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Third Floor, One Brunswick Square,
Bristol, BS2 8PE, United Kingdom
Tel:+44 (0)117 924 9442
Fax:+44 (0)117 311 1534
www.amiplastics.com
www.twitter.com/plasticsworld
Registered in England No: 2140318

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EDITORIAL

Editor-in-Chief: Chris Smith
cs@amiplastics.com

Editor: David Eldridge
de@amiplastics.com

Technology Editor: Peter Mapleston
editorial@injectionworld.com

Contributing Editor (UK): Mark Holmes
editorial@injectionworld.com

Events and Magazines Director: Andy Beevers
abe@amiplastics.com

ADVERTISING

Advertisement Manager: Claire Bishop
cb@amiplastics.com T/ +44 (0)7905 848744

Head - Business Development: Paul Beckley
pb@amiplastics.com T/ +44 (0) 117 311 1529

Advertising Sales (China/Hong Kong): Maggie Liu
maggieliu@ringiertrade.com T/ +86 13602785446

Advertising Sales (Taiwan): Ms Sydney Lai
sydneylai@ringier.com.hk T/ +886-913625628

Advertising and Expo Sales (India): Yogesh Vyas
yogesh@dexspo.com T/ +91 9920735930

Big growth for Haitian International in 2021

Hong Kong-based injection moulding machinery maker Haitian International has reported a 35.7% increase in sales to RMB 16,018.3m in 2021. The company sold a record 56,000 machines last year, including over 10,000 in export markets.

Domestic sales were 33.9% up at RMB 11,088.2m, while overseas sales reached RMB 4,930.1m, 40.1% higher. Haitian added that it "recorded a notable increase" in sales in North America and Southeast Asia and a "steady" increase in Europe and South America.

The product mix was dominated by the Haitian Mars Series, sales of which grew by 33.2% to RMB 10,944.0m in 2021. The Zhafir Electrical Series and the two-platen technology Haitian Jupiter Series both reached all-time highs on the back of the recovery of high-end industries and the automotive sector in China and overseas. Sales of these grew by 44.3% to RMB 2,077.5m and by 54.8% to RMB 2,017.3m, respectively.

Above: Chinese machinery giant Haitian International experienced a 35.7% increase in sales in 2021

The company also stated that it "will drive its corporate and market development in the future with two headquarters". In addition to one at Ningbo, construction of a second at Shunde, South China, is on schedule and is expected to start trial production in the second half of 2022.

Partly in response to high logistical costs, Haitian will also expand overseas assembly and trade-oriented factories into integrated regional centres combining R&D, manufacturing, assembly, application, sales and service in order to localise production worldwide. Digitisation is another core strategy.

"We will promote standardised production of components while meeting the needs of each market segment and individual customers, based on our product strategy 'Technology to the Point'," said Zhang Bin, Executive Director of Haitian International.

› **www.haitianinter.com**

TMA to join Engel Group

Injection moulding machinery giant Engel has acquired a majority stake in Poland's TMA Automation. The two companies had cooperated on customer projects for many years and Engel was seeking to increase its already strong presence in Eastern Europe.

"TMA's technologies perfectly complement Engel's in-house spectrum of robots and automation components," said Walter Aumayr, VP of Automation and Peripheral Units. A particular focus for TMA is automating in-mould labelling processes in the medium performance segment.

TMA will remain independent under Engel and founders Marek Łangowski and Piotr Orlikowski will continue to manage it, alongside Aumayr. A site has already been purchased in Gdansk in order to start building a new office and production facility "in the near future".

› **www.engelglobal.com**

SyBridge buys Advantage Engineering

Michigan-based industrial technology company SyBridge Technologies has made its sixth acquisition in the last 12 months in Advantage Engineering, of Windsor, Ontario, Canada. Terms were not disclosed. Advantage carries out rapid prototyping and 3D printing in plastic and metal, aluminium tooling production and low-volume plastic injection moulding.

SyBridge, which was created by private equity firm Crestview Partners in 2019, said that this will continue the expansion of its Technology & Services business unit. It will also add online quoting for digital rapid prototyping and 3D printing, such that it can produce a prototype within a few days.

Andy Aiton, President of Technology & Services, commented that Sybridge will now be able to better engage with customers during the product development phase for the electric vehicle life sciences and consumer markets. "With the addition of bridge tooling capabilities, we can now effectively 'bridge' the gap between low and high production volumes," he said.

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New Berlin Plastics expands

Custom injection moulder New Berlin Plastics has signed a lease on a second building two blocks from its existing facility in New Berlin, Wisconsin. This will give the company 100,000 sq ft (9,300 m^2) of additional manufacturing and warehousing space, with 12 loading docks.

This move has been made because of the growth of business and new customers in North America, the firm said. It started investigating options for expansion last year and began by moving material and finished parts inventory to a nearby warehouse.

Adding 45,000 sq ft to the existing building was one possibility but, realising that this would soon be inadequate to meet projected growth, the company sought another site. Fortunately, one on the same industrial park became available.

The first phase of the build-out will be to install racking and warehouse equipment to house the inventory currently being stored offsite. New presses and cranes will follow, with the size range of these machines depending on customers' needs. New Berlin aims to start manufacturing in this new space in about six months' time.

Above: New Berlin Plastics is adding a second building two blocks from its existing facility in Wisconsin

"We plan to use the new facility to mould parts that have low complexity and long production runs. In other words, jobs that require minimal labour," said President Jim Schneberger.

"More complex jobs that require secondary operations and value-added services will stay in our existing facility."

› **www.nbplastics.com**

Plastic Omnium to buy ALS

French Tier One supplier Plastic Omnium has agreed to buy German automotive lighting player Automotive Lighting Systems (ALS) from AMS Osram for an enterprise value of €65m.

ALS brings expertise in lighting technologies, electronics, and software for the development of smart lighting systems.

The company said that this represents an important milestone in its smart bumper and tailgate strategy.

› **www.plasticomnium.com**

TriMas buys medical moulder Intertech Plastic in US

US-based TriMas has acquired Intertech Plastics, a provider of complex, precision injection moulded components, expanding its product portfolio and capabilities for applications in the medical market. Intertech, which had sales of about $32m in 2021, has become part of the TriMas Packaging group.

Intertech has two facilities in Denver, specialising in custom injection moulding with advanced manufacturing capabilities for medical, consumer and industrial applications. One is an ISO 13485-certified facility with a Class 8 controlled environment and MedAccred accreditations, including for highly engineered, tight-tolerance components used in vascular access and *in vitro* diagnostics.

"The addition of Intertech, combined with TriMas' December 2021 acquisition of Omega and our existing presence in pharmaceutical and nutraceutical applications, expands our product offerings into the life sciences market, which we believe has attractive long-term growth characteristics," said President and CEO Thomas Amato.

The other Intertech facility makes products for food, wellness, hospitality and e-commerce logistics applications. The company has also invested in sustainable resin technology, including the use of biopolymers in specific packaging applications.

This is TriMas' sixth acquisition in the packaging market since early 2019 and its second with capabilities and customer approvals in medical technology. As well as Packaging, it has Aerospace and Specialty Products groups.

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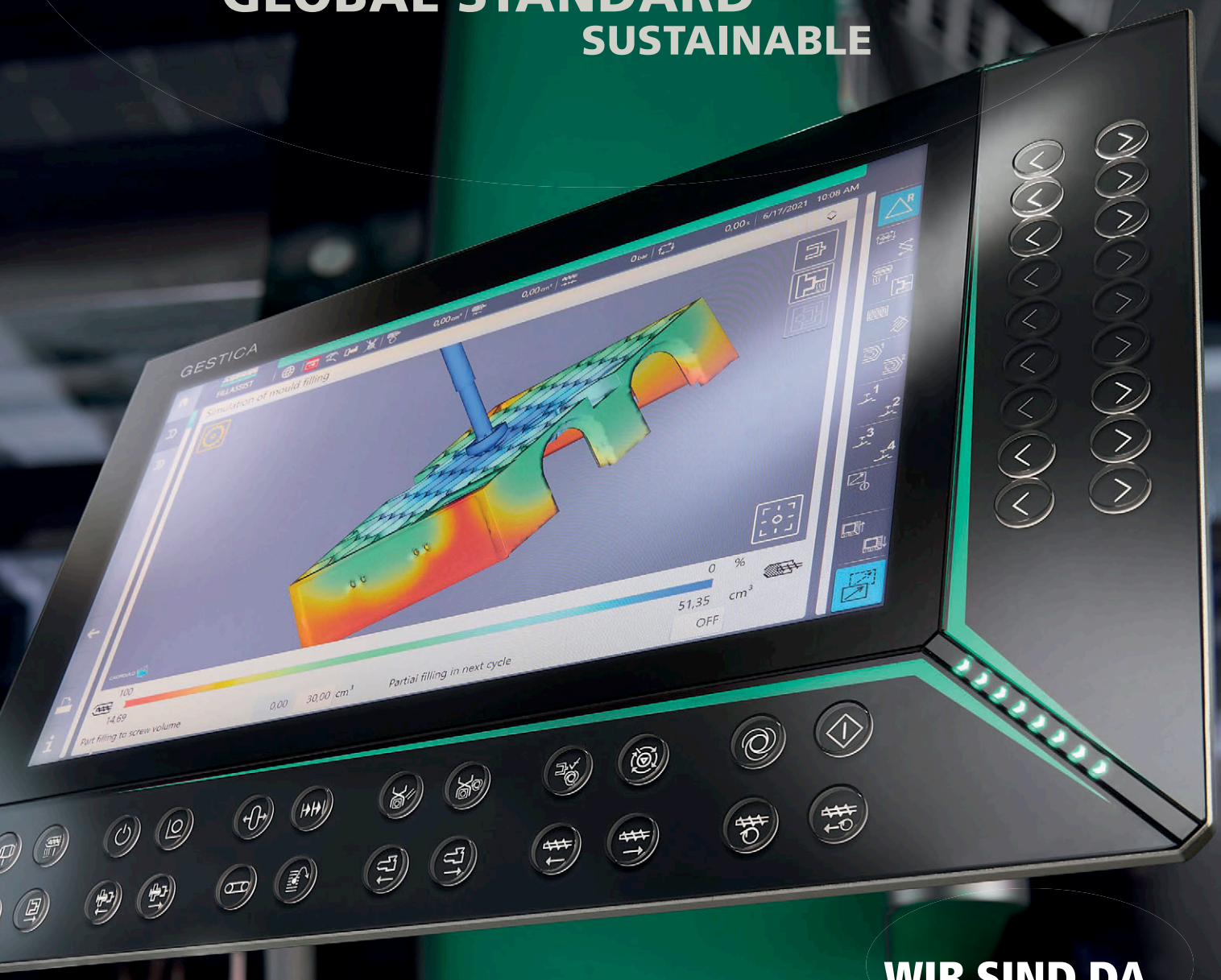

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CurTec expands to US

Netherlands-based CurTec is to open a new 3,000 m² site at the Oconee Industrial & Technology Park in South Carolina in the spring of 2023.

This will be CurTec's first facility outside the Netherlands and will serve as the main production facility for North America.

The Dutch company says there is also scope for future expansion.

According to CEO Bart van Berkel, the firm has seen "a strong increase in demand for high performance packaging by pharmaceutical, speciality chemicals and food ingredients customers in North America". This will strengthen its market position and increase its service level, he added.

› **www.curtec.com**

German converters report 12% sales rise

GKV, the trade organisation that represents German plastics processors, reported a rise of more than 12% in turnover last year.

Despite this, the organisation said that the sector was under heavy pressure from the rising price of both raw materials and energy – and that the outlook for 2022 was "mixed".

GKV said that sales rose to €69.4 billion (US$75.6bn) in 2021, an increase of 12.6% compared to 2020. Nearly 39% of sales (€27 billion, or US$29bn) were from exports – an increase in value of nearly 16%. At the same time, domestic sales rose by nearly 11%, to account for close to €43 billion (US$47bn)

As well as an increase in turnover, processing volumes grew by more than 5% to 15 million tonnes of plastic. Of this, 2.2m tonnes was recyclate – a rise of 10%. In the same period, the industry's workforce declined slightly to around 322,000 people. However, the number of processing plants fell by nearly 4%, to just over 2,900 facilities.

