variation in thermal conductivity in different directions is common when using thermally conductive additives as many are needle or plate-like in shape, leading to anisotropic behaviour.

Timrex C-Therm products from Imerys are high aspect ratio graphite powders, which are claimed to provide thermal conductivity at typically half the additive loading needed with standard graphite. Ellett says the lower loading gives greater flexibility to design formulations containing other ingredients such as glass fibres or minerals and to reach the desired mechanical performance at a lower density. "The recently developed Timrex C-Therm MAX HD grade offers easier handling and extruder feeding due to its superior apparent [bulk] density, leading to higher production output of highly thermally conductive compounds," she says.

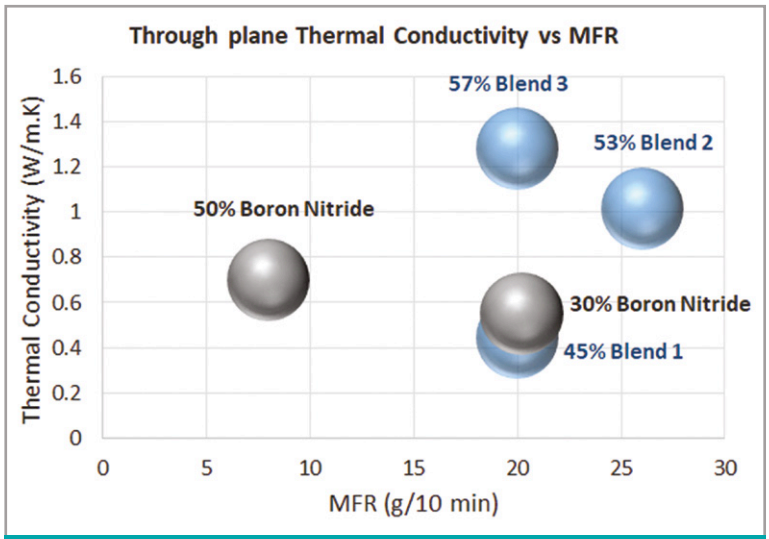

Figure 1: Comparison of thermal conductivity and melt flow rate for various electrically insulative polypropylene-based formulations. Bends 1, 2 and 3 contain combinations of graphite and mineral fillers
Source: Imerys

Minimising trade-offs

With any thermally conductive additive, there is a trade-off between thermal conductivity and processability. Ellett says that to minimise that trade-off Imerys minerals have been used in combination with graphites to achieve superior conductivity and fluidity in polymer compounds (Figure 1). The company has also developed polymer formulations that provide high thermal conductivity while remaining electrically insulating using carefully selected blends of appropriate grades of minerals and graphites. These could be used in applications such as electronic parts, where they may offer cost benefits over established electrically insulating options such as boron nitride and reduced abrasion compared to aluminium oxide, she says.

Avanzare has developed a new multilayer pristine graphene – AvanThermal Conductive NCC-1701-A – for improving thermal conductivity in thermoplastics. "Its extremely high aspect ratio, higher than 10,000, due to its large lateral size and low thickness, makes it possible to create a thermal conductive network in different polymer matrices," says Chief Commercial Officer Javier Pérez. Avanzare previously introduced AvanThermal Conductive 770, described as a "graphene related" material, for similar applications. Peréz says the new grade is more advanced, with improved dispersibility making it more efficient.

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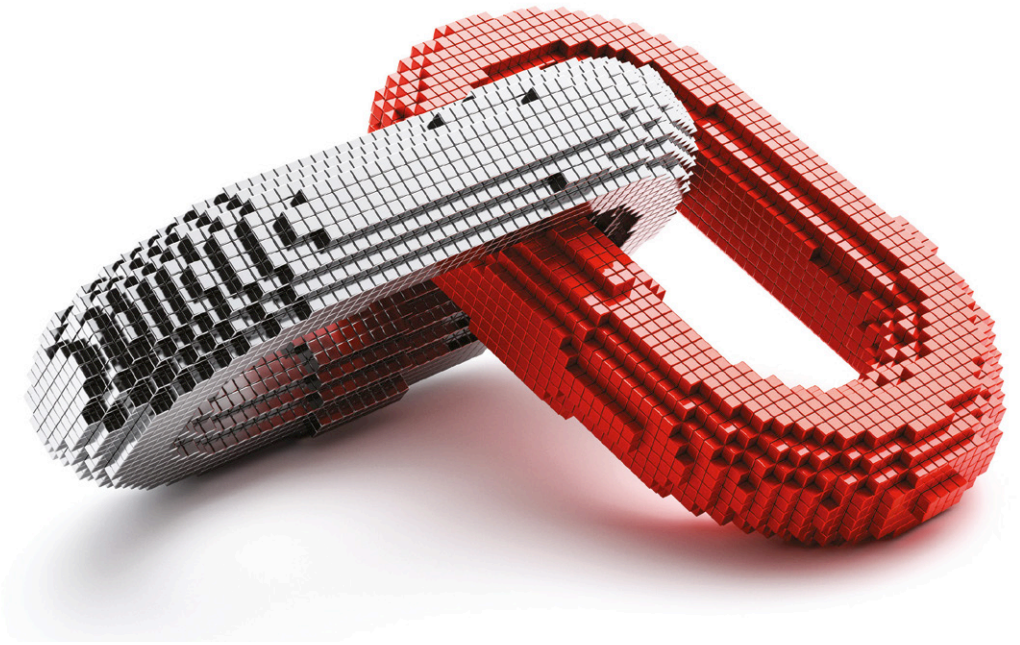

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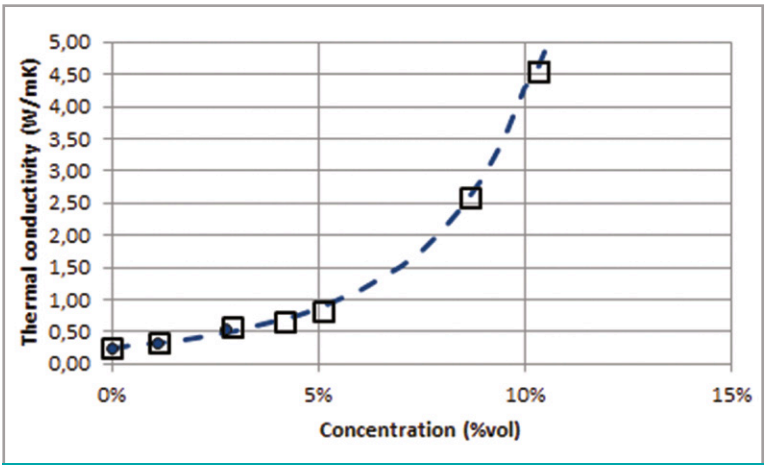


Figure 2: The high aspect ratio of AvanThermal Conductive NCC-1701-A multilayer graphene makes it possible to obtain a percolative network at moderate filler loadings to obtain high thermal conductivity values
Source, Avanzare

matrix requires a balance of a well-organised percolating network and a low number of defects, due to the drop in conductivity associated to defects in the sp^2 structure of graphene materials, he says. "AvanThermal Conductive NCC-1701-A produces a high dispersion degree of the polymer matrix and a good interfacial interaction between the matrix and the nanoflakes. The very low defect content in the graphene plane also allows an easy transport of phonons, responsible for the thermal conductivity. The combination of both properties allows a drastic improvement in thermal conductivity." A phonon is a quantum of vibrational mechanical energy, just as a photon is a quantum of electromagnetic energy.

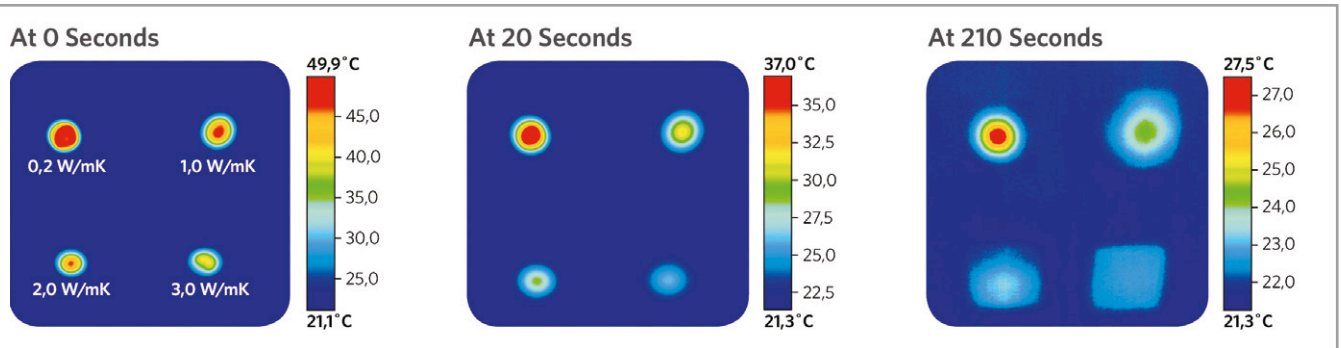
Graphene performance

AvanThermal Conductive NCC-1701-A can be used in diverse thermoplastic matrixes, as well as thermosets and elastomers. It works at very low addition rates (Figure 2) allowing lower densities to be obtained than with other additives, and also improved mechanical properties due to the lower brittleness, Peréz claims. "The quantity needed of AvanThermal Conductive NCC-1701-A to obtain 2.5 W/m.K through-thickness (Guarded Heat Flow Meter Technique ASTM E1530) is at least 80% lower than that needed for other solutions such as aluminium oxide, boron nitride, or graphite," he says.

While graphites and graphenes are aimed at high-end applications, there is room in the market for alternative additives that may not offer such high performance but that some compounders may be more comfortable working with, according to **Huber Engineered Materials**. The company plans to launch a line of thermally conductive Martinal TM additives in the not-too-distant future that it says will build on the Martoxid TM aluminium oxide-based thermally conductive additives it introduced back in 2016.

Martinal is a trade name Huber currently uses for aluminium hydroxide additives (it also markets magnesium hydroxides under the Magnifin name) but the company does not disclose the composition of Martinal TM grades. It says they will be offered where high thermal conductivity is not required, typically providing thermal conductivity in compounds of up to 2W/m.K.

Martinal and Martoxid products are both inert white materials, which enable them to be used in any type of polymer system, including water-sensitive applications. Some Martoxid grades enable conductivities of up to 3W/m.K at loadings of up to 90 wt%. Despite the high addition levels, mechanical strength properties of such compounds are said to be excellent and processability is good. There are four series of Martoxid TM products, with varying chemical properties. Key characteristics of the Martoxid products are said to include isotropic thermal conductivity, high electric insulation, high thermal stability, high chemical stability, and low thermal expansion.



Thermal imaging results showing how samples with different TC values dissipate spot heat (the images are overlaid). A circular heat source at 60°C was placed on each sample for 20 seconds, then removed (time= 0) and the samples allowed to cool to room temperature
Source: Huber

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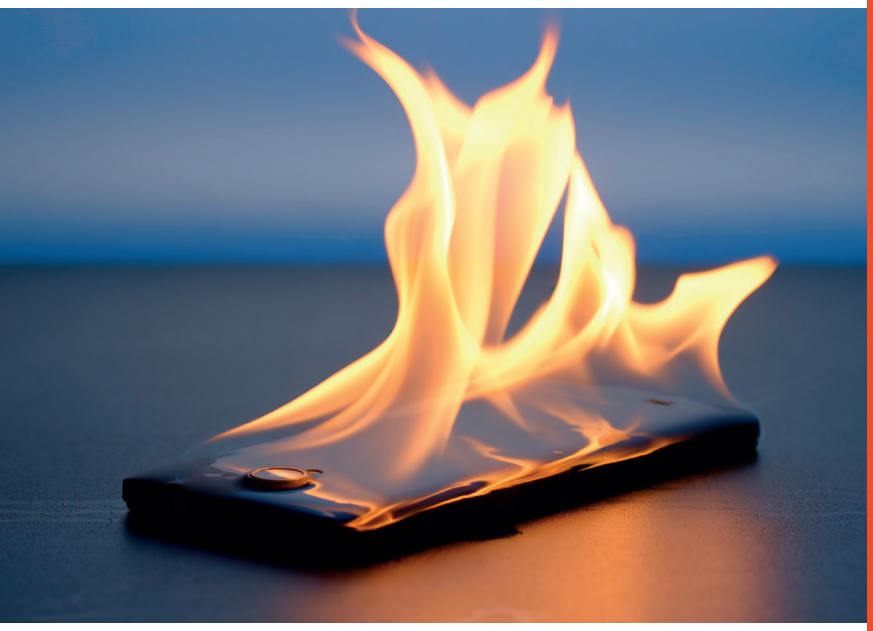

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Right: This LED spotlight panel cooling back plate is injection moulded in Star-T thermally conductive compound by Eurostar EP

Modest moves

A number of compounders are developing and commercialising thermally conductive materials for the many developing applications. However, **Witcom**'s Christine Van Bellingen says there is still a long way to go before the potential of thermally conductive thermoplastics is fully realised in applications. "We perceive a clear interest and development perspective but still only a modest move towards thermally conductive plastics," she says.

