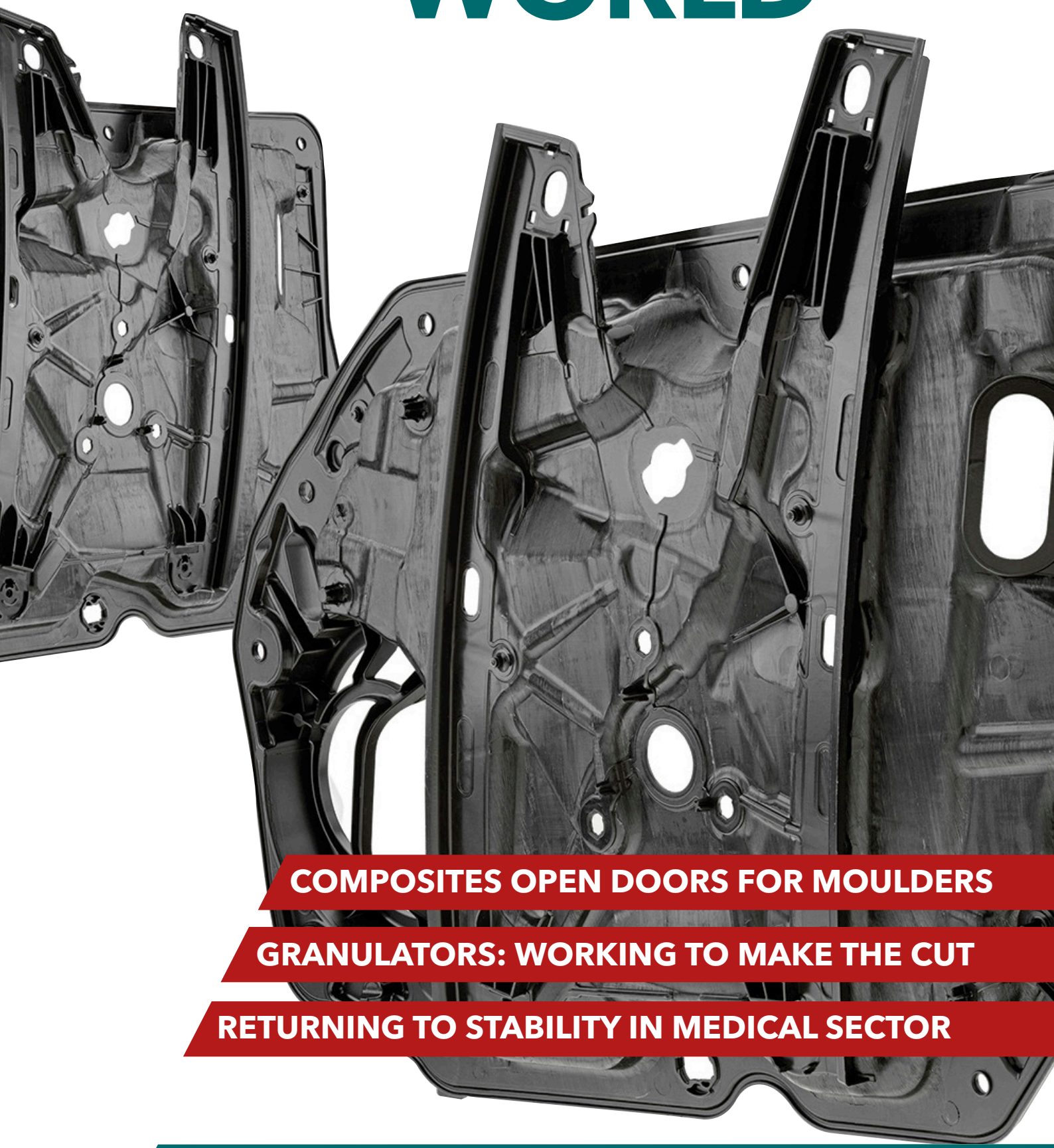
JANUARY/FEBRUARY 2022

ISSN 2052-9376

Injection WORLD



COMPOSITES OPEN DOORS FOR MOULDERS

GRANULATORS: WORKING TO MAKE THE CUT

RETURNING TO STABILITY IN MEDICAL SECTOR

AMI

Bringing the plastics industry together

GET THE APP...