German plastics converting, 2021

	Sales 2021 (bn€)	% Change
Domestic	42.5	+10.7
Export	27.0	+15.7
Total	69.4	+12.6

Source: GKV

Figures are not split into specific processes (such as injection moulding). However, the packaging sector – which is one of the largest plastics markets in Germany – saw close to 7% growth in the amount of material processed (4.7m tonnes). At the same time, turnover in the sector rose by more than 13% to nearly €16.3bn (US$17.7bn).

"Politicians urgently need to reduce government surcharges on energy prices," said Roland Roth, President of GKV.

In a survey of members, GKV said that 2022 is characterised by uncertainty. Just over one-third of members expect to raise profits this year, while just over a quarter expect profits to fall. This was due mainly to a difficulty in passing on higher costs. As a result, a number of companies are thinking about relocating or ending production – and potentially closing operations, said GKV.

› **www.gkv.de**

Hella invests in Austrian moulding site

Hella is investing "several million euros" in a three-level tool storage facility covering 450 m² at the site of its Hella Fahrzeugteile Austria subsidiary in Großpetersdorf, Austria. This has space for up to 60 large jigs and 150 injection moulding machines, as well as an advanced LED lighting system.

Within the same investment, the company is also adding a 600 m² logistics hall for the storage of semi-finished products, bringing the site total to 2,400 m². It is installing special temperature and humidity control, renewing the ventilation and exhaust systems in the existing production and assembly halls, and adding two new injection moulding machines, largely to produce bigger parts in order to meet demand for complete headlamp covers.

Hella Fahrzeugteile Austria subsidiary in Großpetersdorf, Austria

IMAGE: HELLA

This is all scheduled for completion by the end of 2022. Further investments include upgrading the facilities and infrastructure to the latest technology, including Industry 4.0, and a photovoltaic system capable of generating up to 450 kWh at peak.

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Plastics Europe plans measures for transition to circularity

Plastics Europe has released a report written by UK research group Systemiq about the plastics industry's transition to circularity in Europe. It has also proposed measures including "a new and enabling policy framework that better incentivises investment and innovation by fostering a climate of creative competition".

The report, which is called "ReShaping Plastics: Pathways to a Circular, Climate Neutral Plastics System in Europe", was developed by Systemiq with the support of an independent Steering Committee and Expert Panel that included representatives of EU institutions, NGOs, academia and industry. The study's aim was to evaluate current progress and assess the potential of different levers to help transition towards the EU's net zero carbon emissions and circularity goals by 2050.

Plastics Europe said the report "highlights the need for all up- and down-stream levers to be engaged, including mechanical and chemical recycling, the use of alternative raw materials such as bio feedstocks, and designing products for recycling and reuse".

A new and enabling environment for the transition to circularity must make available high-quality feedstock and access to affordable renewable and low carbon energy, it said. The group's plans include:

- Developing a roadmap for Plastics Europe and its members to accelerate the industry's transition towards 2050. This will include interim targets and policy recommendations.
- Ensuring all Plastics Europe policy positions are designed to accelerate the plastics' system's transition towards higher circularity and net zero emissions by 2050. This includes the need for transformation of upstream and downstream GHG reduction and circularity levers.
- Exploring the creation of a new multi-stakeholder platform in 2022, to ensure a step-change in the intensity and effectiveness of dialogue and collaboration with policy makers and the plastics value chain.

› **https://plasticseurope.org**

Free training seminars at US injection moulding exhibition

The speaker line-up has been announced for the Training and Development Theatre at the Injection Molding and Design Expo. The free-to-attend event runs in Detroit, Michigan, USA on May 25-26, 2022. It is being jointly organised by AMI – the publisher of *Injection World* – with Crain Communications – the publisher of *Plastics News*.

The Training and Development Theatre is hosting a series of practical seminars throughout the two days of the expo. These are covering a wide range of themes, including computer modeling, materials selection, factory safety, moulding optimisation, troubleshooting, and business strategies.

"When we first discussed the idea of a focused injection moulding event with the industry, there was widespread demand for educational content to add value for visitors," explained Sean Manson, Senior Conference Manager at AMI. "We have worked with training companies, suppliers and consultancies to put together a program of seminars aimed at employees working throughout moulding operations, from design studios to factory floors to boardrooms."

The first day of the event features presenters from three of the plastics processing industry's leading training providers – Paulson Training Programs, RJG and the American Injection Molding Institute (AIMI).

Todd Bryant, Senior Instructor and Technical Development Director at Paulson, is examining the science behind profitable moulding and providing useful tips for boosting the bottom line. He is followed by Cory Hoeppner, TZERO Project Manager at RJG, who is discussing how to utilise technologies to accelerate tool launches. Jason Travitz, Senior Injection Molding Process Instructor at AIMI, is covering how to utilise knowledge and critical thinking to solve problematic moulding defects.

Another highlight of the first day will be a panel discussion on the all-important issue of factory safety. This will feature five leading experts in global and domestic safety standards discussing how to make the moulding shop a safer place to work. They include: Stan Glover, Director of Technical Sales at Zeiger Industries; Bruce Main, President of Design Safety Engineering; Ted Sberna, Lead Consultant at White Horse Safety; Larry Keller, Director of Engineering at Milacron; and Dale Bartholomew, Technical Manager at JSW America.

Day two of the event opens with a detailed look at material selection for medical devices, from qualification to approval. It will be delivered by Josh Blackmore, Global Healthcare Manager at M. Holland.

Looking at more strategic business issues, Michael Devereux, Partner, and Mark Stevens, Principal, at Wipfli are looking at ways to manage current risks. They are covering supply chain issues, labour shortages and tax policy. In addition, Kathy Kirk, Head of Consulting and Industry Solutions for Consumer and Life Sciences at Bristlecone, is presenting a seminar on harnessing AI and analytics to improve visibility and optimise mould management.

Once again, the industry's leading training providers are well represented on the second day of the event. Daniel Stephens, Vice President at Routsis Training, is addressing the critical issue of reducing changeover times. Jason Travitz of AIMI is returning with a presentation called "Moldflow vs mould floor", while Jacque Gibson, Trainer at RJG, is providing a practical introduction to melt preparation and plasticisation.

The Training and Development Theater is being sponsored by Rainbow Colors, Wipfli and M. Holland. It will run alongside the exhibition featuring more than 120 suppliers plus two conference theatres focusing on Moulding The Future and Designing The Future. You can view the latest programs for all three theatres, check out the list of exhibitors and register for your free ticket to the whole event at the expo website:

› **https://injectionmoldingexpo.com/**

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Techniplas adds new KM system

Techniplas, a maker of plastic components for the automotive and plumbing industries in Treuen, Germany, has put a KraussMaffei MXW 1000 ColorForm system into operation.

This new system will be used for series production of components via injection moulding technology and surface finishing in a single process step.

As well as the injection moulding machine, KraussMaffei supplied the RimStar Flex mixing and metering machine, including mixing heads, which feed the PUR or polyurea surface material directly into the cavity in a second cycle. It has been designed to meet stringent automotive industry requirements of no deviations of more than 0.2 mm on any part of the transparent component.


IMAGE: KRAUSSMAFFEI

At Techniplas, the MXW 1000 ColorForm from KraussMaffei produces premium-quality automotive components

"Not only does the ColorForm technology eliminate the need to transport and paint components, and to invest in a painting plant, the components are also ready for installation as they are discharged from the highly automated production cell," KraussMaffei claimed. "This saves both production time and money for buffer storage and drying of the components."

Techniplas currently has four ColorForm systems in Treuen and another at its site in Rüti, Switzerland. This system has been manufacturing ColorForm parts in series production since 2016.

The in-house technical centre in Treuen operates two more systems and Techniplas has also had the MXW 1000 retrofitted at its main factory in Allach.

› **www.techniplas.com**
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Caps and closures producers and their suppliers have been innovating to keep up with sustainability trends, including mandatory tethering and the growing use of recycled material. By David Eldridge

IMAGE: TETRA PAK

Tethered and recycled: Caps market drivers

Sustainability tops the agenda in the caps sector, just as it does in the wider plastics packaging industry. There is a well-established trend for lightweighting caps and closures, with the benefit of reducing plastics usage and helping brand owners towards their sustainability goals. In the EU, caps producers also need to meet demand for tethered caps as their customers strive to meet the Single Use Plastics (SUP) Directive's 2024 deadline for caps to stay attached to the bottle after opening to prevent them from polluting terrestrial and marine environments. Recycling is another major priority for water and soft drinks brands.

Drinks industry association UNESDA Soft Drinks Europe has made a pledge that all beverage packaging in the EU will be fully circular by 2030. Its commitment relates to primary packaging, corresponding to beverage containers (such as PET bottles), caps and labels. The industry's intent was clear in UNESDA's announcement of the circularity commitment last year: "Our goal is that beverage packaging achieves full circularity and is recognised as a resource in a circular economy: it has value, is recyclable, is collected and used as recycled content," said Ian Ellington, UNESDA President and SVP and Chief Category Officer, PepsiCo Europe.

Companies in the caps value chain have been busy developing tethering solutions since the SUP Directive was introduced by the European Commission in June 2019. "There are a variety of tethering solutions on the market," says Michael White, Director of Business Development Closures at **Husky Technologies**, which supplies cap moulding machines and has developed tethered cap designs in response to the SUP Directive. "We believe that the Husky solution is the best way forward as it offers an intuitive operational approach. The shell is locked in place 180° out of the way to provide easy drinking/pouring."

Husky has designed its PCO1881 portfolio tethered closure for CSD bottles to open to 180° while remaining attached to the bottle. The group's 30/25 portfolio tethered closure is for still water applications with shell locking capability at 160°. These caps have a moulded bridge with a hinge design that provides tactile and audible feedback so the consumer knows when the closure is in the locked position. The caps fully unscrew from the neck of the bottle and behave like any flip-top closure but with the added benefit of locking capability. A more basic alternative uses a slit approach in which the thether is created by simple

Main image: French dairy brand Elle & Vire is using the Tetra Pak HeliCap 23 cap for its cream products

IMAGE: TETRA PAK

Above: Tetra Pak is investing €100m at its Châteaubriant plant in France for the transition to tethered caps

scoring of the closure with a heated blade, after moulding. The advantages of the moulded-in bridge approach include greater design flexibility, no need for a secondary manufacturing step good part-to-part consistency and quality.

White says: "We expect that SUP legislation, similar to what was passed in Europe, will be adopted in other jurisdictions. Adoption of the tethered closure legislation is highly likely in other local, regional, and national jurisdictions."

Husky also expects neck light weighting developments to continue as the industry further emphasises sustainability efforts. This trend will require new complementary closure designs, it says. Other caps trends it expects to see are increased closure barrier properties to improve shelf life and new material types to enhance specific material recycling efforts.

Major packaging companies and caps producers have been gearing themselves up in response to the drive for greater sustainability. Carton packaging giant **Tetra Pak** announced in 2021 a €100m project to expand its Châteaubriant plant in France, which will increase its production capacity to enable the transition to tethered caps by 2024. The group said this will ensure Tetra Pak's customers in Europe will be ready to comply with the SUP Directive's deadline to switch to tethered caps.

Charles Brand, President of Tetra Pak Europe & Central Asia, says: "We are particularly proud of this investment project, which demonstrates how we consistently strive to provide customers with sustainable innovations and meet the rapidly changing demands of regulators and society. High-performance food packaging plays a critical role in feeding the world, but it must do so sustainably, so that food availability does not come at the cost of the planet."

Tetra Pak calls the Châteaubriant plant a "key manufacturing facility" as it has annual production capacity of approximately 5bn caps and it supplies food and beverage manufacturers globally. Before expansion, the site covers an area of more than 30,000 m² and has 19 machines that produce six types of caps. The facility is equipped to produce additional materials that have recycled plastic content.

The first phase of the €100m investment project started in late 2021. Tetra Pak is expanding the Châteaubriant site to allow a 30% increase in manufacturing capacity through the installation of ten new machines dedicated to the production of tethered caps. In the second phase between 2022 and 2023, approximately 50% of the existing machines will be replaced, to expand the quantity of tethered caps it produces.