Witcom has a full range of thermally conductive PA compounds that can achieve from medium to high thermal conductivities, with or without electrical conductivity. All grades are reinforced, and some contain halogen-free flame retardants.

"Getting requirements on in- or through-plane thermal conductivity is of course a good start, but often does not reflect the true thermal conductivity of a moulded part. The moulding will orient the additives and the proportion of random orientation will, for instance, increase the real through-plane conductivity while the measurement on a standard plaque can limit the value to under 5 W/m.K – and cool down customer interest," she says. "Some theoretical models for metal replacement may bring much higher expectations that easily injectable thermally conductive plastics cannot meet. A first necessary step is always to test the performance in the final part and accept to work maybe a bit more empirically at the start, in a less formalised pattern."

IMAGE: WIT

Left: Parts of an industrial camera made with thermally conductive, EMI shielded, halogen free flame retarded PA6 compound from Witcom

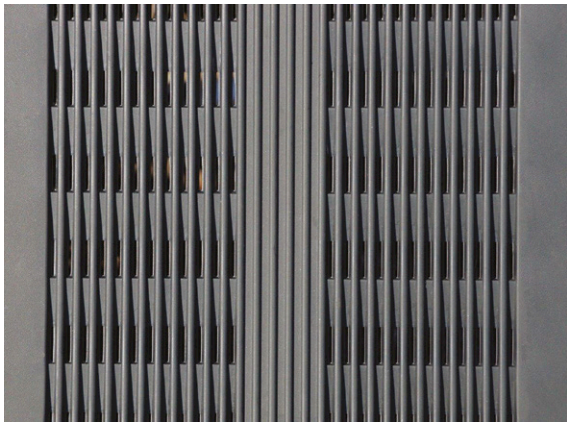

IMAGE: EUROSTAR EP

Van Bellingen says Witcom compounds can readily reach thermal conductivity values of more than 20 W/m.K in-plane. "In most applications, values below 5 W/m.K and even between 1-2 W/m.K through-plane can be enough to dissipate the heat efficiently."

Optimised solutions

At **Eurostar EP**, Alexis Chopin, responsible for technology, says: "We are following two different tracks, as the markets seems to be more mature and the requirements are now more realistic, focused on having the best cost/performance ratio rather than reaching the ultimate performance."

The first track involves what he describes as "versatile thermally conductive products with just enough properties to meet market needs." Referencing the continued miniaturisation of E&E

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IMAGE: EUROTEC EP

Left: Staramide PA6 80E10 compounds, shown in virgin, silver and gold variants, are used in applications ranging from premium packaging through automotive dashboard components to appliance knobs due to their "cool-to-touch" metal-like haptics

systems, he says: "In most cases, assuming the heat sink is well designed and we have a convection-limited situation, thermal conductivity values above 1W/m.K ensure proper cooling and optimum thermal management.

Eurostar EP offers a broad portfolio of thermally conductive plastics, branded Star T, based on different combinations of various additives such as mineral and metal oxide fillers. It also has a new range of thermally conductive, electrically insulative plastics based on polyamide and specific mineral fillers.

Star T PA6 65E12 and Star T PA6 75E12 have been formulated to reach optimum through-plane (respectively 0.9 & 1.5 W/m.K) and in-plane (1.4 & 2.3 W/m.K) thermal conductivities. Chopin claims the through-plane conductivity is among best-in-class while mechanical properties are better than can be obtained using boron nitride. The two grades are also said to be more cost effective and offer good processing characteristics. Eurostar also claims lower abrasion than alternatives based on ceramics such as aluminium oxide. Starflam PA66C10VZ23 is a flame retardant option rated UL94 V-0. Its average thermal conductivity is around 1 W/m.K.

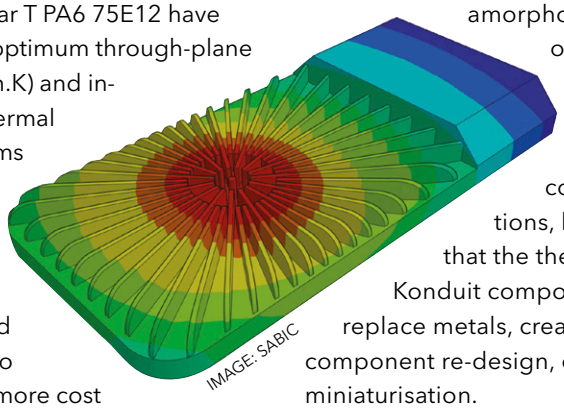


IMAGE: SABIC

Right: Effective use of CFD software allows thermal management to be predicted and optimised, allowing plastics to replace metals in heat sinks, according to SABIC

Perfect touch

On a second track, Eurostar EP has also developed thermally conductive PA compounds with enhanced haptics based on combinations of metallic powders. Chopin says they offer solutions whenever high density, freedom of design, and increased thermal conductivity is needed. They process well, enabling moulding of complex designs. Some grades have been optimised in order to offer a particularly high mechanical property profile: for instance, Staramide PA6 1565VE10, which has a thermal conductivity of 1.1W/m.K, is claimed to offer a modulus of 12.8GPa and Izod impact strength of 62kJ/m^2.

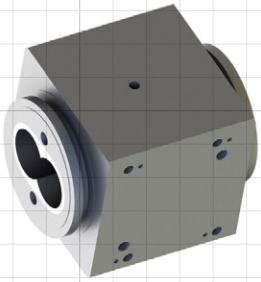
"These compounds can offer metal-like cool touch," says Chopin. "They can improve the feel of plastics parts to match the touch of a surface to its look. Moreover, these compounds are particularly well suited for specific part decoration such as electrostatic painting and electroplating in order to provide the visual aspect of metal."

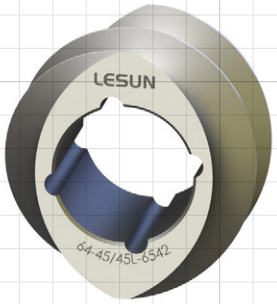
The LNP Konduit product line from **SABIC** covers compounds based on semi-crystalline and amorphous resins, with some offering up to fifty times the thermal conductivity of typical unfilled materials. SABIC says that for convection limited applications, heat transfer models show that the thermal conductivity of Konduit compounds can be sufficient to replace metals, creating opportunities for component re-design, consolidation, and miniaturisation.

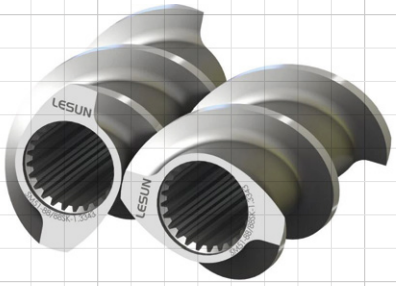
According to the company, SABIC's Specialties business is developing novel LNP Konduit compound formulations that combine thermal conductivity with other desired effects such as EMI shielding. These resins are compounded with thermally conductive fillers with small amounts of

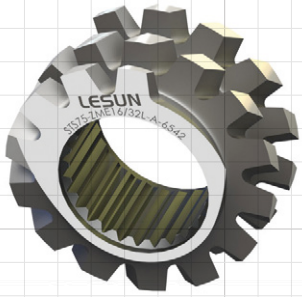
Conductive Plastics 2020, Munich, Germany

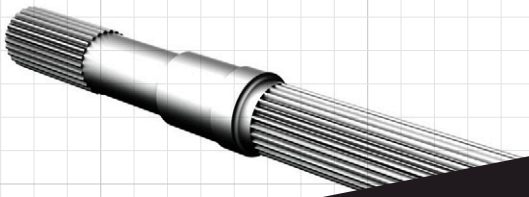
The latest developments in formulation of thermally conductive plastics will be on the agenda at AMI's fifth Conductive Plastics conference, which takes place in Munich in Germany on 1-2 December 2020. Expert speakers include thermal modification specialists from Albis, Fraunhofer Institute, George H Lüh, Grafe, Huber, Imerys, and Witcom Engineering Plastics. Topics on the agenda include development of additive systems to enhance thermal conductivity and flame retardance (Quarzwerke), development of graphite-filled thermally conductive pipes (ZBT), and finite element modelling of thermal conductivity in plastics (University of Applied Sciences, Karlsruhe). Find out more **HERE**











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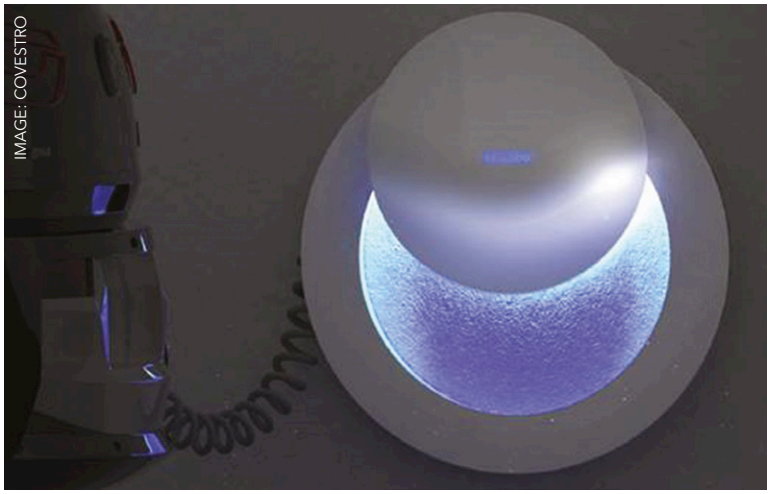
IMAGE: COVESTRO

Above: A thermally conductive polycarbonate from Covestro is used to manage heat in this next-generation EV charging station

glass fibre, where necessary, to improve strength. They can be tailored to meet specific thermal and mechanical requirements.

Light opportunities

"The automotive lighting segment is experiencing significant innovation around current LED solutions," says a SABIC spokesperson. "At a time when space is at a growing premium due to integration of sensor suite components and while heat sinks are increasing in size, future iterations of lighting must consider novel ways to dissipate heat at a competitive cost. LNP Konduit compounds are a cost-effective, resource-efficient heat sink solution that can contribute to the scaling of LEDs."

Makrolon TC thermally conductive polycarbonates from **Covestro** are available with different levels of conductivity in grades for injection moulding (including over-moulding), extrusion, and 3D printing. The portfolio includes electrically conductive and electrical insulating grades: electrically conductive grades offer thermal conductivity up to 16 W/m.K in-plane and are black; electrically insulating grades offer a lower thermal conductivity and are white. All grades are said to exhibit very good flow. The company highlights Makrolon TC110 and Makrolon TC210, which provide good radio frequency (RF) signal transmission stability and toughness. Makrolon TC611 and TC8030 grades offer the highest thermal conductivity and are said to be good corrosion-resistant materials for thermal management in LED luminaires where they can halve weight compared to aluminium.

Battery power

Covestro sees considerable potential for Makrolon TC compounds in battery thermal management. The company says some battery makers are already using Makrolon TC 110 and its flame retarded version for this purpose, where polycarbonate offers the required impact strength, dimensional accuracy and stability, and long-term service temperature.

The Durethan TC (Thermally Conductive) range of thermally conductive PA compounds from **Lanxess** was recently expanded with three new products based on PA6. Two were previously available as trial products: Durethan BTC67ZH3.0EF (previously Durethan TP430-004) and Durethan BTC77ZH3.0EF (Durethan TP430-003). The third, Durethan BTC965FM30, is a flame retardant addition.