Injection WORLD

Read Injection World anywhere on your phone or tablet

The *Injection World* app is available free-of-charge for iPads, iPhones and a huge range of Android-based tablets and smartphones. Aside from enabling off-line reading, the app also gives you fast access to our archive of back issues allowing you to build up your own library. And if you opt for the free subscription on installation, all future editions will arrive on your device automatically.

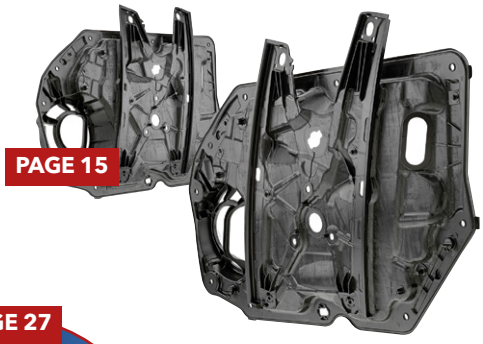
The *Injection World* magazine app has already been downloaded more than 25,152 times by readers in 141 different countries. Why not try it out yourself? You can find the app in Apple's App Store and in the Google Play Store. Just search for "*Injection World*" or "AMI Plastics". Or click the relevant button below.

Download on the App Store

GET IT ON Google Play

Injection WORLD

Chemical recycling presents new opportunities for dealing with plastics waste but what does the technology involve? Who are the key players? And how does it fit in the established recycling hierarchy? Produced by AMI's Magazines and Consulting teams, Chemical Recycling Global Insights 2022 presents an easy-to-digest introduction to this rapidly-evolving sector.



COMING NEXT ISSUE

› Thin Wall Moulding › Product Design › Materials Preparation

CONTACT US

CLICK HERE TO MAKE SURE YOU GET YOUR COPY

AMI

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

DOWNLOAD MEDIA DATA

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

Piovan acquires IPEG in USA

Ancillary equipment group Piovan has agreed with Sewickley Capital to acquire its IPEG business, a US group comprising Conair, Thermalcare, Pelletron and Republic Machine. The combined group had over 1,800 employees, 14 facilities worldwide and pro forma sales of over €450m in the 12 months to 30 September 2021.

"Two years ahead of schedule, we have doubled our size since the year of the IPO," said Nicola Piovan, Executive Chairman of the Piovan Group. The combination with IPEG, he added, will bring together two of the world's largest suppliers of industrial automation for the processing of virgin and recycled polymers and bio-based resins.

IMAGE: CONAIR

Above: IPEG brands include Conair (ECO chiller above), Thermalcare, Pelletron and Republic Machine

The purchase price consists of an initial payment of approximately $125m, on a cash- and debt-free basis, and a potential earn-out payment of up to $22m, to be paid in 2024, depending on IPEG hitting certain EBITDA growth targets in 2021-2023. It is being financed by a mixture of cash and new debt.

Piovan CEO Filippo Zuppichin said that the company will "access a formidable customer base in North America, with the possibility to follow the investments of the main American multinational corporations in the world". In addition, its new scale will enable it to achieve further growth in the area of the circular economy and investments in digitisation 4.0.

› **www.piovan.com**

Berry raises circular target

Berry Global has announced a target of using 30% circular plastics in fast-moving consumer goods packaging by 2030. This includes recycled and renewable resins like bio-based plastics. The company added that it "envisions decoupling from virgin plastic and fossil fuels in the long term".

The target surpasses a previous goal of using 10% post-consumer recycled resin by 2025. It will be achieved by such means as: early access to materials like recycled and renewable resins; agility in its global manufacturing capabilities aligned with evolving recycled content legislation.

› **www.berryglobal.com**

Lego expands China facility

The Lego Group is to expand its injection moulding factory in Jiaxing, China, creating additional capacity to meet long-term growth in China and Asia. Work on the expansion has already commenced and is expected to be completed during 2024. The facility employs 1,200 and carries out all aspects of manufacturing and packaging of Lego products, including element moulding and processing, decoration and packing.