Tetra Pak has made a commitment to invest approximately €100m per year over the next five to ten years to develop more sustainable packaging solutions. "This includes alternatives to replace fossil-based plastics and avoid littering, as well as maximising the use of renewable, responsibly sourced materials in our packages," says Lars Holmquist, Executive Vice President Packaging Solutions and Commercial Operations at Tetra Pak. "Addressing people's needs for recycling is a critical component for not only becoming more sustainable but making food more available and safer for all consumers."

He described the scale of the transformation that is necessary to move to tethered caps. "The significant challenge of deploying tethered caps is the scale of the change that this brings across the value chain. If we look at Europe alone, more than 1,000 packaging lines supplied by us will be potentially transformed, translating into over 20bn packages which are expected to be converted. All of that in three years, while minimising impact on our customers' operations, optimising the consumer experience and contributing to both minimising litter and creating a carton package with increased plant-based and recycled content."

Right: Tetra Pak's HeliCap 26 tethered cap

IMAGE: TETRA PAK

Tetra Pak says it is working across various project streams, which include approximately 40 different packages with tethered caps. These caps are all planned to become available as a plant-

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based option. The first one to be released on the market is the HeliCap 26 Pro closure, which features a new screw and flip concept with a self-locking hinge. According to the company, "Its opening and closing mechanism has proven popular with consumers, demonstrating that the solution is delivering further benefits in addition to meeting legislative requirements."

Sustainable materials are another major area of development for Tetra Pak. As well as using bio-based polymers in its carton and caps, the group is embracing recycled plastics. It has introduced recycled polyethylene in the caps, tops and/or coatings of its packaging, with the first batches from Ineos which is using chemical recycling technology from Plastic Energy. These materials are certified by the Roundtable on Sustainable Biomaterials (RSB).

Alejandro Cabal, Vice President Packaging Solutions, Tetra Pak, says: "Being the first in our sector to be awarded the RSB Advanced Products certification represents yet another milestone in our journey towards the world's most sustainable food package: a carton that is fully made from renewable or recycled materials, is convenient and safe – hence enabling a resilient food system – is fully recyclable and carbon-neutral. Qualifying and providing assurance of mass balance claims is critical to ensure transparency and accountability within the system, therefore enhancing confidence from the end-user perspective."

He says: "There is a long way to go before plant-based and recycled polymers become mainstream. We are working with partners to further explore sustainable polymers, while we continue to assess the use of alternative plant-based products and recycled fibre-based materials. Our long-term ambition is clear, for all our packaging to use renewable or recycled polymers, ending the extraction of fossil feedstock. Coordinated action and advocacy by multiple companies and other actors is required to support the transition to a low carbon circular economy."

The first fruits of Tetra Pak's developments have started to appear in the caps market. France-based dairy brand Elle & Vire (a subsidiary of Savencia Fromage & Dairy) is using the HeliCap 23 cap for its cream products, which are distributed in Tetra Brik Aseptic 1L Slim carton packages. The one-step resealable screwcap is manufactured at the


IMAGE: RIEKE

Right: Rieke's Linfa dispensing pump is made from up to 50% post-consumer recycled plastics

Châteaubriant plant with recycled content (using mass balance methodology).

Marco Marchetti, VP Packaging Materials, Sales & Distribution Solutions at Tetra Pak, says: "As a signatory of the Ellen MacArthur New Plastics Economy Global Commitment, Tetra Pak has pledged to incorporate a minimum of 10% recycled plastic content on average across carton packages sold in Europe by 2025. Having listened to Elle & Vire's demands and activated our ecosystem of innovative partners, such as Ineos and RSB, who are helping us to move away from virgin, fossil-based resources, we are now one step closer to reaching this goal."

TriMas Packaging's caps and closures businesses have been active in the area of sustainability, as shown in their new products. **Affaba & Ferrari**, which was acquired by TriMas in 2020, has developed tethered caps for still water, carbonated soft drinks (CSD) and juices at its base in Borgo San Giovanni, Italy. These feature a new screw and flip concept with a self-locking hinge. The two-piece closure is designed for bottles with the lightweight 26/22 neck finish, which leads to a 36% reduction in cap/neck finish weight. The closure is injection moulded in PP (shell) and HDPE (inner spout).

TriMas says Affaba & Ferrari "has decades of expertise and extensive experience in this field, regardless of EU requirements". Howard Manning, VP Closure Product Division, says: "Our customers need to be aware of the possible measures they need to adopt and investments they need to make at an early stage, in order to implement against the regulatory backdrop."

Rieke Packaging, the TriMas specialist in dispensing closures, has been adopting post-consumer recycled plastics in its products. It says: "We understand that our customers have ambitious sustainable commitments such as '30% of post-consumer recycled content target across all plastic packaging by 2025' or 'Use 100% of re-usable, recyclable or compostable packaging by 2030'." Rieke says it has "taken a huge step into applying PCR to our dispensing pumps".

One example is the company's new Linfa dispensing pump which is made from up to 50% PCR, which it says reduces the carbon footprint, while maintaining optimal performance and keeps the packaged product's integrity with its no metal contact design. Rieke has also integrated up to 50% PCR in its new Push Pull 01 closure, which is intended for packaging dishwasher detergents or other cleaning products.

Another leading dispenser manufacturer, **Aptar**, is also exploring the use of recycled material. The group says it "believes that the packaging industry must move beyond the 'make, use, dispose' behaviours of the past and actively work toward a circular economy. By circulating used plastic and packaging, we keep it in the economy and out of the environment. Therefore, Aptar works to reduce the quantity of plastic needed, use recycled materials, partner with recyclers, and develop reuse models."

Since 2019, Aptar has been involved in a collaboration project with PureCycle Technologies in the US, which is using a patented purification technology from P&G to develop a PP recycling process. The partners are working to determine the right material combination to create hinged closures for food, beverage, and cosmetics applications. Aptar says that, recently, it converted prototype material from the PureCycle Feedstock Evaluation Unit into multiple colours of hinged closures with performances similar to conventional plastics. Aptar will have access to commercial production from PureCycle's first site as well as from its future facilities that it may build outside the US.

Right: Aptar is testing recycled PP material from PureCycle Technologies in caps

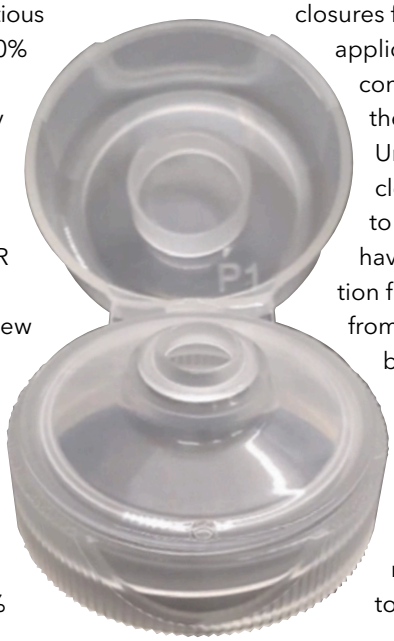

IMAGE: APTAR

In January, major plastics packaging group **Berry Global** announced its new B Circular Range of products which it is developing as part of its commitment to increase circular materials to 30% by the year 2030. The B

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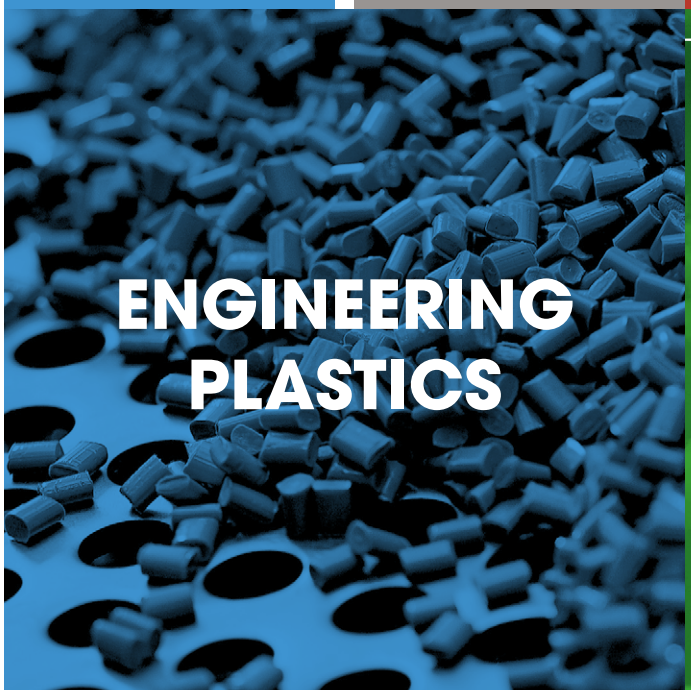

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IMAGE: BERRY GLOBAL

Above: Berry Global's plastics recycling facility in Heanor, UK, has opened a Centre of Excellence

Circular designation is being applied to Berry's bottles, tubes and closures. It says a wide selection of closures made with PCR is available for packaging in the food, beauty and personal care, beverage and home care industries. Closures are available with up to 100% recycled PP and are available in a variety of colours, says the group.

Berry's plastics recycling facility in Heanor, UK, has opened a Centre of Excellence to further enhance the level of quality evaluation of the recycled material that is used to produce the company's Sustane recycled polymer. The new laboratory facility, which complements Berry's existing testing capabilities, analyses the material composition of incoming scrap material, resulting in a higher quality of recyclate for use in the manufacture of second life products.

The group's expansion into recycled materials was confirmed last year by the start of work on a new recycling facility in Leamington Spa, UK, working towards certified FDA recycled PP for use in packaging. "This highly innovative facility will pave the way for the future of rPP packaging using automated sorting processes, integrating online sensor technologies and machine learning algorithms to separate PP containers, tubs, and trays with high accuracy."

The team at Berry has conducted an initial lifecycle assessment quantifying the benefits of its proposed rPP process over the use of virgin PP. The material produced using its CleanStream recycling process has an 80% lower CO2 footprint than virgin resin. Packaging produced from this rPP material will be 35% lower in CO2 emissions and require 50% less water consumption.

Chemical recycling is another route that caps producers can take with materials. **Guala Closures** has worked with polyolefins producer **SABIC** to produce a cap for Ella's Kitchen, a UK baby food brand. Ella's Kitchen is the first company in the baby food category to use certified circular polymers from SABIC's Trucircle portfolio of products that have recycled polymer content from a chemical recycling process. SABIC says this approach enables production of materials for high-quality, food-grade packaging which can then be recycled again many times.

Stefano Manfredi, Global Sales and Marketing Director at Guala, says: "We are delighted to be part of this innovative journey together with our customer and supplier as we have the ambition to offer the largest portfolio of sustainable solutions."

In December 2021, Guala said it had received ISCC Plus certification from Bureau Veritas. This certification covers all closures produced at its Spinetta Marengo site in Italy, according to a mass balance approach, as long as they contain a part manufactured with ISCC Plus certified plastics declared in an audit report.

Injection moulding machinery suppliers are also playing their part in the circularity drive for caps, facilitating the use of recycled content by caps moulders through their innovations. **Engel** highlights the benefits of its iQ Weight Control function, which deals with fluctuations in the ambient conditions and raw material that can change the flow properties of the plastic melt during injection and can impact on the quality of the moulded parts. The company says: "As the use of recycled materials grows in the packaging industry, smart process assistance is becoming increasingly important. Recycled materials typically mean greater batch variations than virgin material. Using iQ Weight Control means that recycled materials can be used in a very cost-effective way for demanding packaging products."

To demonstrate iQ Weight Control in high-performance applications, Engel carried out tests using a 380-tonne E-cap injection moulding machine with a 96-cavity mould for 29/25 caps for still water from Plastisud. MB7541 HDPE from Borealis with an MFI of 12 was processed. The part weight

IMAGE: SABIC

Right: Guala Closures uses chemically recycled material from SABIC to produce a cap for UK baby food brand Ella's Kitchen

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IMAGE: ENGEL

Above: Engel developed the all-electric E-cap machine series specifically for caps and closures production

was 1.25 g, resulting in a total shot weight of 120 g. The cycle time of this application is less than 2 s with an injection time of less than 0.3 s.

In the tests, targeted process changes were introduced, among other things by changing the raw material batch several times. The changes resulted in the production of caps outside the tolerance range. Engel says: "The injected melt volume, for example, exhibited deviations of up to 1.5 cm³ from the reference value. With iQ Weight Control activated, it corresponded to the reference value again. This meant that good parts could be produced from the first shot after the batch change. In addition, the process stability was improved by 66%."