The first two are said to be characterised by significantly higher impact resistance and greater

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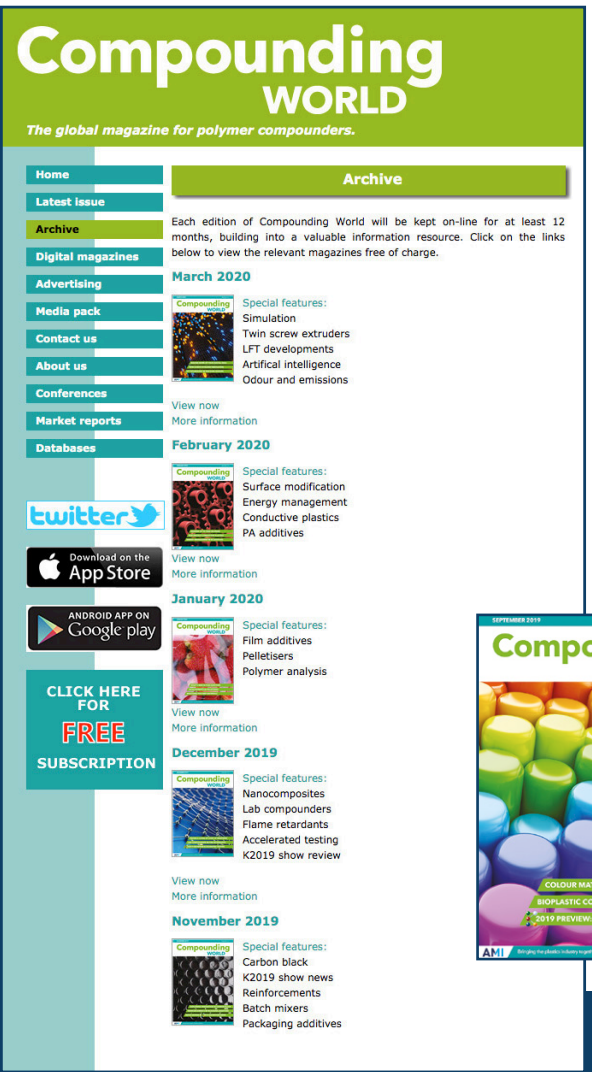

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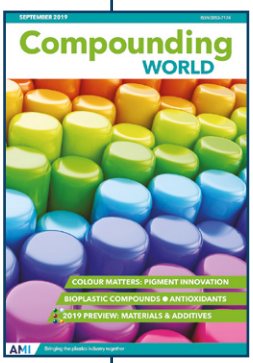

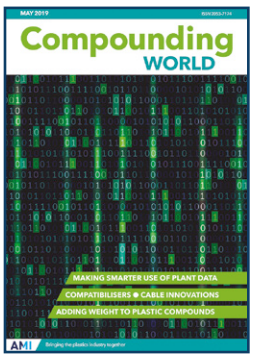

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Right: Thermally conductive polycarbonates can be used in the design of innovative battery pack frames

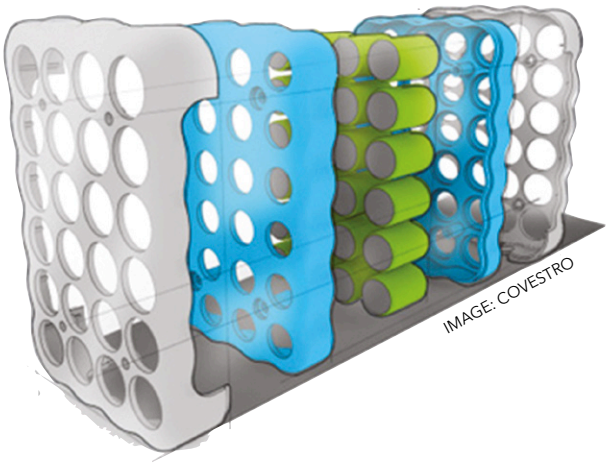
strain capability in tensile and bending tests than other materials in the company's TC product range. The two compounds are respectively filled with 67% and 77% by weight of an undisclosed highly conductive filler that Lanxess says provides almost isotropic properties. In the direction of flow, this is 1.1 or 1.8W/m.K. Both materials have been optimised for good flow performance and are less abrasive than earlier types. Toughness has also been significantly improved, says the company.

Durethan BTC965FM30 is a halogen-free compound that offers a UL94 V-0 rating at 0.75mm as well as good light reflection and tracking resistance. In the direction of flow, its thermal conductivity is 2.5 W/m.K. "It has huge potential for use in components for batteries in electric vehicles as well as plugs, heat sinks, heat exchangers and mounting plates for power electronics," says Gau.

Tisan Engineering Plastics has developed a number of thermally conductive compounds that meet the specific performance needs of customers in the automotive and E&E markets. Each is developed for the specific application. Typically these use graphite additives but the company employs alternatives where it is necessary to colour. It says its thermally conductive compounds are generally used in place of metals, where they offer weight and cost savings as well as improved chemical resistance and environmental stability.

Following growth

Italian compounder **LATI** has been developing thermally conductive thermoplastic compounds since 2003, mainly following the growth of LED lighting industry. Luca Posca, Technical Assistance & Marketing Director, says one of its most promising new grades is its Laticonther MI series of PA-based materials combining glass fibres and conductive fillers to provide heat management as well as structural performance. These are often



characteristics needed for automotive and e-mobility applications.

"Another challenge that LATI wins is to increase thermal conductivity in electrically insulative materials, keeping material price under control," Posca says. "Laticonther CP6 and CP8 special compounds are our answer to this request, a line of products dedicated to E&E and automotive markets where performance must meet cost management and electric safety without compromises."

Posca adds that Lati technical support is working on advanced in-house FEA methods, adopted to carefully evaluate actual conductivity and diffusivity of materials featuring graphite and boron nitride, where fillers anisotropy can play a major role in local thermal performance. "This advanced set of computer aided solutions helps Lati's customers to evaluate part feasibility before investing in tooling," he says.

One of the processors LATI has been working closely with is UK-based Protool Plastics Group, an injection moulding company with particular expertise in production and tooling for polymer heat sinks. The two companies worked together to develop a solution for the Mirage 3 range of luminaires for commercial lighting group Whitecroft Lighting, which uses Laticonther 62 GR/50 graphite flake filled PA6 offering a thermal conductivity of more than 10 W/mK.

Below: Heat sinks for Whitecroft Lighting's Mirage 3 range of LED downlighters are moulded by Protool Plastics using a graphite-filled PA6 from LATI

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Plasticisers continue to trend away from low molecular weight orthophthalate-based chemistries to alternatives seen as safer, particularly for consumer and medical uses. ***Jennifer Markarian*** *reports*

IMAGE: SHUTTERSTOCK

Plasticiser developments follow sustainable path

The PVC plasticisers industry continues to work on development and application of alternatives to low-molecular weight (LMW) orthophthalate-based plasticisers, which do a very effective job but face increasing regulatory restrictions. Today, high molecular weight (HMW) orthophthalates and a range of non-orthophthalate alternatives, including bio-based plasticisers, are already being used.

Europe has led the shift away from LMW phthalates. Some LMW phthalates – benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), diisobutyl phthalate (DIBP), and diethylhexylphthalate (DEHP) – have been restricted through their inclusion in Annex XIV of the Authorisation list in the REACH regulations as Category 1B due to reproductive effects. As a consequence there is very limited production and use of these LMW phthalates in Europe today and biomonitoring studies show a significant decrease in exposure, according to **European Plasticisers**, a sector group of Cefic (the European Chemical Industry Council).

An additional restriction, under REACH Annex XVII, covering the same plasticisers came into effect in July 2020. This restricts, with some exceptions, their use to less than 0.1% in articles for the EU market. According to European Plasticisers, these latest restrictions are intended primarily to target imported products. Enforcement is down to member states.

In addition, the European Chemicals Agency (**ECHA**) submitted a recommendation to the European Commission (EC) in July 2019 to amend the Authorisation List (Annex XIV of REACH) entries by adding endocrine disrupting properties to the BBP, DBP, DIBP, and DEHP entries. "Once the Commission decides on the amendment, some previously exempted uses will require authorisation. For example, [if] DEHP is listed as endocrine disruptor for the environment, authorisation applications will have to be submitted for its use in food-contact materials and medical devices," says Michela Mastrantonio, Manager at European Plasticisers. ›

Main Image: The PVC industry is moving away from low molecular weight plasticisers as the regulatory environment continues to tighten

Right: A new regulation that will further restrict use of DEHP in medical devices has been delayed due to the Covid-19 pandemic

Medical moves

A new medical device regulation – Regulation (EU) 2017/745) – that will further restrict use of DEHP was scheduled to come into effect in 2020, but due to the pandemic, has been postponed until 26 May, 2021. In June 2019, the EC's Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) issued guidelines for the use of DEHP in medical devices as included in the new regulation, says Mastrantonio.

In December 2019, EFSA also updated its risk assessment of DBP, BBP, DEHP, diisononyl phthalate (DINP) and diisodecyl phthalate (DIDP) for use in food-contact materials (FCM). Although EFSA reported they were not a concern for public health, it proposed a tolerable daily intake (TDI) limit, on a temporary basis, of 50 µg/kg of body weight (bw) per day for the combined total intake of DBP, BBP, DEHP, DINP, and confirmed a TDI of 150 µg/kg of bw per day for DIDP.

"It is important to note that the EFSA opinion is not supported by scientific evidence or ECHA's Risk Assessment Committee's assessment of DINP [which said DINP did not warrant classification for reprotoxic effects]. The opinion acknowledges the uncertainties related to the outcome of an assessment that, due to time constraints, could not be performed in a thorough manner," Mastrantonio says. "The European Commission is currently working on a new mandate for EFSA to further assess phthalates in FCM. European Plasticisers provided input in the EFSA public consultation in April 2019 and it is ready to support any further assessment of substances in food-contact materials as appropriate, consistently ensuring a robust scientific weight of evidence approach."

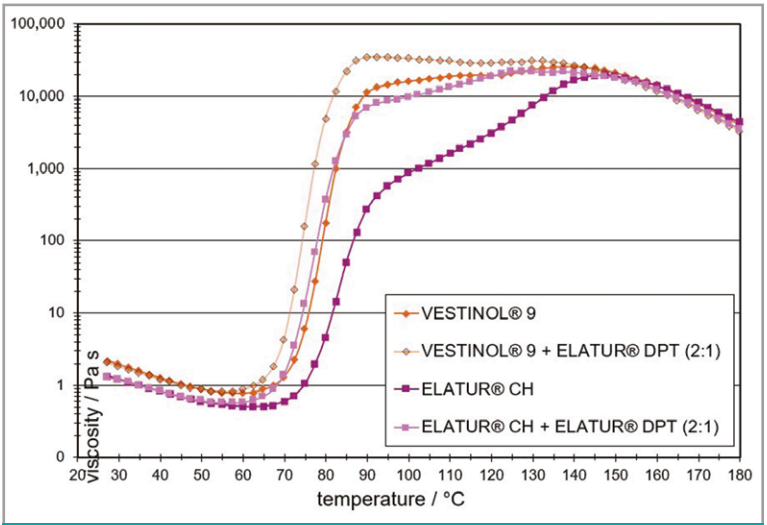

Figure 1: Elatur DPT can boost gelation of Elatur CH to near DINP (Vestinol 9) levels or further speed gelation of DINP
Source: Evonik


IMAGE: SHUTTERSTOCK

Phthalate research

Recent research aims to provide more scientific data on phthalate plasticisers, says the trade association. For example, the University of Edinburgh in the UK is preparing to publish a study comparing DBP and DINP that confirms DINP does not cause adverse reproductive effects and is not an endocrine disruptor. European Plasticisers and VinylPlus say they are are supporting "scientifically solid risk assessments, compared to those which use simple in-vitro studies which are not representative of the complex metabolism in whole organisms" by developing and publishing physiologically based pharmacokinetic (PBPK) models. The group reports that a PBPK model for DINCH has been published in a peer-reviewed journal, and the model for DINP was submitted for publication in 2020. Others are being developed.

In the US, the Environmental Protection Agency (**EPA**) began assessments for phthalates that were identified as high priority chemicals, including BBP, DBP, DIBP, DEHP, and dicyclohexyl phthalate. EPA also began evaluations of DINP and DIDP as requested by their manufacturers – Evonik, ExxonMobil Chemical, and Teknor Apex had requested an evaluation of DINP uses and ExxonMobil had also requested evaluation of DIDP through the **American Chemistry Council**'s High Phthalates Panel. The assessments are expected to take three years and the manufacturers say they are confident tests will show that these high molecular weight phthalates are safe for use.