The expansion will include a new automated high bay warehouse, moulding facility and building for processing Lego elements. The work will add 42,000 m² of built-up area to the current site and will "significantly" increase the potential production capacity. In addition, 17,400 solar panels have been installed on rooftops at the site, which are expected to generate more than 7,000 MWh/year of electricity.

› **www.lego.com**


IMAGE: LEGO

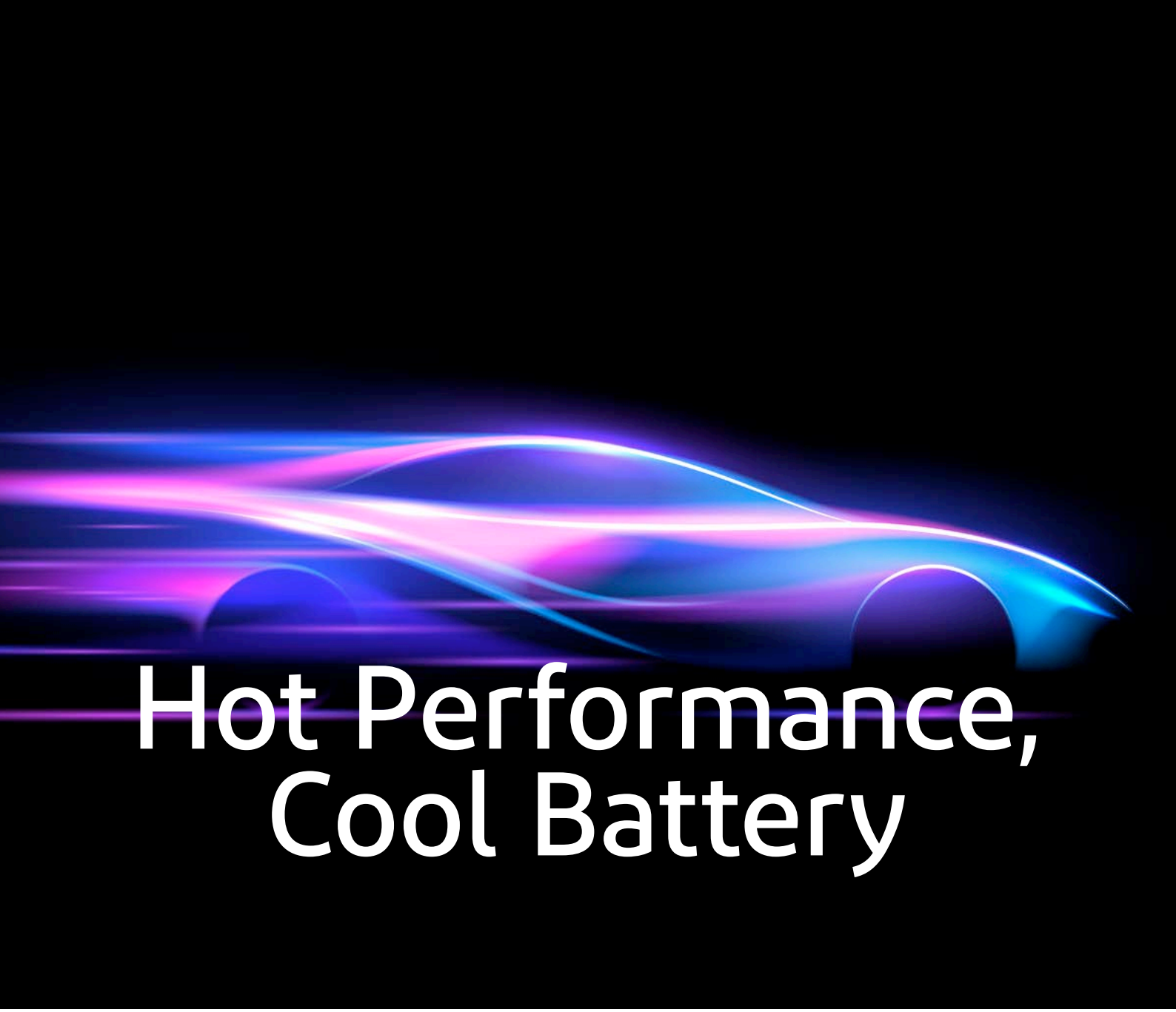
Above: Lego's injection moulding factory in Jiaxing, China

Caplugs buys Polykap in Europe

Caplugs, a division of Protective Industries based in Buffalo, New York, USA, has acquired Polykap as part of its drive to expand its manufacturing and service options in Europe.