Arburg developed its Allrounder Cube machines for high-volume production in the packaging sector using a cube mould, in which four sides of the mould can be used to increase the number of cavities without affecting the cycle time. In July last year, it launched its 180-tonne Allrounder Cube machine, illustrating its capabilities using the example of a two-component sealing cap for personal care packaging.

In this application, the new Allrounder Cube 1800 machine produces four bichrome sealing caps made from chemically recycled PP from Borealis in a 4-cavity pilot mould from Foboha in a cycle time of 8.7 s. Describing the process, Arburg says: "Four frames each weighing 0.85 g are injected at station one. Having been rotated 90 degrees onto the passive side of the cube, the pre-moulded parts are cooled at station two. Following a second rotation, the second component (2.10 g) is injected at station three. Finally, the finished parts are removed automatically at station four, also without influencing the cycle time."

A six-axis robot which is fully integrated in the machine controller sets the finished parts down on a conveyor belt. The controller runs a check for any defective injection moulded parts which are then removed by the robot system. Arburg says that test samples can be removed at the touch of a button and set down in QA trays sorted by cube side for visual inspection of the parts.

The hybrid Allrounder Cube 1800 has a clamping force of 1,800 kN and a distance between tie-bars of 570 x 570 mm. It can be equipped with horizontal injection units in sizes from 400 to 1300 and moving injection units in sizes from 70 to 800. The cube mould from Foboha is easily accessible from above. The rotation of the cube is powered servo-electrically and the horizontal movement relies on rack and pinion mechanisms.

Arburg says that when fitted with an 8+8-cavity mould, the Allrounder Cube 1800 is capable of more than double the output quantity of a conventional size 570 Allrounder with a 4+4-cavity rotary mould working with the same mould mounting surface. Alternatively, it has the same output as at least two Allrounders with comparable tie-bar spacing or one injection moulding machine three numbers larger.

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IMAGE: SHUTTERSTOCK

Widespread adoption of recycled compounds in injection moulding requires input and expertise from a wide range of companies in the value chain. Mark Holmes reports on progress

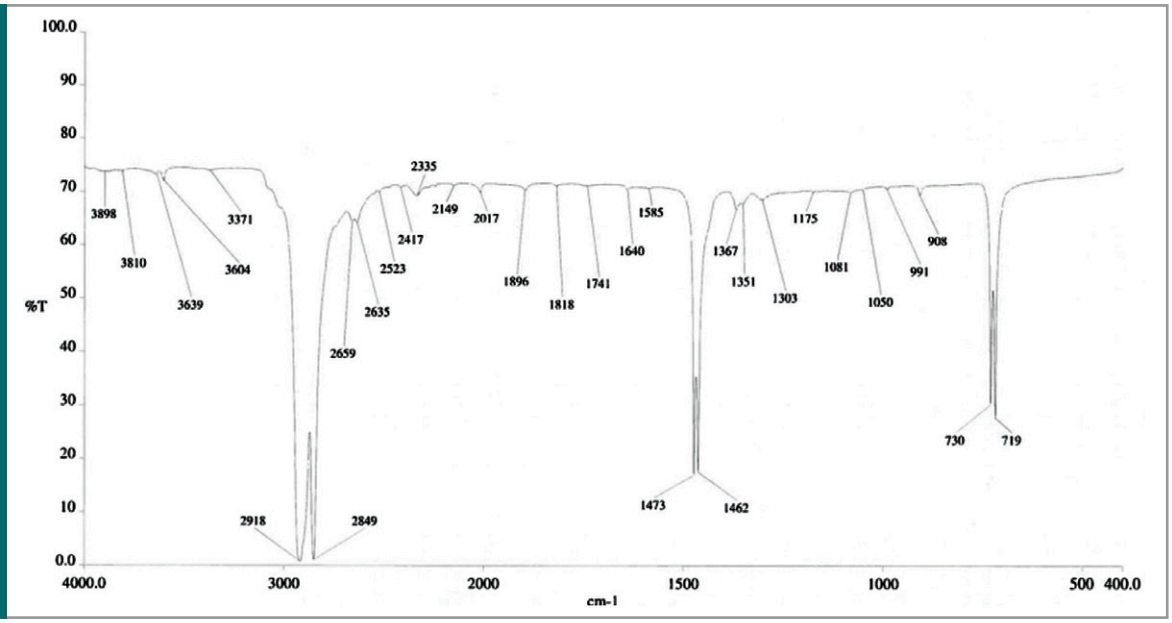
Suppliers boost recycled material offerings

Closing the cycle within the circular economy, as well as meeting sustainability goals for injection moulders and their customers and brand owners, relies heavily on the development and use of recycled plastic compounds. Recycling technologies include widespread mechanical recycling techniques, as well as solvent-based processes, while the development of chemical recycling continues to gain interest. Mechanical recycling of plastics is the most common form of recycling technology currently in use. It is widely used for post-consumer and post-industrial thermoplastics, such as PP, PE, or PET.

In general terms, PE, PP and polyolefin mixes make up the largest proportion of a post-consumer flexible packaging waste stream (PET is a separate waste stream), for example, and the current preference is for mono-PE and mono-PP materials for recycled process development. This makes it easier to recycle and contributes to improving the quality of recycled materials, and so retaining as much value in recycled materials as possible. The potential variation of materials can also significantly impact the quality of the recyclable plastic waste, and manual separation is typically required to help reduce impurities in the final products. Other polymers that might be found in recycling feedstocks include PET, PVC, and PA, which also have challenges. In addition, the material in use, coatings, colour, additives, ink coverage and the type of recycling process can all affect the quality, functional performance, and appearance of recyclate.

A major challenge in the industry is accurate determination of whether recycled materials can be used in typical plastics processing, such as injection moulding. International testing organisation **Intertek** has devised a materials evaluation programme to meet this demand. Marc Triepels, Application Specialist Polymers, Intertek Polychemlab, says frequent monitoring of materials through a structured evaluation programme can add value

Main image: More and more injection moulders are using materials containing recycled plastics



FTIR analysis of recycled material: the spectra suggest that the material is dominated by PE

Source: Intertek

to products and processes. Data mining and Statistical Process Control (SPC) helps to ensure the quality of production, processes and increases productivity. Furthermore, the insight that can be obtained from SPC can help to standardise processes, minimise waste and help optimise the recycled material value. It is important in any evaluation programme that methods are validated against the set criteria for reproducibility and repeatability (independent of user) and the SPC data builds as performance tests are repeated. The insight from a materials evaluation programme benefits all stakeholders from waste collectors, sorters and recyclers, materials producers, and converters through to brand owners and retailers.

Triepels says a typical approach to materials evaluation which is applicable to both virgin and recycled materials, includes initial characterisation through a small selection of analytical techniques to provide insight into the materials involved. This is followed by a processing step involving common methods – injection moulding, cast film extrusion and blow film extrusion – followed by a range of tests to determine physical and mechanical properties. This approach can be applied to the recycled material only or on mixes of recycled and virgin materials.

For initial characterisation and a first step towards understanding the nature of recycled material, Triepels adds that a set of analytical techniques including FTIR Spectroscopy, and thermal analysis such as Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA), can be conducted. These tests help to identify the main polymer present and provide an indication of potential challenges that the material presents, as well as help indicate which processing options could work.

FTIR provides a rapid means of achieving a chemical "fingerprint" of the bulk material. The speed and chemical information provided are ideal for monitoring the major polymer present and can be used to compare batches of recycled materials. The spectra peaks are attributed to the vibrational behaviour of different functional groups within the polymer/additive formulation (see chart above).

In thermal analysis, melting points obtained by DSC techniques can be used to confirm the FTIR spectra suggestions and TGA techniques provide more information about the moisture content, as well as additives present in the compound, such as carbon black and minerals like calcium carbonate and talc.

Common processing approaches are used to produce test materials for evaluation of physical properties. The behaviour of these materials during these processes can contribute valuable information on how stable the process is for the uniformity and quality of the extruded material, and assessment of impurities can be made through a melt extrusion filtration test, says Triepels.

The processed materials are then subjected to a range of tests to determine their physical, thermal, and mechanical properties, following conditioning. ISO 291:2008 sets out specifications relating to the conditioning and testing of all plastics and all types of test specimen at constant atmospheric conditions. Conditioning brings the material into equilibrium with normal room conditions, and this enables more reproducible results that allow a better understanding of a material's performance. Typical conditions include 23°C ± 2°C and 50% ± 10% relative humidity for over 16 hours. Standardised tests that can be included in a materials

evaluation programme include odour/volatiles, ash, density, melt flow rate, Charpy impact, tensile and flexural property testing. Testing flow properties gives a good understanding of the processing behaviour of recycled materials. The response of different batches and blends can be checked with a basic melt flow rate (MFR/MVR) determination by utilising melt flow testers. Unknown and mixed materials, like those involved in recycling, require a variety of testing conditions, including several different test masses.

A wide range of materials suppliers are now offering injection moulding compounds which incorporate mechanically recycled plastics. Large polymer producers are also using chemically recycled waste in new versions of their existing materials that are then certified as having a percentage of recycled plastics, calculated using a mass balance approach.

Automotive compounds

Ford Motor Co is using Akulon RePurposed recycled ocean plastic from **DSM Engineering Materials** in the Ford Bronco Sport. Ford uses wiring harness clips made of ocean-harvested plastic "ghost gear" in Bronco Sport models. The wiring harness clips fasten to the sides of the Bronco Sport second-row seats and guide wires that power various features in the vehicle's cargo area. Ford testing shows that the Akulon RePurposed material, despite having spent time in salt water and sunlight, is as strong and durable as petroleum-based plastic clips. The Akulon RePurposed material is made using nylon fishing nets collected from the Indian Ocean and Arabian Sea. The nets are thoroughly cleaned and processed using a proprietary process to create a strong PA6 engineering material with performance comparable to new petroleum-based plastics. The material is also used in a wide range of applications including furniture, watches and surf boards.

Above: Wiring harness clip for the 2022 Ford Bronco Sport made with DSM Akulon RePurposed recycled ocean plastic PA6

RadiciGroup has launched the Renycle range of engineering polymers which contain recyclate. The Renycle PA6 and PA66 products include a variable percentage of post-industrial and post-consumer recycled polymers, which are the result of careful selection from incoming raw materials and advanced mechanical characterisation. The company says that Renycle products are suitable for applications in all RadiciGroup High Performance Polymers' target markets, including automotive, e-mobility, electrical/electronics, industrial and consumer goods. In the new range, there is also a glass-fibre-filled flame retardant product that is halogen- and red phosphorus-free and a material resistant to engine cooling fluid for the automotive sector.

Repsol has added new products to its Reciclex range of recycled polyolefins, including four polymers for the automotive industry and three new circular PP grades for non-food containers, incorporating up to 80% recycled plastic content. The four new automotive materials are designed for vehicle lighting systems, hidden interior parts, and under-the-hood parts with strict mechanical stress resistance requirements. Repsol says that it uses post-consumer plastics to manufacture these materials, offering quality consistency for its products to meet

Above: Lanxess has introduced Durethan Blue BKV60H2.0EF

the high technical requirements required in this sector. In addition, a further three injection grades have been added to the Repsol Reciclex range of non-food packaging, incorporating between 50-80% recycled plastic content. These three new grades are especially suitable for household cleaning and drugstore product containers with chemical resistance requirements and paint containers with good mechanical resistance to enable stacking, among other properties.

Lanxess has introduced Durethan BlueBKV60H2.0EF, with 92% of the raw materials used in this easy-flowing compound replaced with sustainable alternatives. The company says that the new grade is the first product from the Scopeblue series. The brand label identifies products that either consist of at least 50% circular (recycled or bio-based) raw materials, or whose carbon footprint is at least 50% lower than that of conventional products.