Alternative plasticisers

Evonik produces and sells DINP under the brand name Vestinol 9 and says that in Europe it is an important general-purpose plasticiser for soft PVC because of its broad processing window and beneficial cost/performance ratio. The company also produces alternative plasticisers: cyclohexanoate under the brandname Elatur CH;

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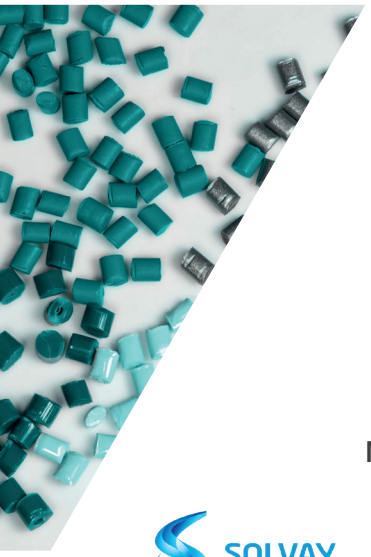

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IMAGE: SHUTTERSTOCK

Above: The medical industry is looking for good performing phthalate-free plasticisers

and dipentyl terephthalate (DPT) under the name Elatur DPT. It describes Elatur DPT as a fast-fusing, low viscosity plasticiser with a very low semivolatile organic compound content and says it is especially effective in combination with Elatur CH in a variety of plastisol applications (Figure 1).

Orthophthalate plasticiser alternatives continue to expand in use in North America, according to Patrick Harmon, Industry Manager for **BASF** Industrial Petrochemicals, who says growth is being led by dioctyl terephthalate (DOTP). "The toys and childcare market have already shifted to alternative plasticisers since global regulations were enacted in the 2000s. Various reports show that DINCH [such as BASF's Hexamoll DINCH], DOTP and ATBC [acetyl tributyl citrate] are the most common plasticisers used for these applications. Retailers and brands also continue to drive additional substitution."

The company says that its Palatinol DOTP has been shown to have low toxicity using the GreenScreen hazard assessment methodology and is listed in the CleanGredients database using the US EPA Safer Choice criteria. BASF has its own program for analysing how products contribute to sustainability, which it calls Sustainable Solutions Steering. The company uses the method for its own products and has made it available to third parties as well. Using this method, DOTP and DINCH are classified as "Accelerators," which are defined as products that have a "substantial sustainability contribution in the value chain."

In medical and healthcare applications, which are highly regulated, concerns about additive safety are a critical issue that has driven some shift to alternative plasticisers, but change is slow due to the costs and regulatory process. In Europe, the new medical device regulation that will go into effect in 2021 may increase the pace of change, suggests Harmon. In the new regulation, substances classified as carcinogenic, mutagenic or toxic to reproduction (CMR) 1a and 1b (which includes DEHP) are restricted unless there is a justification. BASF says that the European Pharmacopoeia has been updated to now include DINCH, DOTP, tris (2-ethylhexyl) trimellitate (TOTM), and n-butyryl-tri-n-hexyl citrate (BTHC) as alternatives to DEHP in medical device applications.

Phthalate-free norm

"Globally phthalate-free solutions are becoming the norm, with DOTP gradually replacing medical-grade DOP [dioctyl phthalate] in the medical sector," says Marat Avetisov, Sales Director, Plastics and Organic Synthesis Products at **Sibur**. The Russian-made medical compound and items based on it have been certified by the country's Federal Service for Surveillance in Healthcare (**Roszdravnadzor**).

Sibur says that in Russia DOTP is being used to make plastic containers for transfusion of blood and its components, for example. DOTP properties claimed to be beneficial for these applications include low volatility and low odour. Compared to DOP, DEHP, and DINP, DOTP has increased volume resistivity, better thermal stability, and improved mechanical characteristics in PVC compounds, the

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IMAGE: SIBUR

Right: Sibur claims its plant at Perm in Russia, opened last year, is Europe's largest DOTP production site

company claims. Low-temperature properties, such as frost resistance, of DOTP are better than DOP/DEHP and slightly better than DINP, the company says.

In May 2020, Sibur's DOTP was certified under European Pharmacopoeia standards for the medical and pharmacological industries, which allows use in medical compounds in Europe. "Given the COVID-19 pandemic and enormous rise in demand for disposable protective medical items and equipment, many processors have switched from technical compounds to medical ones," according to Avetisov.

He cites the example of a Serbian company using Sibur's PVC and DOTP to produce medical compounds for surgical masks used by hospital staff treating coronavirus patients. The mask comes with a replaceable filter so it can be used up to five times. In May, the masks were being shipped to the UK, Croatia, Montenegro, Bulgaria and Romania, the company says. Another Eastern European company set up a production line to make medical compounds using Sibur's DOTP and that compound is now being supplied to ventilator mask manufacturers in Western Europe.

Sibur commissioned its facility at Perm in Russia to produce its DOTP plasticiser in May 2019. The company says the facility is the largest single production site for DOTP in Europe and will supply to the Russian market (replacing imported product) as well as Europe and other regions. In addition to new uses in medical applications, DOTP is used in floor and roof coatings, wallpaper, cable compounds, and automotive coatings.

Off-the-shelf options

Teknor Apex recently launched a range of "off-the-shelf" medical-grade compounds made without DEHP or other orthophthalate plasticisers. The Apex and Flexalloy PVC introductions are intended to help speed time to market and provide multiple options for replacing conventional phthalate plasticisers. "We supply these new products with a full complement of physical property, biocompatibility, and regulatory test data, and we support rapid prototyping by offering quick turnaround times for samples. In addition, identical grades of each compound are available worldwide," says Derek Laffey, Medical Industry Manager for the Vinyl Division at Teknor Apex.

The new Apex PVC and Flexalloy PVC elastomer compounds are supplied in a range of hardnesses, with grades for extrusion (used, for example, in tubing and in cable jacketing on medical devices) and for injection moulding (typically used in luers, canulae, caps, connectors, valves, ear protection, endotracheal airway cuffs, mouthpieces, oxygen masks, safety goggles, resuscitation bags, and bulbs). Standard grades have a high-clarity medical-blue tint but the company says it can custom formulate options to meet a variety of colour, opacity and self-frosting needs as specified by the device manufacturer. The compounds can be ETO, gamma, and E-beam-sterilised and are said to exhibit good colour hold.

Teknor Apex, which produces several plasticiser types as well as formulated compounds, is offering the new grades with TOTM, ATBC, or in proprietary blends with DOTP. TOTM displays the least extractability from the PVC matrix and greatest resistance to crazing or stress cracking when in contact with polycarbonate or ABS, says the company. ATBC, derived from citric acid, is said to offer excellent toxicology and processing behaviour very similar to that of DEHP and is considered to be a good choice where PC or ABS contact is not a concern.

The company says DOTP is a cost-effective

Below: Renewability is rising up the agenda in a range of consumer-facing PVC applications, such as synthetic leathers


IMAGE: SHUTTERSTOCK

IMAGE: PERSTORP

Above: Perstorp says its mass balance concept is based on physical and chemical traceability

alternative to DEHP and blending it with TOTM or ATBC can provide a balance of cost-effective performance, processing, and toxicology performance, as well as maintaining or improving compatibility with PC and ABS.

Renewable solutions

Swedish company **Perstorp** has set itself the goal of becoming "finite material neutral" and, as a result, is looking at all product lines to see if fossil-based raw materials can be shifted to renewable raw materials. "We have seen an increase in requests for biobased or bio-attributed products coming from various industry sectors like automotive and consumer goods, especially for new product lines," says Jenny Klevås, Market Segment Manager for Polyolester Plasticisers at the company.

Pevalen Pro, a PETV (pentaerythritol tetravalerate) based partly on renewable content, is its newest non-phthalate plasticiser offering and is due to be made available to the market in the third quarter of 2020. That is a little later than originally planned – the product launch was pushed back and the audit by ISCC, an organisation that certifies that bio-based input is sustainably sourced, delayed by Covid-19 travel restrictions. With those now loosening, Klevås is hopeful the audit will soon be completed.

Perstorp plans to offer Pevalen Pro in three grades, from 8% renewable content up to almost 40% renewable content. The renewable content is assigned on the mass balance concept, which tracks the amount of renewable material going into a process and allocates it to certain products. Perstorp says it applies the principles more strictly in what they call a "traceable mass balance," which it claims is both physically and chemically traceable.

"Physical traceability means that a production process exists within the site for producing the product from the recycled/renewable raw material(s)," says Klevås. "Chemical traceability is following stoichiometry meaning that there needs to be a real connection between the raw materials and the end product. So we cannot buy 'green credits' and apply them to other products. In Pevalen we have, in total, 25 carbon atoms. To produce Pevalen Pro 36, we change 9 'black' carbons to 'green' carbons, which gives a renewable content of 36%. These green carbons come from biogas, bio-acetaldehyde, and bio-methanol."

She says the aim of this stricter traceability is to create a real transformation that supports the development of recycled or renewable raw materials. The company is also is looking into sourcing alternatives that will allow it to offer Pevalen based on 100% renewable content. "The shift towards renewable raw materials needs to be done in tandem with our raw material suppliers because it all starts upstream; no company is greener than its suppliers," says Klevås.

In October 2019, **DIC Corporation** in Japan announced it had developed a fully plant-based, polyester plasticiser that is derived entirely from biomass resources. The company says the additive is the first plasticiser to earn the "Biomass 100%" Biomass Mark, a designation certifying that a product is made entirely with biomass under the Japan Organics Recycling Association (JORA)'s labeling system. The company has begun shipping samples and plans to scale up its capabilities to facilitate mass production.

Plant-based specialities producer **Roquette** manufactures bio-based building blocks for plasticisers. Its Polysorb isosorbide can be used to make diester plasticisers. Its Biosuccinium biosuccinic acid can be used with alcohols to make di-(2-ethylhexyl)-succinate (DEHS) and with diols as a building block in polymeric plasticisers. DSM and Roquette ended their bio-succinic acid JV, Reverdia, in April 2019, and Roquette now operates the Biosuccinium plant in Italy, with DSM as the exclusive licensor.

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IMAGE: SHUTTERSTOCK

Adding intelligence to compounding

*Capturing and, more importantly, utilising production data is a key element in compounding plant process efficiency improvement. **Peter Mapleston** finds out more*

State-of-the-art data acquisition, processing and analysis can significantly simplify the daily production routines of compounding companies and provide valuable in-depth information for process optimisation. Progress in both hardware and software for "smart" manufacturing continues at a fast pace with providers increasingly adapting their offerings to take account of what compounders really need and to ensure they deliver the maximum gains. This article takes a look at some new developments that will help compounders position themselves better for the fourth industrial revolution – Industry 4.0.

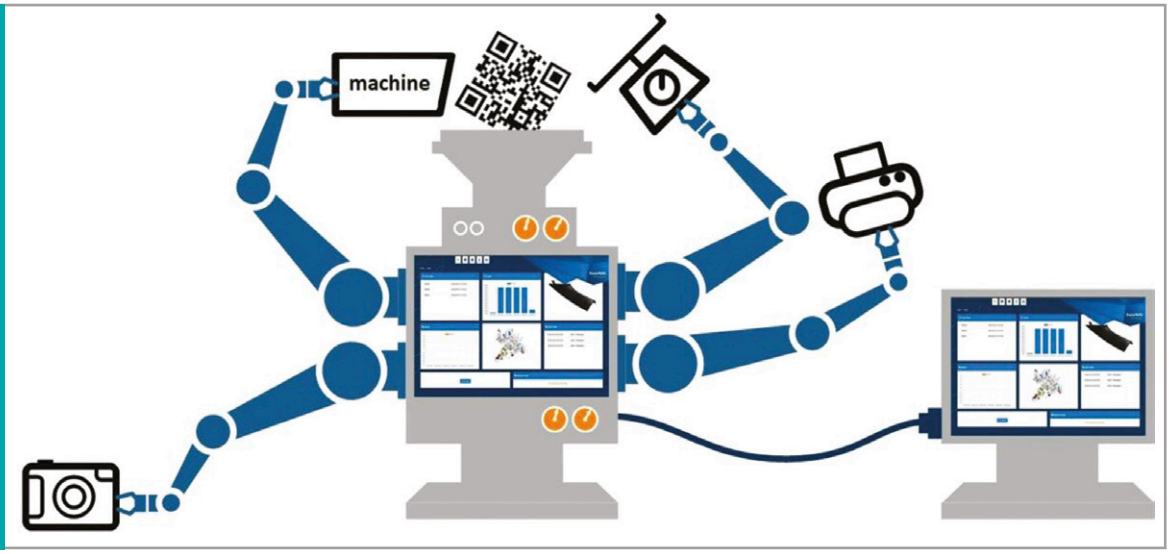
Plastics compounding equipment manufacturers are making progress with their Industry 4.0 developments. Having presented its Industry 4.0 and process control visions at K2019 last October, **Coperion** says it has now integrated the Smart Machine Features into the first production twin-screw extruders.