Polykap supplies more than 9,000 standard caps, plugs and other protective components for industrial manufacturing, heavy equipment, automotive, hydraulic, beverage and consumer product applications. Its operations in San Marino will now form part of Caplugs Europe, which has facilities in Belgium and the Netherlands.

› **www.caplugs.com**



Hot Performance, Cool Battery

Components manufactured with high performance polymers have to take the heat or help dissipate it. Trust DuPont for easy to process, electrical-friendly, heat-resistant thermal management solutions for battery pack components.

When you need hot performance, but a cool battery, we invite you to dEVelop with DuPont.

Let's get to work on new solutions for automotive electrification.

DUPONT™

Injection Molding and Design Expo moves to May 2022

The Injection Molding and Design Expo has been rescheduled to May 25-26, 2022. Organised by AMI and Crain, the free-to-attend expo and conference is being held at Huntington Place (formerly the TCF and Cobo Center) in Detroit, Michigan, USA.

PHOTO: HUNTINGTON CONVENTION CENTER

"Since launching the event, we have received widespread industry support for the format and location of the focused injection moulding expo with its high-level conference content," said Andy Beevers, Events Director at AMI. "However, a number of companies have asked us to consider moving it from March to later in the year, when the plastics industry events calendar is less crowded.

"We listened closely to our customers and checked availability of later dates with both the venue and our suppliers. Having secured an alternative option, we held discussions with as many companies as possible and received unanimous support for the date change."

The exhibition is making strong progress with well over 50% of booths already booked by more than 100 leading suppliers of injection moulding machinery, moulds, auxiliary equipment, materials and industry services. They include Absolute Haitian, Accede, Ampacet, Cavalier, Chroma Color, Conair, DME, EAS, iMFLUX, Incoe, KraussMaffei, M Holland, Mastip, Milacron, PCS, Progressive Components, StackTeck, Star Plastics, Wittmann-Battenfeld and many more.

"The new May dates will allow us to build on these early successes and create a larger expo that delivers great results and an enjoyable experience for exhibitors and visitors alike," said John Hickey, Sales Director at Crain's *Plastics News*. "Since announcing the dates to prospective exhibitors, we have seen a big jump in interest in booking booths; prime positions are filling up fast."

A key attraction of the Injection Molding and Design Expo will be its three free-to-attend conference and training theatres. For details of their programmes, see our preview on **page 35**.

For more information please visit:
› **www.injectionmoldingexpo.com**

Union Plastic buys APE Medical

Union Plastic, a subsidiary of France's Omerin Group, has agreed to acquire its compatriot APE (Avenir Performance Européenne) Medical. This follows the takeover of Prince Medical in 2020 and will add to the six production sites and 600 employees already in Omerin's Health division.

APE Medical specialises in medical devices for the pharmaceutical, diagnostics and veterinary markets. It has 2,000 m² of production space, including 250 m² of ISO 7 cleanroom space, and an ISO 13485-certified QA system. Among its products are devices for the transfer and dosing of drugs, such as the new Vial Adapter, Snip Guard safety devices and analysis cuvettes for optical diagnostic consumables.
› **www.union-plastic.com**

Euromap issues draft of OPC 40079

The joint working group of Euromap and the OPC Foundation has published the draft of the new OPC 40079 specification for standardised data exchange between injection moulding machine and robot. It described this as "an Industry 4.0-compatible interface with an extended range of functions and thus the successor standard to Euromap 67".

This follows six years of work in developing the information model.
› **www.euromap.org**

Eaton buys Royal Power Solutions

Automotive supplier Eaton has completed the acquisition of Royal Power Solutions, a US manufacturer of high-precision electrical connectivity components used in the electric vehicle, energy management, industrial and mobility markets. The purchase price is $600m or about 13.6x projected EBITDA for 2022.