One of the raw materials used in the production of this PA6-based high-performance compound is cyclohexane from sustainable sources – meaning cyclohexane that is either bio-based, recycled bio-based or produced by means of chemical recycling. The material is also strengthened with 60%-by-weight of glass fibres comprising industrial glass waste instead of mineral raw materials. The alternative raw materials that Lanxess uses in the precursors for PA6 are chemically identical to their equivalents of fossil origin (drop-in solutions), so Durethan BlueBKV60H2.0EF exhibits the same characteristics as the virgin material and can be processed just as easily using exactly the same production tools and facilities with no conversion work needed. Lanxess adds that the compound can be used for the production of car front ends, brake pedals and oil pans, for example. The company is currently working towards 100% sustainable raw materials in this compound.

With Durethan EcoBKV30H2.0, EcoBKV35H2.0 and EcoBKV60XF, Lanxess has introduced three PA6 compounds containing 30, 35 and 60%-by-weight respectively of recycled fibre made from glass waste as calculated using the ISCC Plus-certified mass balance method. This product family has been extended to include even more compounds based on PA6 and PA66. Lanxess is also using the recycled glass fibres for the mechanical reinforcement of its Pocan PBT compounds. Early products include Pocan EcoB3235 and the flame-retardant EcoB4239, each of which contain 30% by weight of recycled glass fibres, as calculated using the certified mass balance method.

Eurotec has developed Tecomid Eco, technical recycled PA compounds produced from industrial textile fibre waste, with partially or 100% recycled PA polymer content. Eurotec says that its PA recycling formulation, testing and processing, provides reliable and traceable material solutions using characterisation, viscosity, mechanical and thermal tests. Tecomid Eco displays similar test performance to that of virgin materials. Its main characteristics are high thermal stability, good stiffness and tensile strength, as well as good chemical resistance and reduced environmental impact. The company says that Tecomid Eco grades are suitable for a range of industries such as automotive, electrical and electronics, sports and leisure, industrial and home appliances.

Tecomid Eco NB and Tecomid Eco NA are available in various grades with up to 60% glass or carbon fibre content, and flame retardant grades are also available. For example, Tecomid Eco NA43 GR30 BK005 HS exhibits good thermal, chemical and long-term mechanical properties and it is safely used for pedal housing, cooling fan housing, air intake manifold, oil pans and engine cover automotive applications. Tecomid Eco NA43 GR25 NL (BK002) XA43, which is a PA66, 25% glass fibre reinforced, heat stabilised and flame retardant compound, graded V-0 at 1.6mm, exhibits good mechanical properties. It is used in switches and oven lights for household applications. Finally, due to high mechanical and UV stability performance, Tecomid Eco NB40 GR30 BK009 provides solutions to metal replacement in guardrails for a safe working environment.

The company has also developed Tecotek Eco, Tecopet Eco and Tecodur Eco, which are technical recycled PC, blends of PBT and recycled PET, and recycled PET compounds respectively. The 10% glass fibre reinforced material with halogenated flame retardant properties, Tecotek Eco PC44 GR10 GR003 ZG70, is used in electricity meter housings. It is graded V-0 at 1.6 mm according to UL94, with good dimensional stability. Tecopet Eco PT74

GR20 BK002 DA offers high stability and low moisture absorption properties, and is used in heating, ventilation and air conditioning components. Tecodur Eco grades feature a blend of PBT and recycled PET that meet requirements for lighting applications due to their good thermal stability proven in the automotive industry. In addition, Tecomid NA40 CF30 BK111 HS is a black PA66 compound that is 30% reinforced with recycled carbon fibre and is heat stabilised, which provides a tensile strength of 225 MPa and a tensile modulus of 18,000 MPa.

Elix Polymers has launched the E-Loop brand to highlight new sustainable innovations. One of the first product introductions in the mechanical recycled materials group is E-Loop H801 MR, a countertype of the standard high heat and high impact grade Elix ABS H801. This new grade has been formulated using post-industrial recycled PC as reinforcement to the ABS prime resin. This material is commercially available and is mainly used for exterior and interior painted automotive applications. However, it can also be used as a pre-coloured alternative. The paintability of the new E-Loop H801 MR grade has been validated by several tier companies and paint suppliers. Tests based on the Daimler DBL 5425 and BMW GS94007 standards have been carried out to verify the paintability of the plastic substrate using several paint systems. The performance shown in all cases is equivalent to the standard alternative, including adhesion and surface quality characteristics.

In addition, the PVD metallisation decorative process was validated by one of the largest companies in the production of lighting systems for the automotive industry with good results. Paint and PVD metallisation validation tests are part of the high-quality requirements that Elix Polymers is applying to the development of upcycling mechanically recycled materials with less restrictions of use in high performance parts, which also includes emission tests or extensive and high-quality characterisation levels for mould-filling simulation software.

LyondellBasell has extended its Circulen range of sustainable compounds to its Advanced Polymer Solutions (APS) segment. LyondellBasell's Circulen portfolio of compounds and solutions is derived from mechanical and chemically recycled and renewable-based materials for its customers in areas such as automotive and household appliances. The APS segment produces and markets compounds and solutions, such as PP compounds, engineered plastics, masterbatches, colours and powders, engineered composites and advanced polymers, including Catalloy and polybutene-1.

IMAGE: LYONDELLBASELL

Above: CirculenRenew polymers from LyondellBasell are now being used to make coffee capsules for Nestlé's Nescafé Dolce Gusto

The company is now manufacturing PP and PE on a commercial scale with measurable and certified C14 renewable content (mass balance) from renewable feedstock. The renewable feedstock – CirculenRenew – is supplied by Neste and is 100% produced from bio-based waste and residues, such as used cooking oils. The renewable content in this grade of CirculenRenew is measured by a third party to ensure that the C14 content of the polymer is consistent with renewable feedstocks and stated as a parameter on the Certificate of Analysis (CoA). Furthermore, these new CirculenRenew grades are drop-in solutions and therefore do not require any modification of existing processing equipment. With the support of Greiner Packaging, CirculenRenew polymers are now being used to make coffee capsules for Nestlé's Nescafé Dolce Gusto, meeting the strict requirements of the food industry. Both LyondellBasell and Greiner Packaging sites involved are ISCC PLUS certified.

SABIC has launched the first automotive grades containing mechanically recycled content within the company's Trucircle portfolio. The new resins are: SABIC T2E-3320EH PP compound, a high-flow, low-emission, talc-filled PP; Xenoy T2NX2500UV resin, an unfilled, UV-stabilised blend of PC and PET; and Xenoy T2NX5230 resin, a mineral-filled PC/PET blend. All three materials contain up to 29% recycled content and offer good performance similar to that of the incumbent virgin resins. The new products are the first of many SABIC

IMAGE: SABIC

Left: The Microsoft Ocean Plastic Mouse has an exterior shell containing 20% recycled ocean plastic from SABIC

resins to be introduced with mechanically recycled content for potential use in interior and exterior automotive applications. They also may complement other types of sustainable materials, such as certified renewable products from bio-based content, which are also being developed.

SABIC T2E-3320EH PP compound features stiffness, low emissions and high heat resistance for non-visible heating/ventilation/air conditioning (HVAC) components within the instrument panel and interior and under-the-hood parts. Xenoy T2NX2500UV resin contains 21% recycled PET. It provides good heat and impact performance, dimensional stability and low shrinkage for painted exterior body panels, spoilers, fuel filler doors and trim. It is also UV stabilised for potential use in unpainted applications. Xenoy T2NX5230 resin contains 16% mineral reinforcement and 29% recycled PET. It is also a potential solution for painted body panels, trim and other components. The product's reinforcement delivers higher stiffness and a lower coefficient of linear thermal expansion (CLTE) compared to Xenoy T2NX-2500UV resin, making Xenoy T2NX5230 resin a good candidate for roof spoilers and exterior trim. Both Xenoy grades offer high flow for improved throughput, says the company.

SABIC has also launched a certified circular PC resin and blends made from the upcycling of post-consumer mixed plastic. According to an internal SABIC LCA study, the certified circular PC offers a potential carbon footprint reduction up to 23% in comparison to its incumbent. The PC Lexan resins are suitable for applications in E&E, automotive, healthcare and consumer goods.

The company is also collaborating on the Microsoft Ocean Plastic Mouse, with an exterior shell containing 20% recycled ocean plastic, which is defined as plastic that has been certified by a third party as recovered from any ocean or ocean-feeding waterways or where it washed ashore from these locations.

Packaging and more

Borealis and Reclay Group have joined forces to satisfy increasing market demand for the supply of recyclate material for use in high-end plastic applications. The partnership will optimise the recycling value chain, starting with Germany, one of the largest European recycling markets. The new agreement provides Borealis with access to a secure and steady supply of feedstock in the form of lightweight packaging waste collected by Reclay's Extended Producer Responsibility scheme in Germany. The plastic packaging waste is then processed at Borealis' own recycling plants, extending the range of applications for which recycled plastics can be used.

Borealis has also partnered with Swiss dairy company Emmi and Greiner Packaging to create the first chemically recycled PP ready-to-drink iced coffee cups. Chemical recycling renews plastic to form recycled materials with a level of purity equivalent to fossil-fuel based PP, for protective, food-safe and other demanding applications. In this way, Emmi is utilising difficult to recycle

Recycled PVC compounds for shoe soles

In recent months, European compounder Benvic has been integrating a number of recycling competencies in-house, mainly via its subsidiary Ereplast which it acquired in 2019 and, in particular, relating to the company's core expertise in PVC and PVC compounds. When Benvic integrated a range of TPE compounds into the company during 2021 it gained a foothold in the market for shoe soles which is also a significant consumer of PVC – the soles of which are processed by injection moulding.

Benvic says PVC recyclate is currently better valued than 100% virgin PVC and so commercial factors make injection moulded shoe soles in PVC containing recyclate more economically viable. "However, technical constraints can appear," the company says. "The choice of colours, for example, is highly dependent on the types of incoming recyclate. Indeed, light colours can only be addressed with transparent recycled products, which also has an impact on the design of the shoe as well as on the availability. Fortunately, Benvic is in a position to propose and create solutions across the colour spectrum."

Benvic says it is developing new materials with higher added value, and this requires an exacting tailor-made approach for customers, both for the recycling and formulation part. This is a new challenge because it concerns PVC recyclates that are intended for injection moulding and not for extrusion.

The company says it is helping create a truly circular economy by directly engaging with the producers of footwear. For example, it is part of a circularity scheme which allows the company to treat the used soles after collection, in order to produce a new compound, either resold to the producer or sold into the market. Other circularity schemes are also being developed for multi-product partners, allowing the recycling of flexible PVC from other returned products into shoe soles.

IMAGE: RAAN GMBH

Left: A partnership with Reclay secures plastic waste for Borealis to convert and revalorise in high quality recyclate materials

feedstock and depending on the availability of suitable material, the amount of recycled plastic in the packaging is to be further increased in the future. The technology to recover the PP is currently still in its infancy and only limited quantities of chemically recycled PP are currently available. The chemically recycled PP used in the cup is manufactured with Borealis' Borcycle C range of chemical recycling solutions.

Avient is supplying BIC with reSound R recycled-content TPE for a new sustainable women's razor, providing a soft, grippy feel that is highly colourable. The high performance TPE has a recycled content of 62%. By combining reSound R TPE with a transparent plastic that also has recycled content, the BIC Soleil Click 5 handle reaches over 40% recycled content in total.

Avient adds that it is able to increase the overall percentage of recycled content in additional reSound R grades to over 80% at performance comparable to prime grades. These grades can replace traditional TPEs in personal care, lawn and garden, outdoor high performance, footwear, office supplies, houseware durables, and automotive applications.

Avient has also made Complēt R long fibre-reinforced composites commercially available, which incorporate post-consumer recycled PA 6 material reclaimed from end-of-life fishing nets. "We're delighted to be introducing our first recycled-content long fibre composite material in a planned larger portfolio based on recycled resin," says Eric Wollan, General Manager for Long Fiber Technologies. "Historically, it has been a challenge to source streams of recycled resins that are compatible with the pultrusion process used to manufacture long fibre composites. But we're committed to leading the industry by offering sustainable options even in our performance-critical materials like long fibre composites."

Potential markets for Complēt R PA 6 long fibre composites contain companies whose products involve structural applications often deployed in demanding environments. Examples include lighter-weight adventure gear for outdoor recreation, next-generation vehicles that go further using fewer energy resources and recycled-content office furnishings that contribute towards LEED certification for buildings.