Integrated into the machine control technology, the Smart Machine Features comprise a package of different functions that are designed to help reduce waste material, increase the availability of the machine, and allow earlier detection of processing issues. The company says it has used its extensive process know-how to ensure the control system is able to monitor all the process conditions and detect deviations that could affect product quality.

"We are very confident that the Smart Machine Features will help our customers to prevent production of large amounts of off-spec material and even reduce their effort in quality control in the future," says Markus Schmudde, Head of Research and Development, Compounding & Extrusion, at Coperion. "Today's machine operators have many tasks to perform which are not necessarily located at the extruder, so the immediate detection of failures becomes less likely. Coperion's Smart Machine Features can help to overcome this issue by actively informing operators in case of problems."

For preventive maintenance Coperion offers a condition monitoring system for the extruder drivetrain, including the gearbox. This system helps to reduce maintenance costs and to detect possible failures early enough to prevent long-time production stops caused by severe and sudden damages. "This system is perfectly integrated into

Main image: Capturing and making effective use of in-plant data promises to lift productivity and quality across the compounding industry



EasyTrace from KraussMaffei collects all relevant production data and transmits it to customer-specific systems for evaluation

Image: KraussMaffei

the Smart Machine Features' maintenance function, wherein the operator or maintenance manager gets an overview of the maintenance status of the extrusion system," says Schmudde. "This supports spare parts ordering and maintenance planning to avoid unnecessary downtimes."

Development of Coperion's Industry 4.0 platform C-Beyond also continues at full speed, says Schmudde, adding that first applications of the new product portfolio will be announced soon. "It will give customers much deeper insight into their data and provides visualisations for data-based decision-making," he says.

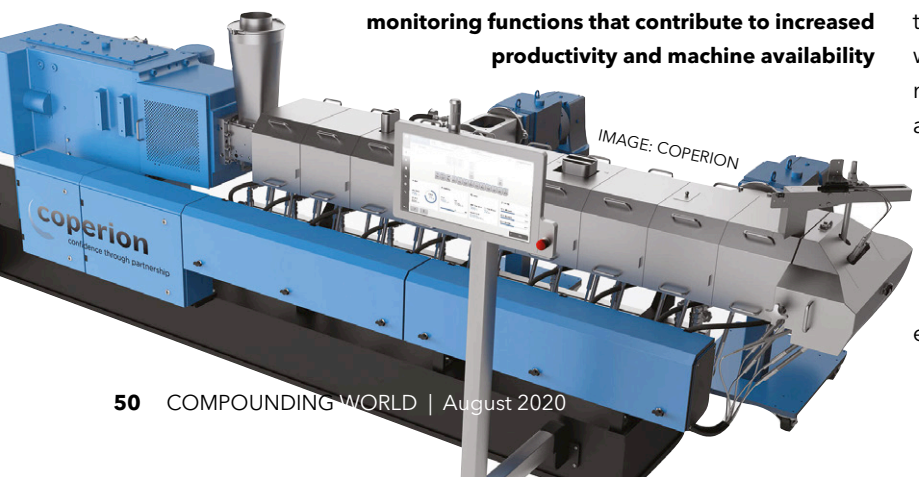
Open platforms

Coperion's new control systems are equipped with OPC 40084 interfaces. These are uniform standard interfaces based on OPC UA (Open Platform Communications Unified Architecture) for extruder communication with higher ranking manufacturing execution systems. OPC UA is a platform-independent interoperability standard, providing secure and reliable data exchange in the field of industrial automation. The OPC 40084 specification was jointly established by the European plastics and rubber machinery industry association **Euromap**, the German mechanical engineering industry association VDMA, and leading machinery manufacturers.

Leistritz says its control systems have been linked up for a wide range of applications since the beginning of its work on Industry 4.0. For example, process data is recorded both locally and globally, compounders have the option to connect the system directly with their infrastructure, and remote access to the system control is available via Smart Monitoring.

OPC UA will forge a link between the IP-based IT world and a compounder's extrusion line, says the company. "Interfaces, gateways and the accompanying loss of information will soon be a thing of the past, as all the data of the production process will be transferred via a single protocol – whether inside a machine, between machines, or between a machine and a database in the cloud," the company says. Leistritz is a member of the VDMA working group and is involved in defining the standard for extruder-specific interfaces.

Below: Coperion's latest extruder control includes smart support programs with intelligent diagnosis and monitoring functions that contribute to increased productivity and machine availability



Creating transparency

KraussMaffei has developed easyTrace, a cross-platform system that gathers all relevant production data in plastics processing and transfers it to the specific customer systems for evaluation, whether from the extruder, injection moulding machine, automation, or peripherals. "EasyTrace acts as a central data hub between the individual levels of production, creates more transparency over the entire value chain and supports quality assurance," claims the company.

"Making all data available together for evaluation—for example by an MES system—is essential, particularly in the age of Industry 4.0,"

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IMAGE: SESOTEC

Above: German compounder Sitraplas has networked its metal separators to ensure immediate operator notification and response to any issues

says the company. "These systems should be as simple as possible and not overloaded with powerful IT systems. However, this is a shortcoming of most solutions. They are not adequately tailored to plastics processing…KraussMaffei is closing this gap with easyTrace."

EasyTrace acquires information from material dryers, plastics processing machines, complex automation systems, cameras, printers, and scanners. It supports most interfaces available in the market—including E63, Profinet and E77—which makes it possible to integrate machines from different manufacturers or older equipment into digital production.

Cutting downtime

One ancillary equipment company making use of OPC UA for smart manufacturing in the compounding sector, among other industries, is **Sesotec**, which makes systems for contaminant detection and material sorting. It highlights the use of its technology at Sitraplas, which produces engineering plastic compounds at Bünde in Germany.

"Unplanned downtime is a nightmare for every company, but especially for continuous production facilities," says Sesotec. "Troubleshooting in the event of equipment failure is not only tedious and complex, but also very expensive. In turn, the lost time and resources associated with downtime can negatively impact both productivity and the competitiveness of the company."

The implementation of OPC UA communications protocol has had many benefits for Sitraplas. "Since we have been using OPC UA, we've had minimal maintenance and downtime," says Tim Hencken, Managing Director of the company. "System availability has seen considerable improvements."

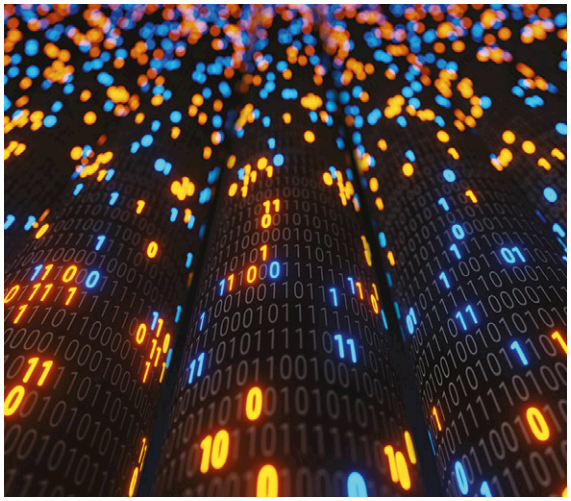
Last year, *Compounding World* reported on a new initiative at intelligent industrial automation provider **Oden Technologies** to help machinery manufacturers help their customers eliminate unplanned downtime. It partnered last September with WorldWide Polymer Compounding (WWPC), a specialist in process development and troubleshooting for the compounding industry, to offer Oden's products to polymer and food compounding manufacturers in North America.

Facing challenges

Oden says companies operating compounding facilities face various technical and operational challenges that have the potential to be resolved using Industry 4.0 solutions. "Specifically, manufacturers are struggling with maintaining the highest throughput rate and product quality on a continuous basis as well as hiring operators and process engineers with the right skills to oversee their operations," it says.

Oden's intelligent industrial automation platform is claimed to provide continuous visibility into factory operations and processes. The company says customers can see improvements such as a 20% increase in monthly output, due to the combination of optimised production rates, increased yield, and reduced downtime. It claims its AI-powered data analytics helps manufacturers achieve as much as a 50% decrease in total scrap

IMAGE: SHUTTERSTOCK



through its Golden Run recommendation engine.

The company describes Golden Run as "a proprietary recommendation engine specifically designed to address the needs of manufacturers for effciency and to identify the most profitable way to make a product. It enables manufacturers to solve problems faster than ever before and unlock cost-saving effciencies from data that could have remained hidden. Using machine learning algorithms, Golden Run identifies where changes and improvements can be made and generates new settings so manufacturers can continually realise cost-saving improvements."

The company says it has found that plastics manufacturers gain specific benefits from predictive performance or predictive quality applications and is now focusing more on those areas. "For plastics manufacturers we began targeting areas for faster ROI including predictive performance and quality applications," says Oden CEO Willem Sundlbad. "Uptime optimisation solutions are still an important component to our offering, but we've seen manufacturers achieve a faster ROI through predictive performance and quality."

Sundlbad explains that by identifying critical conditions to reduce quality failures, Oden was able to help one company involved in plastics extrusion eliminate $5m per month in cost of non-conformance. "Teams know they need a better way to process data and proactively identify and address potential quality failures," he says. "The value of increased visibility into production process controls is immediate and, in this case, the prescriptive performance saved over 200 production hours by adjusted settings while improving quality and even helped regain a lost customer."

Integrating AI

Industrial software supplier **Aveva** – best known for software that until a few months ago was called Wonderware – has recently introduced its Insight OMI app, which it describes as "a first in the industry to infuse real-time artificial intelligence (AI) into an operator's decision-making as well as improve overall operational agility."

Aveva says the app provides various types of manufacturing businesses (not only plastics compounding) with an accelerated path toward implementing artificial intelligence in the control room or on the plant floor, "presenting real-time anomaly detection in a context-aware OMI visualisation display."

The company says: "The Aveva Insight OMI app introduces AI capabilities into the Aveva System Platform, formerly Wonderware, and leverages predictive early warning and automatic detection of unusual operational behaviour. This provides users with early notification so they can quickly resolve issues before they become critical business problems such as unplanned downtime and production losses."

The app's AI engine adapts to an enterprise's specific implementation, says Aveva. As anomalous patterns are identified, they can be captured and presented within an organisation's Supervisory Control and Data Acquisition (SCADA) solution.

"IIoT [Industrial Internet of Things] applications have driven a massive increase in the collection of real-time operations and manufacturing data," says Rashesh Mody, Vice President, Monitoring and Control, at the company. "Operators often cannot effectively react to or distinguish between process-critical situations and false positive alarm conditions, resulting in the loss of operational time and resources. By harnessing the power of AI and advanced cloud analytics, Aveva is enabling operators to take proactive action, before process and maintenance problems occur."

A systems control company with considerable experience in the compounding field is **Kirchhoff Datensysteme Software** (KDS). Its Poly.ERP is an Enterprise Resource Planning (ERP) software

Left: Aveva sees the fusion of artificial Intelligence (AI) and production data improving plant operational decisions

Below: Many compounding operations face the challenge of connecting multiple levels of in-plant data, according to Poly.ERP developer KDS

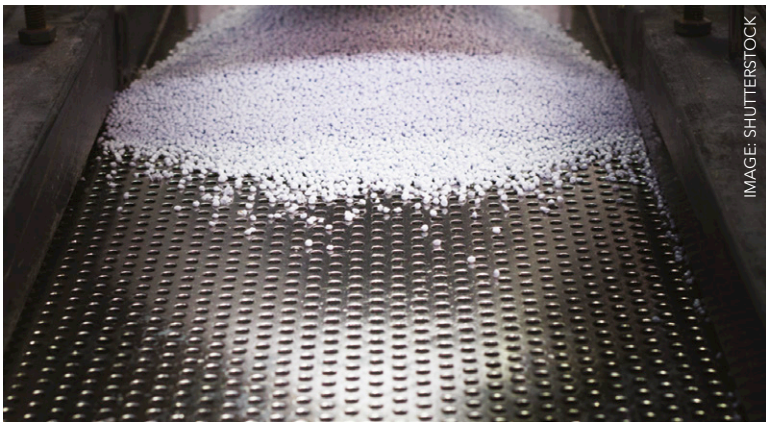
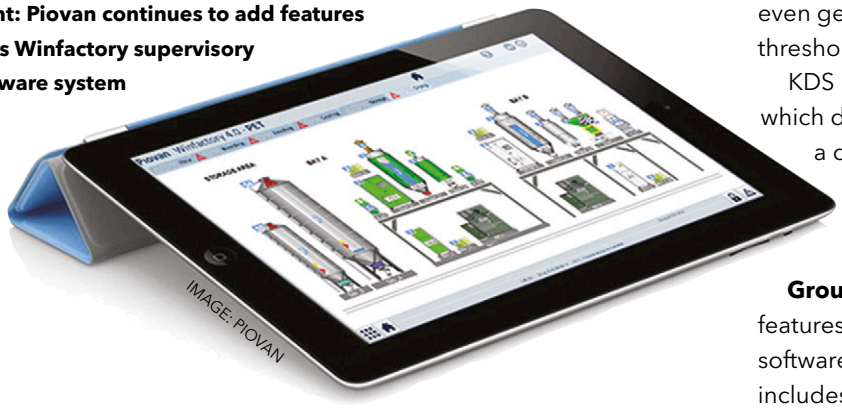


IMAGE: SHUTTERSTOCK

Right: Piovan continues to add features to its Winfactory supervisory software system



solution developed specifically for compounding operations. KDS says that with its integrated database and its consistent processes through all compounding business areas, Poly.ERP provides the fundamentals of an industry 4.0 architecture. Introduced around 10 years ago, it is now used by more than 20 compounders around the world.