Royal Power Solutions has about 450 employees.
› **www.eaton.com**

Make an impact with your career

Moulding and Production Technicians, Plymouth

BD is one of the largest global medical technology companies in the world–focused on innovation, we produce the highest quality products in high quality facilities – clean, efficient and cutting edge. Work with us in our state-of-the-art facility, with up-to-date training, competitive pay and benefits, and rewarding long-term career opportunities.

Learn more at
BDOpsCareers.com

Scan here to
view our open roles

BD

Tide Rock adds PMT to portfolio

US holding company Tide Rock Holdings has acquired Plastic Molding Technology (PMT), a full-service precision injection moulding company based in El Paso, Texas. Charles Sholtis, former owner and CEO of PMT, will remain as an advisor.

Tide Rock will add PMT to Pikes Peak Plastics and Altratek to form a new plastics injection moulding company for the industrial, energy, electronics, telecommunications, medical and automotive industries. It also owns Interconnect Solutions and Plastics Design & Manufacturing.

"We now can serve customers from multiple strategic locations, each with a highly skilled workforce and 95 total moulding machines ranging from 20 to 500 tons," said group CEO Michael Engler.

› **www.pmtinc.com**

Engel: New unit at BMW and management moves

BMW has launched a new Engel production unit at its Landshut plant, which will produce the kidney-shaped badge for the electric BMW iX in a cleanroom atmosphere. The manufacturing process has changed fundamentally because, with the electrification of the drivetrains, the badge now protects the camera and several sensors for assisted driving.

For the part, a heatable functional film is back-moulded with PC and flood-coated with PUR in an Engel technique called Clearmelt. This technique had previously been used in vehicle interiors, but not in the series production of functional exterior components.

The production cell integrates a Duo Combi M injection moulding machine with a horizontal rotary table, two large articulated robots to handle the films and moulded parts, a film cleaning system, an inline quality control station and peripheral units, including PUR technology. The clamping unit and the robot work areas are encapsulated over a length of 6 m and a height of more than 4 m to achieve an ISO class 7 cleanroom.

IMAGE: BMW

Above: The kidney-shaped badge for the electric BMW iX produced in the Engel unit

■ Christoph Steger, Chief Sales Officer, is leaving the Engel Group "to further develop himself vocationally and to change his career orientation", the company has announced. His role is being taken over by Stefan Engleder, CEO, as of 1 February. The company said that Steger has "significantly contributed" to its success in the past ten years.

Engel also announced it has appointed Gerhard Dimmler (previously VP Research and Development) to the board as Chief Technology Officer leading the Development division. Chief Financial Officer Markus Richter is leaving the group at his own request at the end of March and his successor Simon Zeilberger will join as Commercial Director on 1 April.

› **www.engelglobal.com**

LS Mtron to show new electric machine range

The One*-E, a new, all-electric injection moulding machine from LS Mtron, will be shown for the first time at Plastic West at Anaheim, California, USA, on 12-14, April, the Georgia-based firm has announced.

The One*-E is currently available in five sizes (120, 140, 190, 310, and 390 US tons) and LS Mtron plans to introduce four more later this year. It is said to be ideal for high-cavitation, high-speed, and thin-wall moulding for packaging and medical part applications. It is also Industry 4.0-ready, offering users LS Mtron's CSI monitoring and control software for retrieving and controlling data.