Avient says that Complēt R PA 6 long fibre composites provide stiffness, strength, and toughness performance on par with standard PA 6 long fibre formulations using virgin resin, giving these materials the structural capability necessary to be used as an alternative to metals. Formulations are available globally in a standard black colour at typical weight percentages of long glass fibre, long carbon fibre, or hybrid combinations. Levels of post-consumer resin content vary within the offerings, which allows end products to meet different performance and sustainability requirements.

Covestro is collaborating with Netherlands company Fairphone on the use of circular material solutions for its ethical smartphones. Fully and partly recycled thermoplastic polyurethanes (TPU) are used in the protective case of the Fairphone 3 and its successor, the Fairphone 4. Products from Covestro's post-consumer recycled PC range are used in the Fairphone 4's rear device cover, middle frame and wireless charger. With a PCR content of 30-50%, this Makrolon PC portfolio has physical properties comparable to virgin material and offers good impact strength, balanced flow behaviour, and high stiffness and flame retardancy to ensure a long service life while reducing carbon dioxide emissions by 30% compared to virgin material.

Covestro has also developed a new range of recycled and partially recycled TPUs of the Desmopan brand, which are now used in the protective cover of the Fairphone 4 and are certified according to RCS (Recycled Claim Standard), an international standard for the traceability of recycled raw materials within supply chains. This includes Desmopan 3095AU RC100, which was developed after identifying several streams of post-industrial recycled plastics. The fully recycled material exhibits the typical advantages of TPU, for example, high chemical and abrasion resistance, but easier processability because it melts at lower temperatures and flows better than virgin material. The product has proven itself when used in the protective case of the Fairphone 3 and is now being used in the Fairphone 4. It is available in

IMAGE: AVIENT

Left: The BIC Soleil Click 5 women's razor handle utilises Avient reSound R TPE with 62% recycled content

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Fairphone devices are known for their modular design, which favours better repairability. Such a design requires materials with robust mechanical properties to enable repeated disassembly and repair. The glass-fibre-reinforced grade of the Makrolon PC portfolio offers a good solution for the heavily stressed centre frame of the Fairphone 4. Covestro also supports a mono-material approach in each case for the use of polycarbonates in the housing and TPU plastics in the protective cover to facilitate recycling of the smartphones at the end of their useful life.

Celanese and **Mitsubishi Chemical Advanced Materials (MCAM)** are collaborating to develop mechanical recycling solutions for both post-industrial and post-consumer sources of polyoxymethylene (POM, or polyacetal). The companies plan to work together to assess options to convert waste streams into marketable, end-product formulations so that Celanese can offer its customers sustainable options for scrap or end-of-life waste with assurances of closed loop material reuse. The recycled content option of the Celanese Hostaform/Celcon POM product will be marketed as POM ECO-R. MCAM would conduct the waste collection, separation and processing, while Celanese would provide the formulation, product technology and production capability. Celanese expects to offer to existing and new customers its POM ECO-R solution with a recycled content offering of up to 30%. POM ECO-B, where the polymer itself is identical to its fossil-based twin but where the carbon feedstock is replaced with bio-based feedstock in a mass-balance approach, is different from POM ECO-R in that POM ECO-R would be derived from both post-industrial and post-consumer sources of POM to offer a recycled content solution.

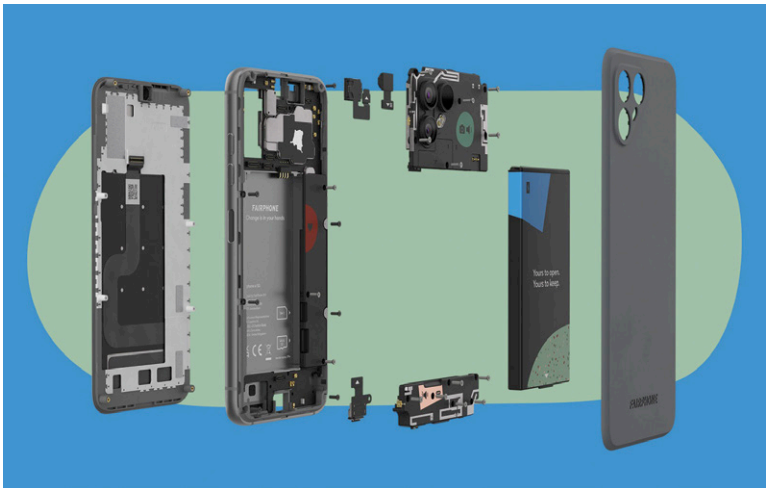

IMAGE: COVESTRO

Above: Covestro and Fairphone are collaborating on the use of circular material solutions for ethical smartphones

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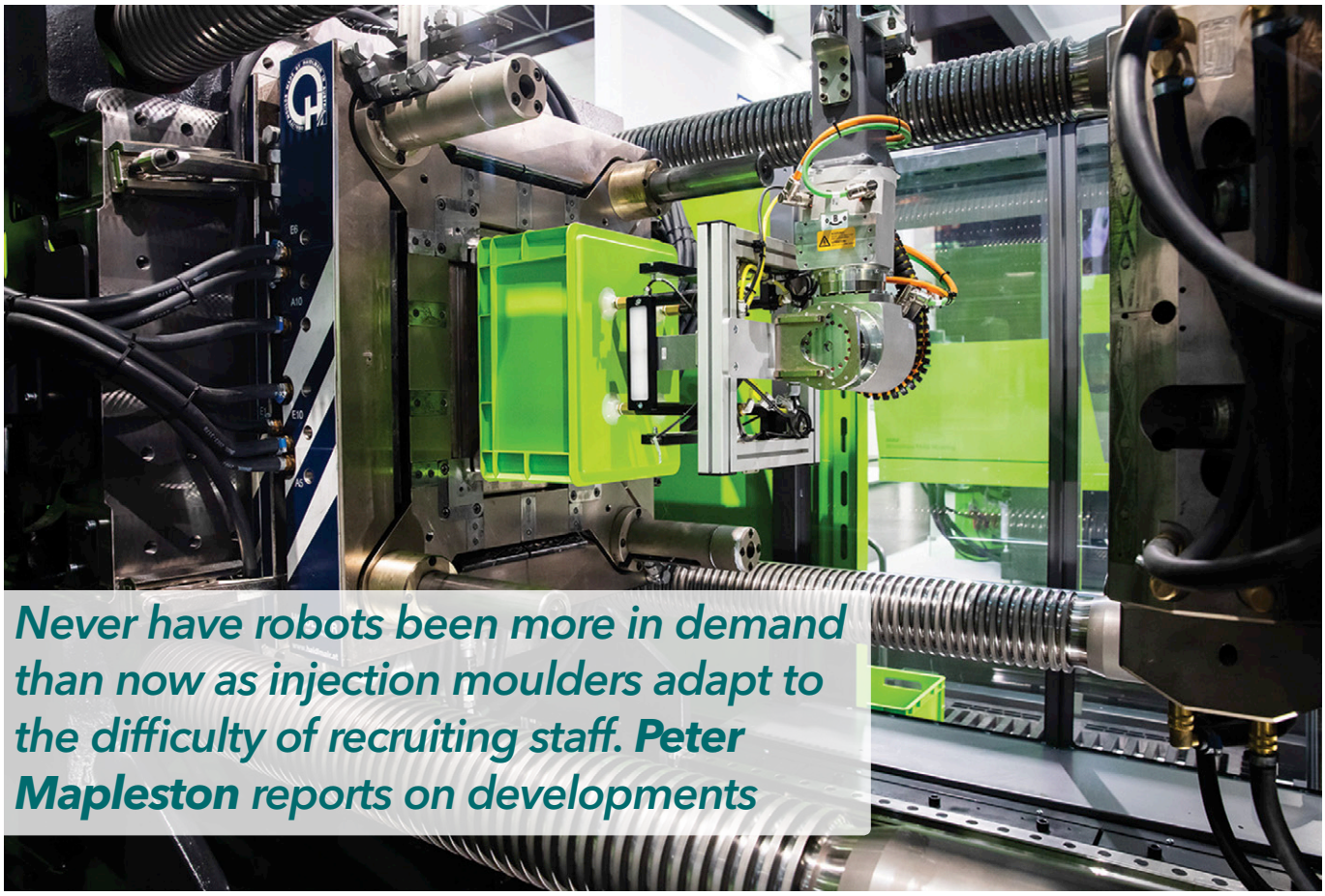


IMAGE: ENGEL

Never have robots been more in demand than now as injection moulders adapt to the difficulty of recruiting staff. Peter Mapleston reports on developments

In search of lost time: Robots help cut cycle times

Automation systems involving various types of robots are helping injection moulding companies produce better parts, faster. They are also helping them recover from reductions in the workforce caused by long- and short-term factors: getting people to do mundane jobs has never been easy and it is getting harder; plus, Covid-19 continues to cast its shadow over operations in closed environments.

Andreas Armbruster, Head of Automation & Turnkey Solutions at Arburg, says: "The level of automation in plastics processing is continuously increasing. Arburg currently supplies around one in three injection moulding machines worldwide together with a robotic system. Not only is the complexity of the systems increasing, but very flexible automation solutions are also in demand. The range of automation solutions extends from simple sprue pickers and linear robotic systems to six-axis robots and complex turnkey systems."

He continues: "Robotic systems are particularly helpful in the production of medical equipment during pandemics. The increased demand for cleanroom production that has been observed for several years has once again gained significant momentum as a result of the current situation."

Arburg six-axis robots have the same user interface as the Allrounder machine controller. As the Gestica control system is gradually replacing the proven Selogica, all six-axis robots made for Arburg by Kuka have been equipped with the new Gestica user interface as standard since the start of the year. This ensures even better performance: with the new sequence editor, robot programs can be created much more quickly than before.

(Arburg customers can decide which robot system they prefer; however, Kuka is the only six-axis robot solution with the Gestica user interface, which means that its sequence can easily be defined ty the machine operator, with no need for special programming knowledge and

Main image: If the robot can travel into the mould area during the mould opening movement, cycle time can be shortened. The effect is particularly large in the case of parts with long cores, such as boxes, shown in this photo from Engel

IMAGE: ARBURG

Right: Arburg six-axis robots have the same user interface as the All-rounder machine controller – since the start of the year, the Gestica user interface has been standard

(expensive) external robot experts.)

Arburg also offers an optional feature, Dynamic speed control, with which speeds and acceleration of the servo axes in linear Multilift robotic systems can be automatically adapted to the injection moulding cycle outside the mould. The robotic system is ready about one second before the mould-entry operation but does not move any faster or more dynamically than necessary. This significantly reduces wear and energy requirements.

Artificial intelligence (AI) is becoming increasingly important in mechanical engineering, not least because of the need to automate injection moulding processes efficiently and flexibly despite ever smaller batch sizes and shorter product life cycles, says Armbruster. "A useful application example of AI is the automatic programming of robotic systems. The idea is that the operator simply enters the starting point and destination, as with a car navigation device, and the system automatically calculates the optimal route."

Engel showed its expanded range of smart assistance systems at the Fakuma 2021 show in Germany last October. The new iQ motion control enables Engel Viper series linear robots to make a safe early start combined with fully automatically optimised track planning.

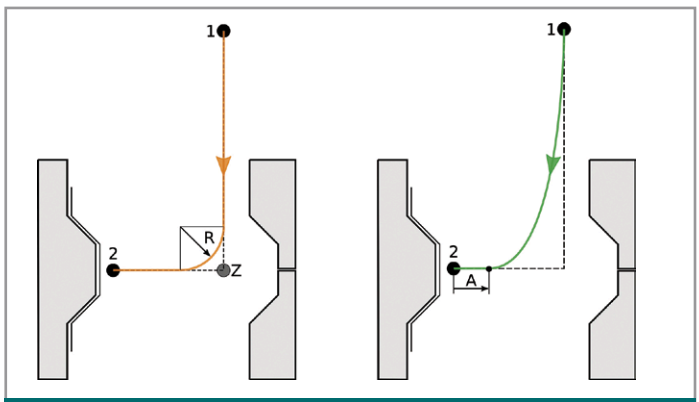
When movements of injection moulding machine and robot are coordinated, cycle times can often be reduced. This is because the robot arm can start moving into the mould area before the mould is completely open. Nothing new here in principle, but the implementation of the concept is becoming more sophisticated.