Streamlining systems

KDS says Poly.ERP is designed for the individual ERP and MES (Manufacturing Execution System) processes of compounders, recyclers and masterbatchers. Poly.MES is the dedicated MES for companies that already have a corporate ERP system in place, but are still seeking to streamline their compounding production and operations specific processes at a plant level. It fully integrates with the corporate ERP to allow for seamless end-to-end processes and reporting.

Oliver McKenzie, CEO at KDS, says a central target of Industry 4.0 is the integration and optimisation of production and quality processes. "But how is it possible to easily and flexibly manage the large heterogeneity of machines, interfaces, and data, if the relevant data must be retrieved and integrated from numerous source systems?"

Answering his own question, he says the first necessary step is the consolidation of data. "Poly.ERP offers functionality to manage all relevant machine data in a structured way and supplies that data just in time. With production release, the material formulation, mixture settings and machine parameters are handed over to the control level. With the start of production, the data gets activated on the several machines. If changes of parameters are performed during production, the changes are reported to Poly.ERP and therefore available for analyses and future knowledge on parameterisation.

"Furthermore, the Poly.MIS Management Information System offers the possibility to consolidate the process data and to link them to testing results of the quality assurance module or even generate proactive signals in case of certain thresholds being exceeded."

KDS is preparing a White Paper on Poly.ERP, which discusses machine connectivity initiatives at a client's plastics compounding operation. Some highlights are presented in the follow-on story on the next page.

Among ancillary suppliers, **Piovan Group** says it continues to extend the range of features offered by its Winfactory 4.0 supervision software for the digital factory. This software also includes a module for monitoring energy efficiency and a module to monitor cooling solutions developed by the company's Aquatech business.

Material tracking

Starting with the premise that data context integration and digital interconnection throughout the process are the guidelines of Industry 4.0, Piovan says it has developed a new material tracking system (MTS). This consists of a terminal capable of reading barcodes for the identification of users and materials and an associated raw material management app. The system enables optimisation of storage of materials and identification of the flow of different batches from the initial phase to the finished product.

Piovan says that typical Winfactory 4.0 supervision functions can now also be combined with a wide array of new ones to create tailor-made systems. These new characteristics include increased control of the production process via the material traceability system; interactive manuals of every machine available on-line; flexible and secure access control; state-of-the-art analysis tools; integrated management; communication and data exchange with WebService for on-line data exchange with the customer's MES, ERP or supervision systems; and energy use optimisation tools. The last of these is provided through Piovan's Winenergy module, which can be applied to all the customer's electrical loads, monitoring and analysing energy consumption and capturing data related to electricity used, thermal energy, flow rate of fluids and gases, and temperature.

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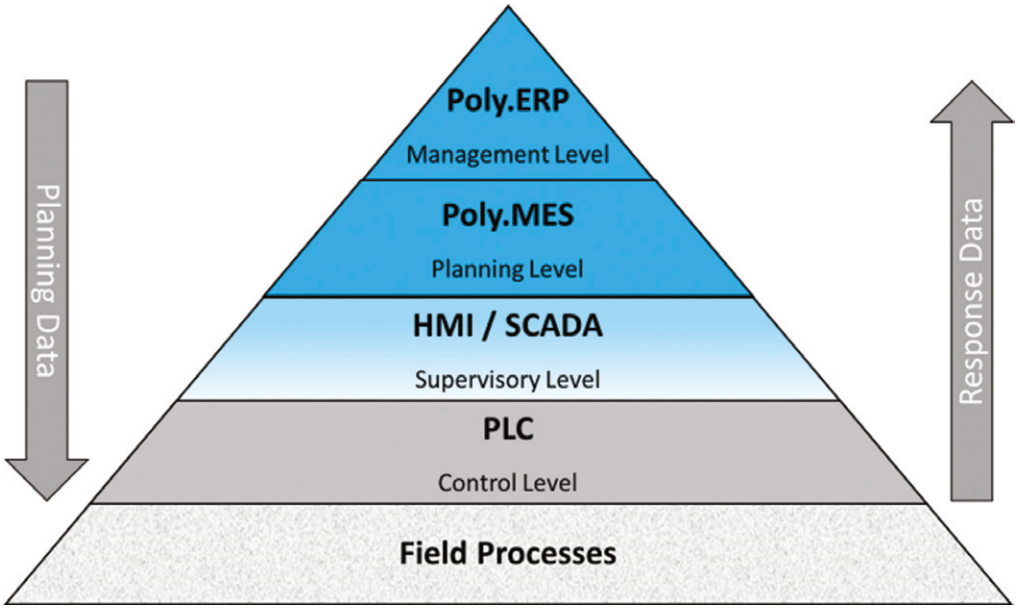
A roadmap to Industry 4.0

German PVC compounder Polymer Chemie recently embarked on an Industry 4.0 digitalisation programme with Poly.ERP software developer Kirchhoff Datensysteme Software (KDS). The two companies share their roadmap here

The central objective of Industry 4.0 is integration of production with existing business applications. The foundation for this integration is harmonisation of the IT landscape and the creation of a unified data basis across the various automation layers (ERP, MES, SCADA, etc). In many compounding companies, however, a wide range of predominantly non-system-based processes prevail.

PVC compounder Polymer Chemie has been a long-time user of Kirchhoff Datensysteme Software's Poly.ERP for its resource planning. Next to the core ERP functions, it also has specific end-to-end processes in production planning and control (PPS), quality assurance, recipe management and plant calibration reproduced in the system. Mobile data terminals, tablets and integrated scales have replaced paper-based production processes and, as a result, cumbersome data consolidation and the implementation of interfaces across various levels of the automation infrastructure is no longer required.

With this foundation in place, Polymer Chemie has now committed with KDS to a roadmap of Industry 4.0 initiatives together with Poly.ERP. The first course of action is the system integration of plant controls, which will be achieved through a cost-effective four-step pragmatic and manageable approach that allows for measurable outcomes and is outlined here:



The foundation for Industry 4.0 digital competence – an integrated ERP/MES System
Source: Kirchhoff Datensysteme Software

- Process data import (not real time): Many Polymer Chemie plant controls are delivering process data in the form of intermittent data exports. Integration of this data will allow for comparison of 'as-is' against 'to-be' values. The result will be full traceability of production data.
- Process data integration (real time): Polymer Chemie will address use cases that yield additional value through real-time data integration. Controls that are able to collect and send real-time data will be linked with the Poly.MIS (Management Information System) analysis tool and transferred data consolidated to the appropriate functional level. This will enable creation of alarms to prevent defective or costly operation failures.
- Connection of dedicated plant controls: Some extrusion equipment includes systems and sensors with their own controls outside of the central control system. In some cases, these allow communication with the central control system, in others they operate stand-alone or lack sensors for data capture altogether. The likely scenario of the digitalisation initiative will be a sensor connected to a decentral control unit. Collected data will be read using a bridge, which acts as an interpreter in the network between the plant controls and other systems (such as MES orERP). The result will be an enriched data source for analysis and deeper process insight.
- In-system-handover of plant parameters in Poly.ERP: The fourth stage of the initiative will see specifications such as plant parameters or recipe mixtures being communicated seamlessly between the Manufacturing Execution System (Poly.MES) and the plant control system on the other hand. The result will be less error-prone manual processes.

According to KDS, what is important in this four step approach to Industry 4.0 is that the digital initiatives are not implemented as ends in themselves but always on a business case. It says the first steps of the initiative will amortise within the first few months of implementation.

› **www.kds-kg.de**
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Getting to the core of compounding

Screw elements and barrels define the compounding process. Mark Holmes learns more about the latest designs and improvements in wear and corrosion resistance

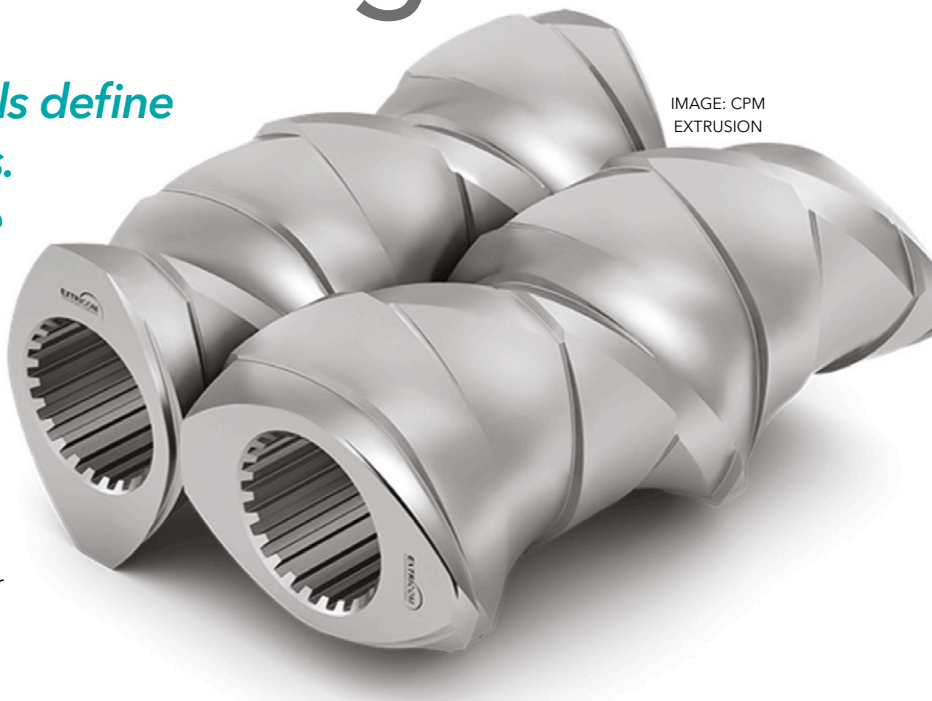

IMAGE: CPM EXTRUSION

Main image: Optimised screw profiles are even more important for today's high torque/high speed compounding equipment

Screw and barrel technology is advancing continually as extruder manufacturers design their machines to take on a wider variety of tasks, more efficiently and with easier changeovers of screw and barrel configurations. As the heart of the compounding system, screw and barrel wear and corrosion resistance is also essential and both extruder manufacturers and specialist providers of components and surface treatments are helping meet these challenges.

According to **CPM Extrusion Group**, with high-torque/high speed compounding extruders now increasingly the norm, compounders are finding the resulting higher melt temperatures and shear rates are degrading some of the more sensitive polymers and additives they work with. This is forcing them to sometimes operate at reduced screw speed and capacity to meet the specific compound property specifications. As a result, machine manufacturers are scrambling to create novel element designs that provide good dispersive mixing with lower shear input.

CPM Extrusion has been deploying its High Performance Element (HP) designs for applications where traditional Erdmenger kneading elements are limiting twin-screw extruder productivity. "The T3-Profile kneading elements, originally developed for the RingExtruder, have proven themselves in field trials at customers with significant reduction in shear-induced degradation and melt temperature," says Adam Dreiblatt, Director of Process Technology. "With an asymmetric geometry that enhances elongational mixing, the T3-Profile avoids the shear and pressure peaks associated with Erdmenger profile elements."

The company adds that one example illustrates the significant difference possible with elongational mixing used T3-Profile kneading elements at the same throughput and processing conditions as traditional kneading and mixing elements. Melt temperature, measured directly from the extruder screw tips, was reduced from 185°C to 130°C on a 58mm extruder. This allowed the material to be processed with an active ingredient without it breaking down and maintained the efficacy of the product.