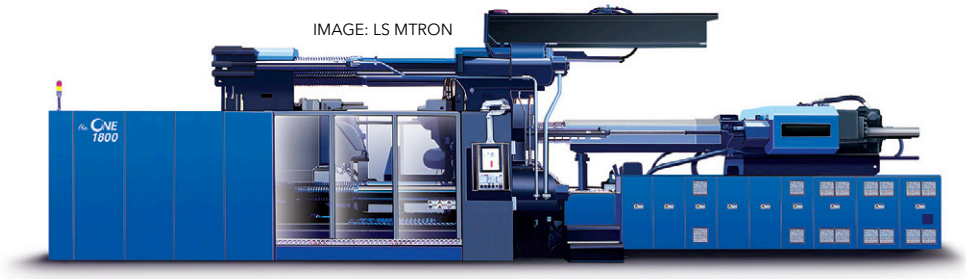


IMAGE: LS MTRON

Left: The new One*-E machine

› **www.lsinjection.com**

Join the industry at this year's edition

AMI | Events

Plastic Closure Innovations

7-9 June 2022 | Barcelona, Spain

Connecting the industry to explore the latest technical developments and trends

- Find out how changing market demands and legislations are shaping new material and technology developments
- Gain comprehensive insights and stay ahead of market trends and growth opportunities
- Get first-hand insights into the most recent caps and closures innovations
- Hear expert opinions and debate key issues with industry professionals
- Meet and reconnect with event attendees and capitalise on highly effective networking opportunities

Secure your place today

Save €200* when you book before 11 March 2022

Sponsored by:

lyondellbasell *Advancing Possible*

VASANTHA

UNITED CAPS CLOSE TO YOU

ERMO

Media supporter:

Injection WORLD

CONTACT US

Angelina Ruocco
Conference Organiser

T +44 (0) 117 314 8111
E angelina.ruocco@ami.international

*VAT may apply. Discounts cannot be used in conjunction with other offers

JOIN US NEXT MONTH!

Single-Serve Capsules
VIRTUAL SUMMIT

29-31 March 2022

Identifying opportunities and overcoming obstacles in the single-serve capsules industry

Five reasons to attend:

- **Gain** insight into the latest industry trends and product innovations
- **Discover** dynamic new applications from food companies
- **Network** with key stakeholders from the supply chain from the comfort of your own home or office
- **Learn** about the latest developments in recycling opportunities for single-serve capsules
- **Explore** different approaches to sustainability from material innovations to end-of-life choices

If you are a brand-owner, roaster or capsule filler, you are invited to attend this virtual summit free of charge*! Please contact Agata Swietek to secure your free place.

BOOK YOUR PLACE HERE

Sponsored by:

IMA COFFEE Coffee Processing & Packaging Solutions

AluSense Aluminium Capsule Solutions

cama GROUP Innovation meets Experience

CODAGROUP

GOLDEN COMPOUND

MENSHEN

NatureWorks

Media supporters:

Injection WORLD

Film and Sheet EXTRUSION

Speakers include:

Jason Farrell
Mother Parkers Tea & Coffee

Pablo Flores
Café Señor K

Eileen Gordon-Laity
European Coffee Federation

*AMI will check that applications for free places meet its criteria and reserves the right to refuse free admission

ABC Technologies to buy Karl Etzel in Germany

US-based automotive supplier ABC Technologies Holdings has entered into a definitive agreement to acquire Karl Etzel in Germany from the Schürrle family for about $95m. This will be funded by new debt entered into by ABC's controlling shareholder, AP IX Alpha Holdings, and others.

This acquisition is expected to be completed in the first quarter of 2022, subject to approval by the German and Austrian regulatory authorities. Etzel is based in Muhlacker, Germany, and is a Tier 1 and 2 supplier to the German luxury OEM market. It had sales of about $100m last year.

Above: Karl Etzel produces car interior and exterior parts in Muhlacker, Germany

ABC said that Etzel's expertise in injection moulding plastics for OEM interiors and exteriors "will grow ABC's product suite in the European market as well as provide greater diversification to German-based global OEMs". Its own wider footprint will also enable Etzel's technologies to be marketed outside Europe, especially North America, the company added.

› **www.abctechnologies.com**

MPE Partners to sell PCI

Morgenthaler Private Equity (MPE) Partners has agreed to sell Lighthouse Holdco, the parent company of Plastic Components (PCI), to the US subsidiary of Sweden's Rosti Group.

PCI is based in Germantown, Wisconsin, with additional locations in Cary, North Carolina, and Clearfield, Utah. It supplies engineered plastic components to the plumbing, consumer, pool and aquatics, automotive technology and medical markets.