Individual movement points as well as the speed and acceleration of the entry movement are specified during the teach-in. Whereas in the past, the trajectory of the robot was determined manually, the new iQ motion control reduces this teach-in to a few clicks, with software doing all the hard work. IQ motion control is now included as a standard feature on all new linear robots in the Engel Viper series.

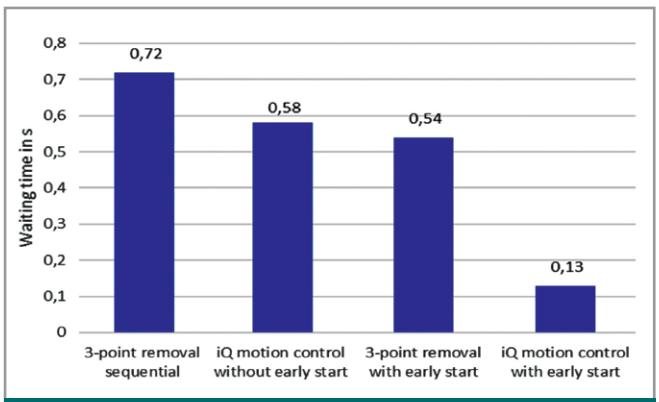
Engel says the efficiency gains are particularly clear in applications with large mould opening strokes, such as the production of deep housing components, boxes or containers, which require long mould cores.

To exploit the potential, Engel has performed tests with a Viper 12 linear robot. With a mould-opening stroke of 490mm and a maximum velocity of the movable mould mounting plate of 1,465 mm/s, an overall cycle time of 15 s was achieved. The robot early start was at mould position 303 mm. A greatly shortened waiting time was found (see bar chart). Waiting time is defined as the time that elapses between the completion of the mould motion and the end of the phase during which the gripper enters into the mould space.

With an overall cycle time of 15 s, for an as-



Engel's iQ motion control operates with optimised motion planning (right). The path is computed as a whole and not generated by approximate positioning of single-axis movements
Source: Engel



Trials confirm the greatly reduced waiting time with Engel's iQ motion control and early start
Source: Engel

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sumed continuous operation of 24 h, with iQ motion control and with early start, 236 more parts per cavity can be produced per day than with sequential three-point removal.

In January, **KraussMaffei Automation** launched a similar function called "synchronous motion." Again, component demoulding and the opening movement of the machine are synchronised. "Sometimes, this also makes it possible to do away with expensive gripper hardware," says the company. "The ejector movement is often used for difficult-to-demould parts. The robot grips the finished part during the demoulding process and the ejector pushes the component onto the gripper. This requires a costly pneumatic system at the handling. However, if the gripper moves along with the ejector, no pneumatic system is required."

The synchronous motion enables the demoulding time to be reduced by approximately 35%, according to KruassMaffei. In the production of refuse containers, for example, this means a 6% reduction in the complete cycle time; for crates, it can be up to 4%.

KraussMaffei offers synchronous motion both for new machines and in the form of an update for the MC6 machine control system for existing machines and complete systems. It can be applied to LRX linear robots and IR industrial robots.

Sumitomo (SHI) Demag has launched its own range of cartesian robots engineered in-house. The SAM-C (SAM denoting: Sumitomo. Automation. Machine) series is claimed to deliver the smallest injection moulding footprint comprising robot and material handling technology. The company says it has intentionally focused its efforts on developing scalable units with more automation functional elements. The "handle & place" robots are already available in four payload sizes – 3, 5, 10 and 20 kg – for injection moulding machines with clamping force sizes between 500 and 5,000 kN, and for standard applications with cycle times of 10 s and higher. Further robot kinematics and functional elements will roll out in the next couple of years.

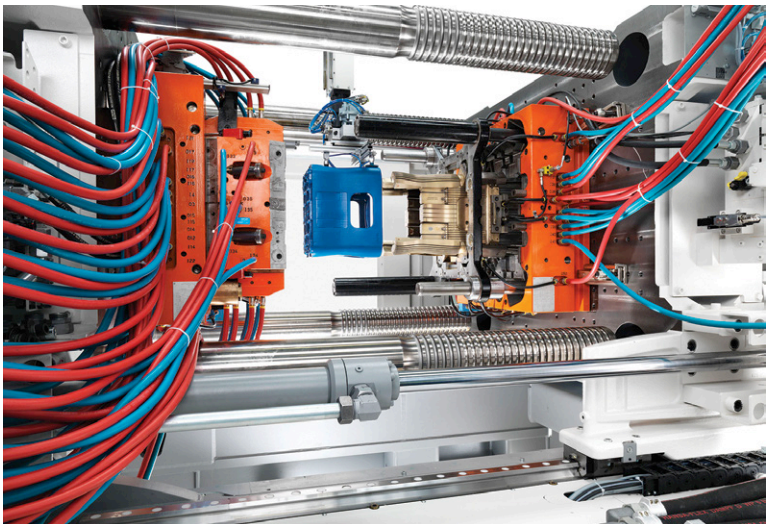

IMAGE: KRAUSSMAFFEI

Above: With the synchronous motion function from KraussMaffei, the gripper of the robot starts faster, saving cycle time

IMAGE: SUMITOMO (SHI) DEMAG

Left: Sumitomo (SHI) Demag's new SAM-C robots are available in 3, 5, 10 and 20 kg payload sizes

Nigel Flowers, Managing Director at Sumitomo (SHI) Demag's UK subsidiary, says: "The pandemic has amplified the focus on productivity and forced injection moulding decision makers to reconsider how automation and digitalised technologies can facilitate working smarter. Scalable, flexible units are in greatest demand. That's why the group launched the SAM-C series at Fakuma last year."

He says: "Automation like this can help customers to address the acute staffing shortages. Although labour was a challenge before the pandemic, filling certain jobs is becoming ever more challenging. Jobs being vacated by the baby boomers (which accounts for over 25% of the workforce in some territories) are not attracting the Millennials and Gen Z's, which is another pressure on top of escalating material prices and supply chain issues." ›

Factory robot density is accelerating

According to the **International Federation of Robotics** in its 2021 World Robot Report, the use of industrial robots in factories around the world is accelerating at a high rate: 126 robots per 10,000 employees is the new average of global robot density in the manufacturing industries – nearly double the number five years ago. The average robot density in Asia/Australia is 134 units, in Europe 123 units and in the Americas 111 units.

Europe´s most automated country is Germany; 38% of Europe's operational stock is in that country. The UK has a robot density below the world average of 126 units with 101 units, ranking 24th. The exodus of foreign labour after Brexit increased the demand for robots in 2020. This situation is expected to prevail in near future.

Cobots expand

In March, **Fanuc**, one of the world's biggest suppliers of robotics, extended its range of CRX collaborative robots (cobots) with the CRX-5iA, CRX-20iA/L and CRX-25iA units. It says it now offers the most extensive line-up of easy-to-use cobots available on the market today. The numbers indicate maximum payload. Fanuc offers cobots as a safe, easy-to-use, reliable and a versatile solution for a wide range of applications. No maintenance should be required for up to eight years.

Ralf Völlinger, Vice President, General Manager, Robot Business Division, Fanuc Europe, says: "Equipped with intelligent features such as vision and force sensors, the flexibility of cobots means they can perform tasks like palletising, parts handling, assembly, bin picking and arc welding."

Italian ski goggle producer LEM makes use of cobots from **Universal Robots** in three separate processes in its operations. One works with a laser that marks the lenses in an operation that requires very precise positioning (there are actually two identical cells). "We wouldn't have been able to do this without the cobots," says Stefano Lodigiani, general manager and co-owner of LEM. "Manually, it is simply impossible to keep a constant distance from the laser focal point, whereas the cobots guarantee the precision and repeatability we need to perform the process impeccably."

In the second process, a cobot applies adhesive to the foam cushioning that is later fitted to the goggle frame. The operation is carried out on a mezzanine floor, so the low weight of the cobot was an extra advantage.

In the third process, a cobot works very closely with operatives on injection moulding of the frames. The process is unusual in that the parts are removed from the machine together with the mould insert. The operative separates part from the insert away from the machine. Lodigiani says: "The cobot improves the ergonomics of the moulding station (the inserts weigh about 1 kg each, so the operator is required to handle about 4 kg of material every 60/70 seconds) and optimises the rate of production. The cobot ensures that the application proceeds at a constant rate and pressure."

Below: Workers at LEM in Italy working with cobots from Universal Robots

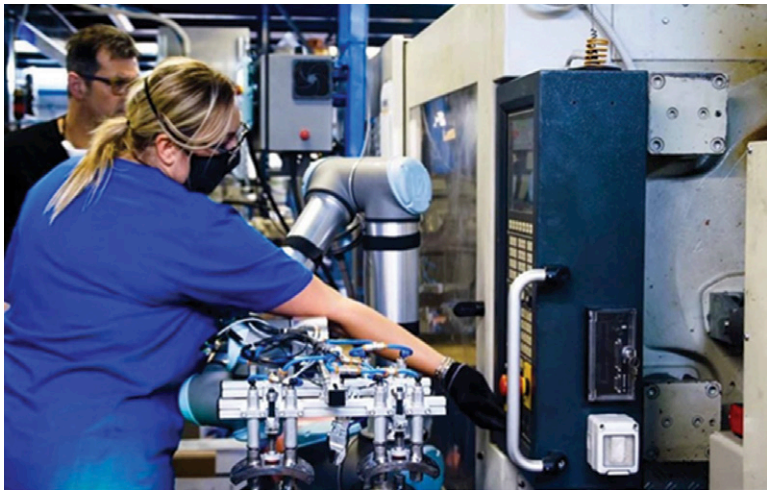

IMAGE: UNIVERSAL ROBOTS

Right: Fanuc CRX cobots

IMAGE: FANUC

In February, **Muller Technology**, which specialises in automation solutions for thin-wall packaging, launched an automated six-axis case packer for high-volume production of lid and container packaging. According to Taras Konowal, Muller's Director of Sales and Marketing for North America, Muller developed the new system after customers, mostly in North America, called for a solution to ongoing problems in finding staff to pack containers and lids manually. Konowal says interest is now picking up in Europe too, mostly in Germany, for the same reason. First installations are currently being implemented.

"Applications are mostly for high volume operations, where you would normally employ at least two people to fill boxes," says Konowal. "With this solution, you can have one person dedicated to several machines, making and closing the boxes."

Konowal says the six-axis case packer delivers greater productivity than a cobot case packer launched last year (see *Injection World* April 2021). "We have found that cobots have more limitations than we expected for this application. They are inherently not as fast as regular robots, and if operatives come into range, not always intentionally, they go into collaborative mode, which is even slower. Employees need to get used to working with cobots, and that is not always easy. The six-axis robot on the other hand is completely guarded. It is one of our most productive systems for high-volume packaging lines." It can handle up to 64 cavities every 6 s for lids and 5 s cycles for containers.

The new case packer can be purchased sepa-

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rately or integrated into automation systems, including IML systems, in which Muller also specialises. The product platform will be manufactured in Switzerland and Colorado.

Growth in IML

IML started in Europe long before it took off in North America. Recently though, Konowal says, business has been slowing down in Europe, partly due to a fall in new product introductions. In North America, business dropped off when Covid-19 took hold – "Businesses just wanted to get stuff on shelves," he says – but in recent months it has dramatically increased. "Orders are now double what they were in the middle of the pandemic. Lots of round containers are now being converted to IML from shrink labels, driven by sustainability issues. With IML, the container and the label are the same polymer – usually PP or PE – so they are easier to recycle than products with shrink labels that are typically in polystyrene."

VistaTek, a custom injection moulder based in Stillwater, Minnesota, is one processor using IML technology from Muller to make mono-material containers, but the material in question is PLA, and the containers are compostable plant pots.

The 100-mm round pots are said to be among the first to contain plant nutrients which are compounded into the plastic resin formulation. The plant is put in the earth still in the pot, which then degrades in a few weeks. The nutrients which are compounded into the plastic break down and feed the plant, thus enhancing the overall growth potential.

VistaTek developed its first garden pot in 2014 and it has since evolved with different materials and now an added label decoration. The company developed a special PLA formulation and a patented four-tab construction.

Innovation in the Muller IML system takes care of the unusual design of the VistaTek pots, which have vent holes to allow for passage of water when the pots are planted in the earth. "The label has to go around the holes, there is no room for error," says Konowal. "The trick has to do with the dummy cores, and how the IML system works with the mould to signal that the label is in position."