Further customer trials are planned to identify those applications where elongational mixing can improve productivity and/or product quality. "We are focusing on applications where machines cannot operate at high screw speed without degrading the properties of the material, such as ABS, TPU and POM," says Dreiblatt. "Our HP elements enable high production rates without experiencing the shear and temperature peaks that tend to result in increased Yellow Index, for example. Our CXE series compounding extruders fitted with such elements can provide improved product quality and high capacity." ›

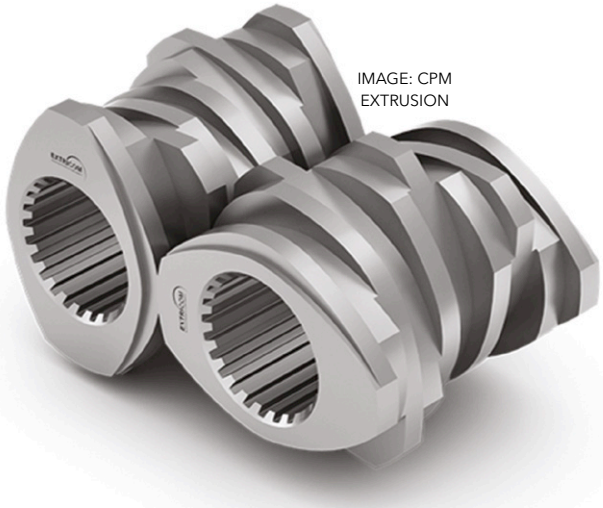

IMAGE: CPM EXTRUSION

Right: Assymetric T-Profile kneading elements from CPM Extrusion Group

Degassing gains

Another area being explored for HP elements is in the degassing section of the twin-screw extruder, where the novel geometries provide increased surface renewal and so improved devolatilisation. Current state-of-the-art for screw design in degassing zones uses traditional Erdmenger conveying elements, which do not produce any significant surface renewal outside of the intermesh region. By introducing mixing while under vacuum, this increases the diffusion of volatiles in the melt. CPM Extrusion Group is focusing this area of development towards solutions for VOC reduction for ABS and polyolefins, which includes use of stripping agents in combination with HP elements for degassing.

The general trend in development of screws and barrel sectors has focused more on materials than on new shapes for conveying or mixing sectors, according to Italian extruder manufacturer **Comac**. "Although the geometries now available on the market are numerous, most continue to use the traditional two-lobe shapes both for conveying and mixing. While these generally provide good mixing and maintain a perfect self-cleaning profile, good self-cleaning cannot be guaranteed in different gear tooth shapes or in the IGEL type, which – even if they are used only in particular circumstances – have the disadvantage of risking polymer block that can degrade thermally," says Dr Riccardo Pellegrini, Research and Development Director.

"On the construction steel side, our research has instead shifted towards specific materials to address problems most common in a customer's processes. Therefore, we do not use steels suitable for corrosion problems that have less resistance to mechanical wear for processes in which corrosive by-products are developed. Instead, we concentrate on steels that have a high hardness and wear resistance for customers producing highly abrasive compounds with glass, carbon or other fibres. These special steels meet standards which ensure average values of resistance to both corrosion and wear. In the same screw composition, sectors of different steels can often be placed side-by-side, according to the area and functionality of the screw sector."

The same applies to steels used in the barrel segments, for which Comac has a standard length of L/D of 4. "This is even the case if the HRC hardness of the barrels has always to be kept higher than the screws to guarantee a longer life," adds Pellegrini. "The novelty of barrels manufactured by Comac for a number of years now is the three piece 'sandwich' model, which has replaced the model with internal sleeves."

IMAGE: COMAC

Right: Comac says steel election is critical for screws and barrels

Faster maintenance

Comac adds that the main advantages provided by its concept barrels compared with a traditional design include that they offer faster and more convenient maintenance. In addition, barrel modules and sleeves can be disassembled and reassembled without special tools and with reduced handling of heavy parts. Correct alignment of modules at reassembling is easy, which makes spare parts perfectly and directly interchangeable. More convenient changing of the barrel configuration is also possible, which in some cases is required when changing the screw profile, and a full set of spare parts for the whole barrel is also said to be cheaper. The company also claims that more accurate thermoregulation can be achieved by temperature probes positioned very close to the inner surface in contact with the material being processed. And the design provides optimised tight coupling of modules to each other.

JSW Japan is set to introduce a new screw element called V-Kneading, which is a special V-shaped kneading element designed to achieve higher dispersion in the compounding process. Currently under development, the company plans

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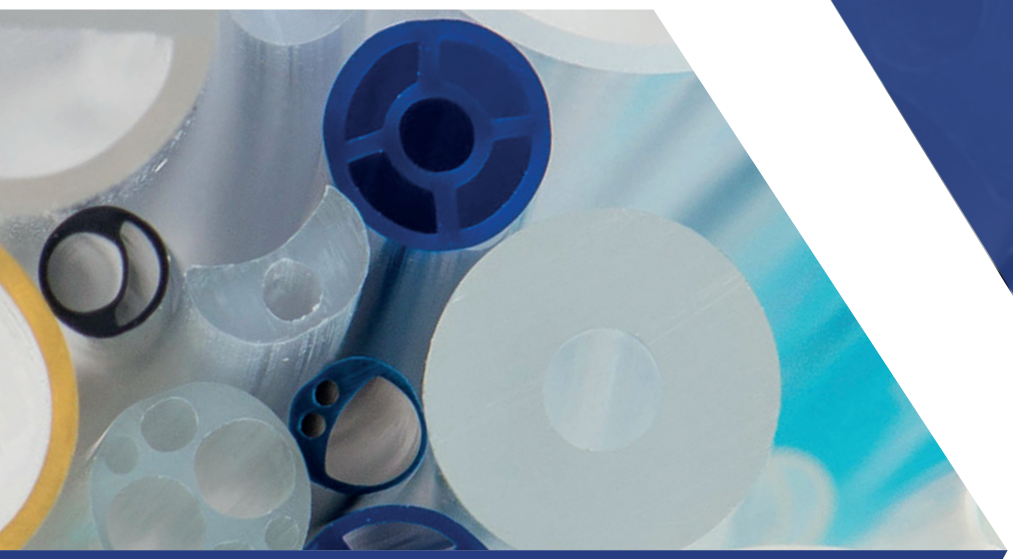

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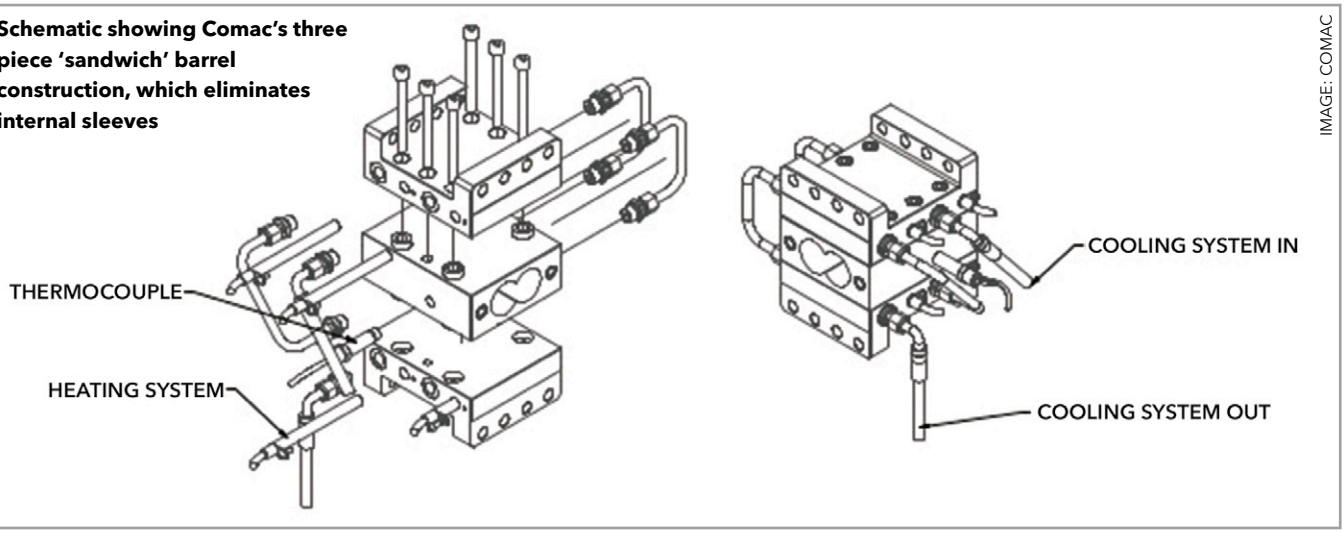
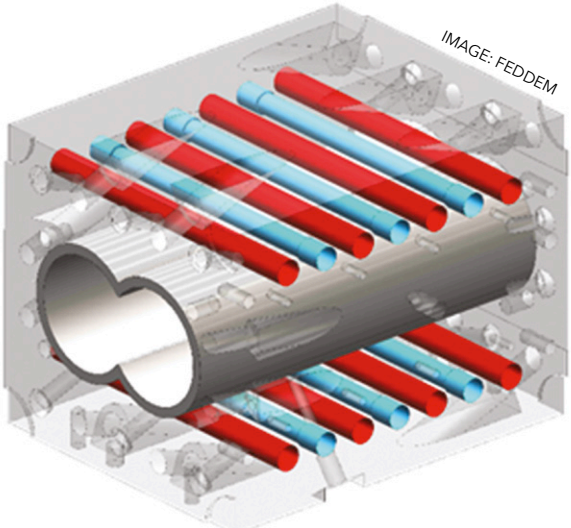


Schematic showing Comac's three piece 'sandwich' barrel construction, which eliminates internal sleeves

to start a major experimental testing programme in August with a view to launching the new screw element later this year.

Simpler selection

The company believes screw selection has become too demanding, with many types of screw element with complex geometries currently on the market from manufacturers for various applications. "In our experience, when screw geometry gets too complex it gets increasingly difficult to understand the performance and behaviour of it - good or bad," says Daigo Saga, Extrusion Process Supervisor. "Without doubt the easiest and most popular screw element for compounding currently is the standard kneading element, with combinations of left-handed, neutral and right-handed elements. Our newly developed V-Kneading element is a kneading element in appearance, except that it has a unique V-shaped screw tip. Overall it shows quite similar conveying and resistance behaviour to standard kneading elements, except that it provides a boost to apply extra shear stress to the polymer," he says.



Right: Feddem's extruder temperature regulation system with heating cartridges shown in red and water cooling channels in blue

"We developed this screw element initially for Cellulose-Nanofibre (CNF) compounding applications. These are currently getting increasingly popular in Japan, although not so much in the European and US markets yet because CNF compounding requires high shear-stress mixing," he explains. "With this development proceeding, we are now planning to expand the range of applications of the V-Kneading element in forthcoming trials in August."

Feddem says it has optimised the mixing performance of its extruders through combinations of its type FME mixing elements with the benefit of extended lifetimes of barrels and screws. The company says the goal is to expand the application range of its screw geometries to a wider variety of materials and reduce the need for exchanging screws and reducing down time of the compounding line.

Cooling gains

In addition, the company is making improvements to its extruder cooling systems. "Cooling borings perpendicular to the process direction provide the best combination of cooling efficiency and ease of access when cleaning of the cooling system is required," says Klaus Hojer, Business Development Manager.

"We have worked on expanding the maintenance intervals on the extruder's cooling system and increasing the service life of its components. We have optimised the selection of materials for piping, fittings, solenoid valves and circulation pump in the cooling loop of the extruders to work in combination with the steel casings of the extruder barrels. With appropriate cooling water specifications and periodical monitoring of the composition of the circulating water, maintenance intervals can be expanded, substantially," Hojer says.

"Over time scaling may occur in the cooling

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IMAGE: COPERION

Above: Coperion has developed a quick-release screw shaft coupling for its ZSK 26 Mc[18] extruders

borings through the frequent evaporation of cooling water during normal cooling action. When required, mechanical cleaning of the straight through holes can be applied in-situ with a pipe brush and a power drill after dismounting the fittings," he says. "As a result, bothersome cleaning with acidic liquids for scale removal can be eliminated and mechanical cleaning efforts can be easily focused on the critical areas of the cooling borings that are exposed to frequent evaporation stresses."

Tackling wear

A constant challenge for wear resistance in compounding extruders - especially for barrels - is the high load of the latest machine types, according to **Coperion**. The company says customers are increasingly utilising the full torque of the compounder, which increases the mechanical forces inside the process section, so it has recently updated the standard wear protection material for ZSK extruder barrels to WP 043+ for all machine sizes.