› **www.plasticcomponents.com**

IGS GeboJagema launches US subsidiary

Medical mould specialist IGS GeboJagema of the Netherlands has launched a new subsidiary dedicated to the US market. The company has experienced strong growth in this market and the US now accounts for over 50% of its sale. It said the subsidiary will enable it to provide faster sales and service support.

"In short, this is the logical next step for IGS GeboJagema and our clients, as we create the future of injection moulding together," the company stated.

› **www.igsgebojagema.nl**

INJECTION MOLDING & DESIGN EXPO

FREE CONFERENCE PROGRAM OUT NOW

MAY 25-26, 2022
DETROIT, MI, USA

Hear from expert speakers including:

Katie Roco
Customer Engineering Director, **Faurecia Interiors**

Mark Gomulka
CEO, **Westfall Technik**

Troy Nix
Executive Director, **MAPP**

Jeff Stout
Executive Director, **Yanfeng Automotive Interiors**

Gene Altonen
Chief Technology Officer, **iMFLUX**

Haleyanne Freedman
Market Manager and Engineering Consultant, **M Holland, 3D Printing Group**

Diane Marret
Sustainability Manager, Consumer Packaging North America, **Berry Global**

Carla Bailo
President & CEO, **Center for Automotive Research**

Grey Parker
Principal and CEO, **Sundberg-Ferar**

REGISTER FOR FREE HERE

Headline sponsor:
MHolland

Brought to you by:
Plastics News Injection WORLD

REGISTER FOR FREE TODAY

Christian Herrild
Director of Growth Strategies, **Teel Plastics**

Gary Hulecki
Executive Vice President, **MTD Micro Molding**

Laurie Harbour
President & CEO, **Harbour Results**

Megan Tsanoukakis
Vice President, Supply Chain, **Sussex IM**

Patricia Miller
CEO, **Matrix 4**

Millie Nuno
Director of Business Development, **Hoffer Plastics**

David Clark
Vice President, Sustainability, **Amcor**

John Budreau
Director of New Business **PTI Engineered Plastics**

Camille Sackett
Vice President of Sales and Project Management, **Accede Mold & Tool**

Alper Kiziltas
Technical Expert, Sustainability and Emerging Materials, **Ford Motor Company**

Organized by:

AMI CRAIN COMMUNICATIONS GLOBAL POLYMER GROUP

Check out the two-day programs for each of the theaters here

Performance Polyamides

13 - 14 September 2022
Maritim Hotel,
Düsseldorf, Germany

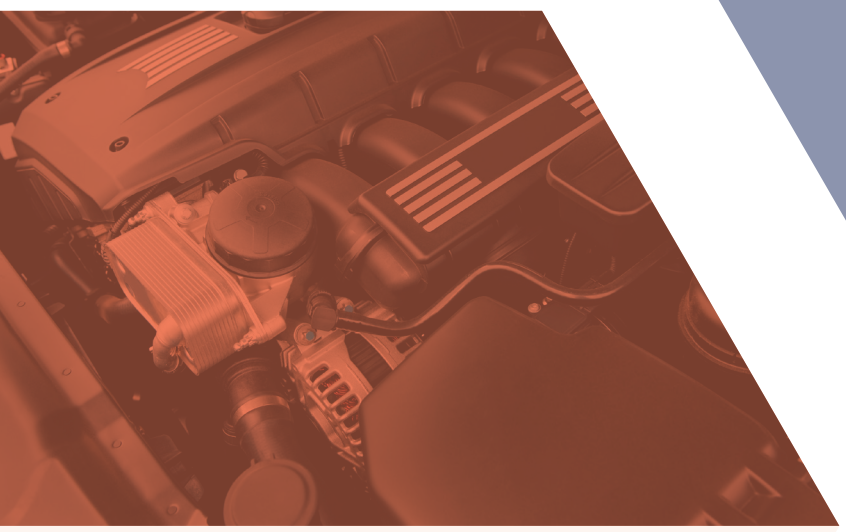
Developing new formulations and applications for high performance polyamides

Secure your place today at:
www.ami.ltd/attend-PA

BOOKING IS NOW OPEN!

Save €300*
if you book your delegate place before 18 March 2022

*VAT may apply. Discount cannot be retrospectively applied or used in conjunction with any other offer. Valid off full price.