IMAGE: VISTATEK

Left: Biodegradable plant pots from VistaTek are 100% PLA, including the IML label

IMAGE: CAMPETELLA

Above: Campetella's Modula W high-speed side entry robot for stack moulding has carbon fibre reinforced composite arms that show minimal vibration while guaranteeing very precise label positioning. It will be on display in a fully automated system for IML production at K 2022

Star Automation Europe is another player with extensive experience in IML automation systems. "In particular, we have developed great experience in IML automation systems dedicated to fruit and vegetable crates, in particular for IMMs with a clamping force ranging from 6,500 to 10,000 kN, in order to improve the impression of the crate quality and to enhance the perception of the content itself," says Sebastiano Deppieri, Marketing & Branding Manager.

"With a dry cycle time lasting less than two seconds, a Cartesian robot ensures a faster actioning time in comparison with a six-axes robot, and this is something that must be absolutely kept in mind when a swift and continuous production is required. Moreover, a Cartesian robot saves a good deal of space."

Star Automation EOATs for labels are slightly unusual in that the labels are not electrostatically charged by metal tips but by a special bicomponent resin, which evenly shares electrostatic charge on the entire surface. This is said to reduce the weight of each EOAT for labels by 15%. Any risk of electrostatic charge between the EOAT and the cavities of the mould is also eliminated.

Italian robot maker **Campetella Robotic Center** says the Covid 19 pandemic sparked an "explosive" growth in medical and packaging industries, while the automotive industry's growth was prompted by investments in electric cars.

"Being outstanding at providing All-In-One

IMAGE: WALDORF TECHNIK

Above: Modular automation system by Waldorf Technik based on Vario TIP platform

standardised automation solutions, Campetella has benefited even more from this growth," says Marketing Manager Gaia Campetella. "Large companies have been struggling to find and keep operators to perform repetitive tasks, such as packaging finished products. Campetella provided them with a complete range of standard robots to be integrated within downstream automation solutions."

Campetella has turned to 3D printing technology to produce hundreds of components overnight in a much cleaner and faster process than traditional CNC production. "Moreover, such parts are much lighter than metal equivalents, enabling robots to work faster and without vibrations," Campetella says. "Wherever possible, our engineers are also replacing pneumatic actuators with electric servomotors in order to reduce CO_2 emissions while increasing reliability and efficiency."

Waldorf Technik is specialised in the high-speed automation of injection moulding processes in the field of medical technology. It has developed a new modular automation system that it says helps manufacturers of diagnostic consumables such as pipette tips to significantly reduce time to market. "With the global pandemic we all learned that time is even more crucial than before," says Martin Maier, Head of Sales. "Thanks to the introduction of standardised designs based on the modular automation system, Waldorf Technik was not only able to significantly reduce the entire project development but also reduce the effort for the qualification and commissioning of the systems."

The system is composed of modules for each individual step, such as removal, filter assembly, visual inspection, as well as exchange or refill modules and various packaging modules.

Depending on customer requirements, Waldorf's Vario TIP FSS (Floor Space Saving) module for cavity-sorted filling of a workpiece carrier can be used. This carrier is used to transport, for example, a packaging unit (rack) through all process modules and ensures high precision in the modules as well as 100% cavity traceability. The parts are not put into the final packaging until all process steps have been completed. This allows the concept to be easily adapted to different packaging variants and requirements.

Waldorf says the modular approach has enabled it not only to significantly rationalise project development but also reduce the effort for the qualification and commissioning of the systems.

At **Sepro**, one of the biggest suppliers of robotics for injection moulding, Raul Scheller, Managing Director, North America, says: "It is probably not surprising, but medical is the obvious market where we have seen a significant increase in the past 18 months. Fortunately we also have seen increases across the board in almost every market. Due to the continued strong demand from consumers, as well as the labour shortages, our customers continue to move and add automation in their sites. Robots and automation give them an opportunity to further optimise and increase output, and to have full control over their operation. Also, we are seeing customers purchasing robots and/or automation for the first time, many of whom would never have considered it a few years back. They have made this decision in order to stay competitive, and they have seen a good return on their investment. Plus, it provides them with full control of their operation."

The value of robots in a complex injection moulding job is illustrated by automotive supplier **KE Elektronik** (part of connector company Amphenol) headquartered in Kressberg-Marktlustenau, Germany, which produces engine fan connectors by overmoulding four metal contacts with three different plastics. Production is complex and involves numerous testing stages as well as complete traceability. With demand continuing to increase and skilled workers hard to find, the company needed a new intelligent automation solution.

It chose **EGS Automation** to create an automated manufacturing island interlinking two punching and bending units and two Arburg injection moulding machines with an output of several million connectors per year, running at cycle times of under 10 s. The result, which fits into a space 15 x 6 m, includes six Motoman robots by **Yaskawa**, a lot of handling and testing technology, and a palletising system. The plant has been running in three shifts since September 2021.

The complete line is divided into four modules. In the first, two punch-bend units ensure continuous provision of signal and power pins. Each unit

has a Motoman GP7 with mechanical gripper equipped with integrated sensor technology.

The contacts are positioned in workpiece carriers, which are then passed to a Motoman GP50 on Module II. This 6-axis robot, with a reach of 2 m and a maximum payload of 50 kg, fits the carriers into a two-component injection moulding machine that first fixes the contacts in position, and then overmoulds a connector plug.

Finally, the overmoulded connectors are placed on another workpiece carrier, which is transferred to Module III. Here, another Arburg machine overmoulds a liquid silicone rubber lip onto the connectors. This obviates the need for a separate seal. Module III also uses a Motoman GP50. It removes the connectors from the workpiece carrier and checks to make sure they are at the right temperature before overmoulding, by holding them in front of a thermal imaging camera.

Another Motoman GP7 is used on Module IV, where the task is to pick up the finished parts and move them to a revolving transfer unit. "On this revolving transfer unit there are various test stations and an assembly station equipped with a Motoman SG650 SCARA robot. We've succeeded in integrating a really large number of processes in an extremely compact space," says Jens Gradenegger, Team Leader Injection Moulding Automation at KE Elektronik.

Early in the Covid-19 pandemic, **Stäubli** collaborated with companies in the Auvergne-Rhone-Alpes region of France in a high-speed project to create an automated production cell for medical ventilator filters. The cell, which combines Stäubli's TS2-60 SCARA robot and TX2-90 6-axis robots, was designed and manufactured in under ten weeks.

Infiplast, which specialises in medical devices, was charged with the design, prototyping, testing and manufacture of a new housing containing the heat and moisture exchanger (HME) filter. The cell takes up only 8 m² of space.

The TX2-90 robot collects the various plastic parts for the filter from the press outlet. It places the base of the case and its cover on a turntable. After inserting the foam and the membrane, the six-axis robot assembles the box and places it on the ultrasonic welding station.

The TS2 SCARA robot then positions the boxes for final operations: testing and labelling. It directs the compliant filters toward packaging, and channels non-compliant filters to the rejects. A quality assurance system is integrated into automated production.

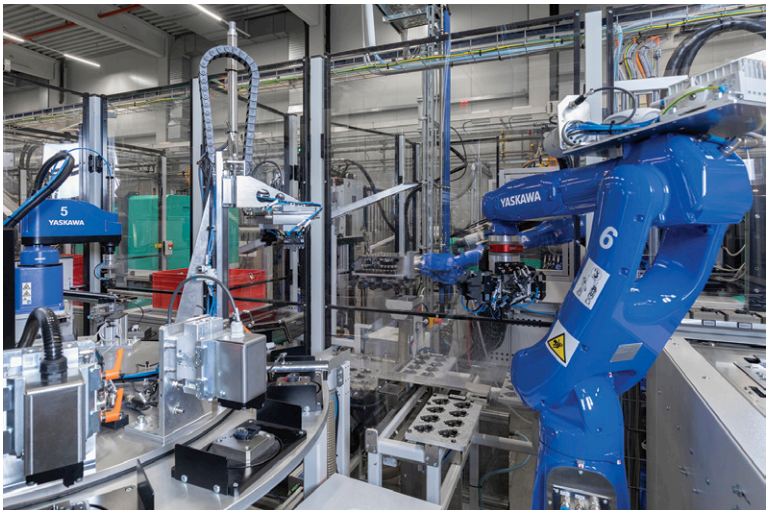

IMAGE: KE ELEKTRONIK

Above: The Yaskawa Motoman GP7 robot at KE Elektronik is critical in terms of the time cycle because it not only loads the rotating transfer unit but also finalises the process by placing the finished parts in trays in an automated palletising system

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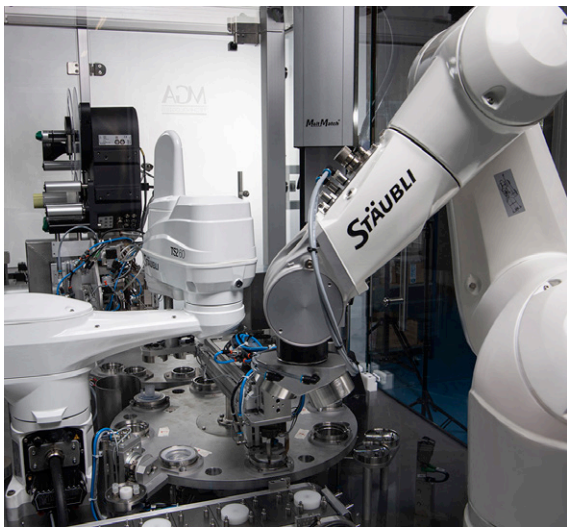

IMAGE: STÄUBLI

Left: During filter production at Infiplast, the two robots, a Stäubli SCARA TS2-60 and a six-axis TX2-90, work hand in hand

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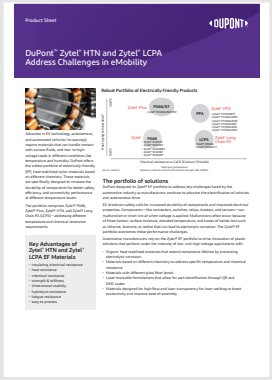

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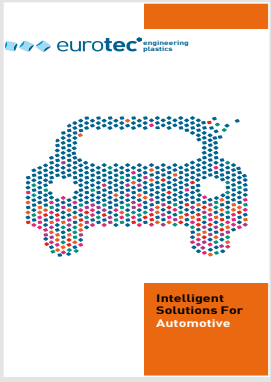

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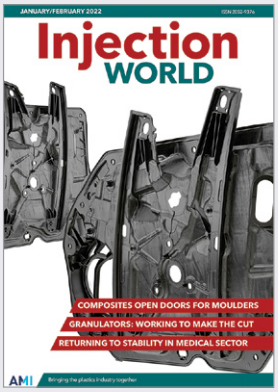

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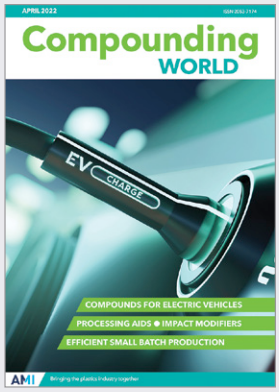

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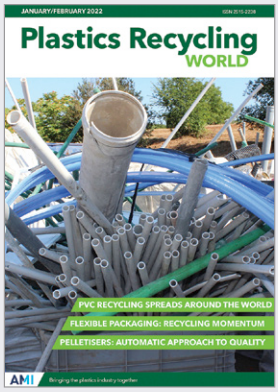

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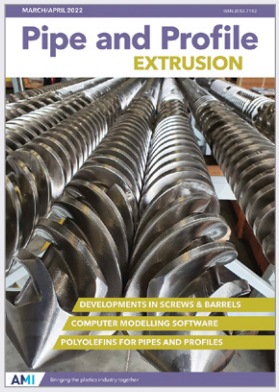

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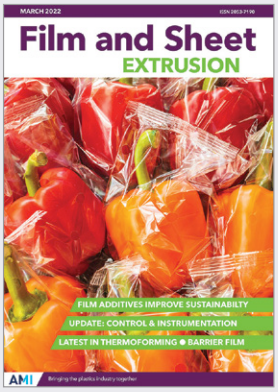

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