With a significantly increased impact energy, the WP043+ coating can better tolerate high forces than the former standard WP043. The result is less damage at similar abrasive wear resistance and increased corrosion resistance. In addition, Coperion's high performance C-Rock material is now available for ZSK 70 and ZSK 92 twin screw extruders. The company says it offers best-in-class wear and corrosion protection, especially for challenging process conditions.

Coperion has also developed the quick-release screw shaft coupling that enables screw changes to be performed as quickly as possible for ZSK 26 Mc[18] compounding extruders. This new addition means cleaning times are reduced to a minimum when changing between colours and recipes.

Extreme Coatings has improved its CarbideX coating technology for replacement of nitriding and chrome plating on conical and parallel twin feed screws. The company says the move was prompted by environmental concerns with chrome plating and the need for better protection against wear and corrosion. According to the company, equipment operators can achieve two to five times longer equipment life with CarbideX formulations (C1000, C2000, and C9000-nano) of tungsten and chromium carbide encapsulation. Wear resistance capabilities can be improved on a variety of components, including twin extrusion screws, continuous mixing rotors and other parts in the plasticising process.

Chrome replacement

The company says its Chrome Plating Replacement (CPR) is virtually non-porous, so corrosive gasses from PVC cannot attack the base of the screw. However, unlike nitriding, it says CPR also adds corrosion resistance as well as greatly increased wear resistance. CPR is also said to be more environmentally friendly than chrome plating. Extreme Coatings says the chromium (vi) compounds used in chrome plating are known carcinogen but the chromium (iii) carbide compounds used in its CPR C4000 system are not known to be carcinogenic or toxic.

In some applications where abrasive fillers cause premature wear, the company says its C1000 or C9000 nano formulations of tungsten carbide encapsulation will provide superior wear resistance combined with a high level of corrosion resistance – minimising wear and maximising profit.

Extreme Coatings says its approach to any wear or corrosion problems is analysis then development of a customised solution to maximise component life. "Advancements in polymer technology demand parallel advancements in feed screw and processing technology," says Curt Kadau, President of Extreme Coatings. "Extreme Coatings has kept pace with these advancements and will continue to develop new products to meet the demands of our customers."

Single approach

While most compounding applications are twin-screw, **Nordson Corporation** has assembled a selection of Xaloy screw and barrel options for single-screw compounding, particularly for abrasive or corrosive ingredients. "The choice depends on the percentage loadings of the additives and fillers and on the point at which these ingredients are metered into the plasticating

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Right: Xaloy 800 inlay is claimed to provide the highest level of barrel wear and corrosion resistance

system," says Walter Smith, Senior Extrusion Process Engineer. "In order to achieve complete and uniform dispersion of ingredients, Nordson recommends screws equipped with its StrataBlend I and II mixers."

Smith says the most common screw materials are heat treated 4140 and 4340 alloy steels. "For compounding high loadings of fillers and reinforcements or corrosive resins and additives, these alloys provide poor to fair resistance to wear and corrosion. Nitrided steel provides better wear resistance, and stainless steel offers better corrosion resistance. For performance superior to these materials, Nordson offers several alternatives," he says.

Thermal spraying

For extreme wear resistance, Xaloy X-8000 nickel alloy with tungsten carbide is a thermal spray coating for screws processing highly filled or corrosive materials. The company says that it can be applied to the full length of the screw or to specific areas susceptible to wear. It forms a metallurgical bond to the base steel, with an estimated bond strength of 280 MPa, as compared with 72 MPa for standard thermal spray coatings.

Xaloy X-830 is a nickel-based alloy with tungsten carbide for high-hardness flight welding. This is plasma-transfer arc welded onto the flight lands. The alloy is an anti-corrosive, anti-abrasive material best used in combination with Xaloy X-800 barrel liners.

For root protection against abrasives, an alternative to Xaloy X-8000 encapsulation is a J-shaped weld applied to the "pushing" side of the screw flight, particularly in the feed section to avoid premature wear from abrasive additives metered into the barrel from the hopper (Figure 2). The alloy used is Stellite 6, a high-hardness cobalt-based metal. For more extensive protection from abrasion, Nordson can also encapsulate the entire root with a weldment of Stellite 6 in the area of the screw where high loadings of abrasive filler are fed into the system.

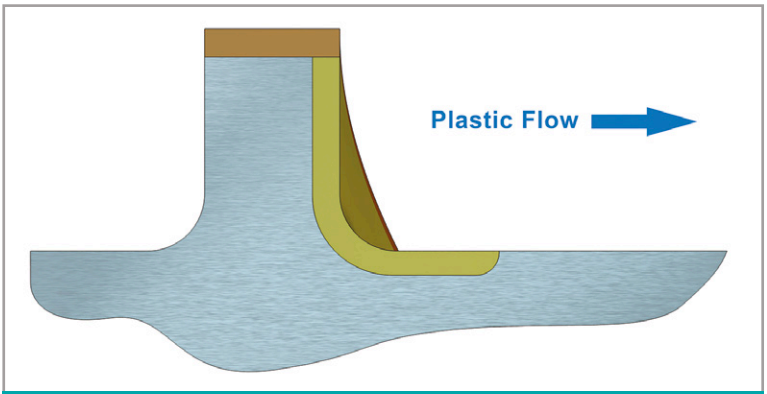

Figure 2: J-weld application of Nordson's Xaloy X-8000 can provide root protection on screw flights
Image: Nordson Corporation

For the lining of extruder barrels, Nordson says its Xaloy X-800 inlay provides the highest level of wear and corrosion resistance, including resistance to attack by aggressive volatiles. This inlay consists of tungsten carbide particles dispersed in a nickel alloy matrix. It can be used with filler loadings up to 50% and with corrosive substances such as flame retardants and fluorocarbons. These extrusion barrels can be manufactured up to a 600 mm ID, depending on the length and weight.

China's **Nanjing KY Chemical Machinery** says it has developed new Hot Isotactic Pressing (HIP) materials to improve the service life of screw elements. According to the company, its HIP coatings can be directly powder-formed and treated materials can achieve 100% densification, which improves overall mechanical properties. KY Chemical says its PMHIP coating offers a number of favourable characteristics including high alloy content, uniform carbide formation by heat treatment and long service life. Compared with domestic Chinese high-speed tool steel, service life is increased by 5-10 times.

Other claimed benefits for its PMHIP steel include the ability to meet individual requirements for wear or corrosion resistance and more consistent product processing. The company says the coating meets the requirements of machinery with torque ratings of up to 18Nm/cm³ as the screw elements can adopt a soft core structure, which provides improved toughness.

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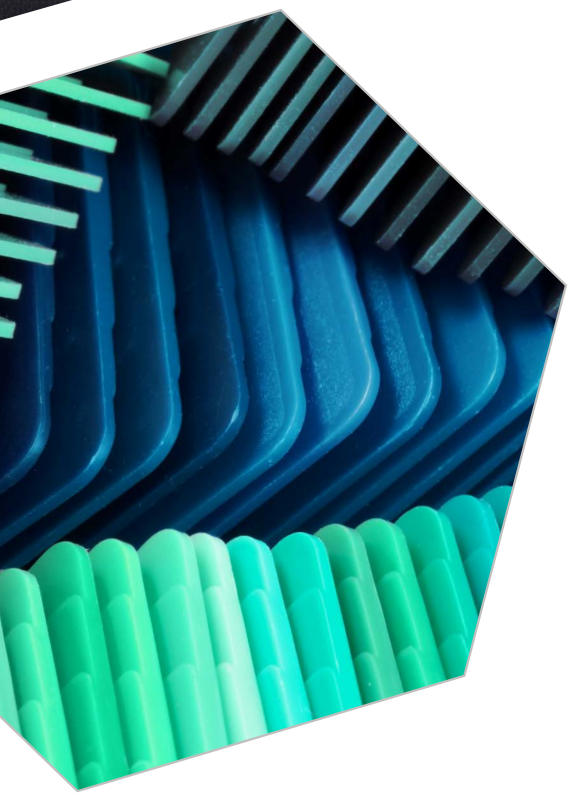

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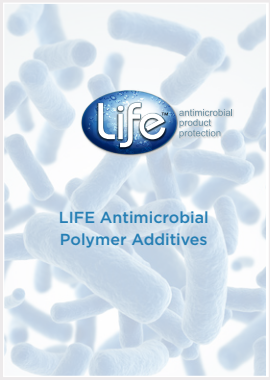

Life Material Technologies offers a full range of antimicrobial additives for protection of plastics from bacteria, fungi and algae, including silver inorganics, synthetic organics and natural botanics. Find out more in this four-page brochure.

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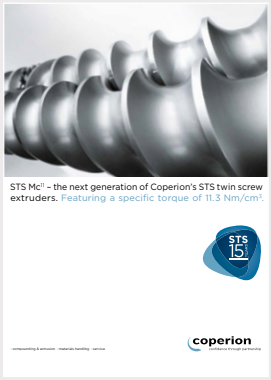

Coperion's STS Mc11 line of twin screw extruders provides performance at a competitive price. This brochure describes the full features of the range, from the newly launched 80 kg/h 25mm diameter laboratory model to the 4,200 kg/h 96mm version.

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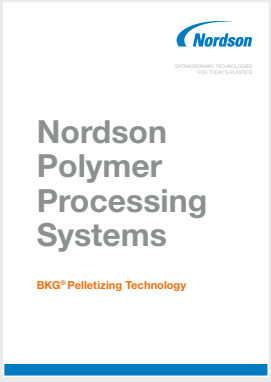

The BKG range of pelletisers from Nordson Polymer Processing Technology includes underwater, water-ring and strand systems suitable for almost any thermoplastic pelletising application. Find out more in this six-page brochure.

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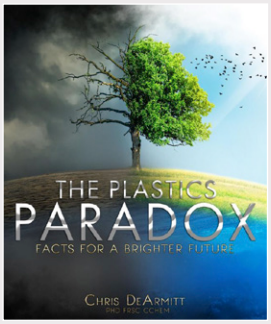

Plastics consultant Chris DeArmitt examined more than 400 peer-reviewed scientific articles to present this interesting perspective on plastics and the environment. *Compounding World* subscribers can read the entire book for free.

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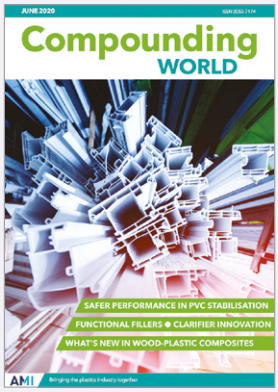

Compounding World June 2020
The June issue of Compounding World looks at how suppliers of PVC stabilisers continue to work on improving the effectiveness and safety of their products. Features also cover functional fillers for better mechanical performance, clarifier additives and wood plastic composites.

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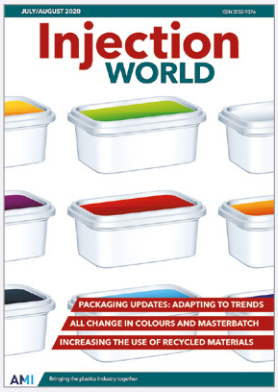

Injection World July/August 2020
The July-August edition of Injection World has two articles on challenges and trends in rigid packaging. Plus there are features on increasing the use of recyclate in new injection moulded products and developments in colour masterbatch.

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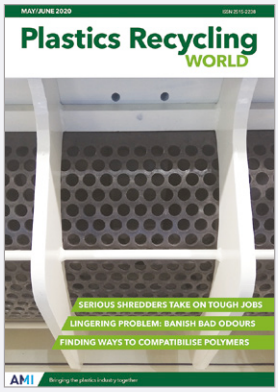

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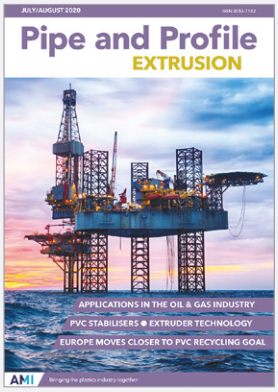

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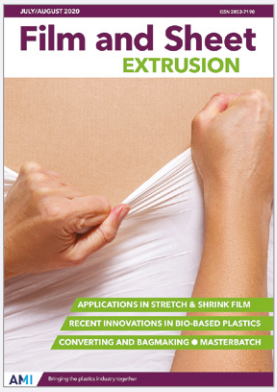

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The July/August 2020 edition of Film and Sheet Extrusion magazine looks at developments in shrink and stretch films. It also explores the latest in bioplastics, masterbatches, film conversion technology, and progress in European PVC recycling.

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