CONTACT US

Joe Huckings
Delegate Service Executive

T +44 (0) 117 314 8184
E joe.huckings@ami.international

AMI

To speak, sponsor or exhibit

please get in contact

Thermoplastic composite materials and new machinery developments can provide injection moulders with the means to compete with metals and make complex structural components in high volumes. Mark Holmes reports

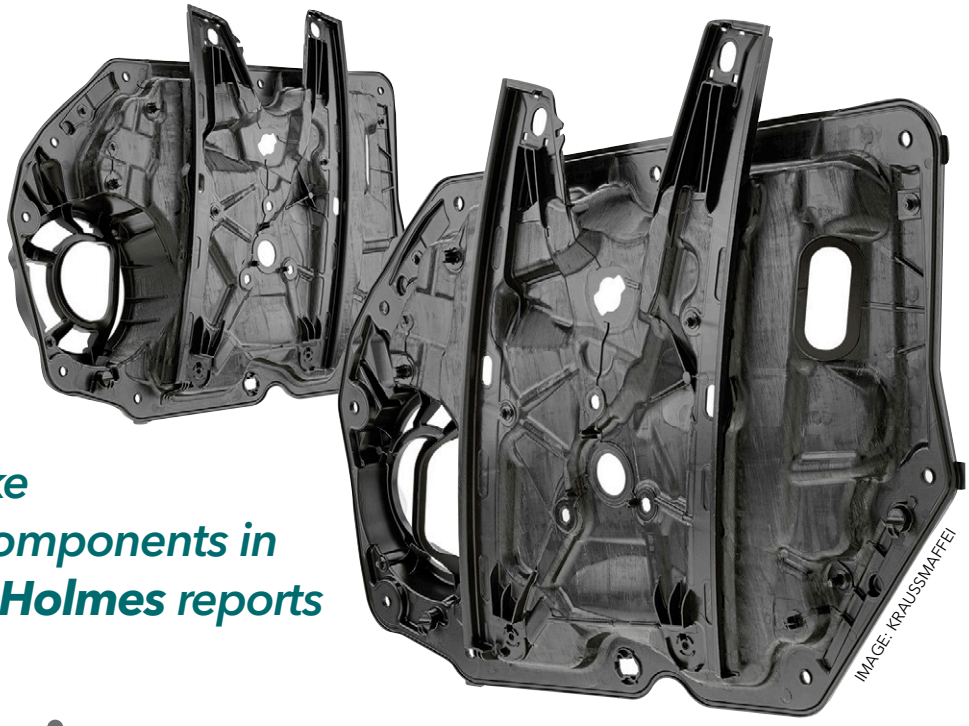


IMAGE: KRAUSSMAFFEI

Composites open new doors for injection moulders

Thermoplastic composites continue to increase in importance as high-strength, lightweight construction materials in a number of industries, in particular the automotive sector. To make these innovative plastics a production reality, injection moulding machinery manufacturers have found new ways to use these complex materials suitable in series production. Not only are thermoplastic composites replacing traditional construction materials of choice, such as steel and aluminium, but also offer significant advantages over thermoset composites due to shorter production cycle times and improved recyclability.

Thermoplastic composites are central to sustainable lightweighting in industries ranging from transport to sport and leisure. **Engel's** Lightweight Future Day 2021 highlighted a number of initiatives where thermoplastic composites were meeting lightweighting requirements while also accelerating series production. For example, automotive supplier **Brose** reported developments in door solutions. The company's Michael Thienel said that through an intelligent mix of materials, Brose had succeeded in developing a door system providing new standards in lightweight, functional and flexible design. Compared to steel-based products, weight savings of 5 kg – 40% of the total weight – were achieved while maintaining the same crash safety standards. This is possible with a wall thickness of just 0.6 mm. One million door modules made of fibre-reinforced thermoplastics (thermoplastic sheet) have been supplied to Ford annually since 2018. Brose has also developed the next generation of door modules with a new structural element that saves a further kilogramme of weight per car door.

FACC is a specialist in lightweight components for aircraft construction, also using thermoplastic composites. The company manufactures manned air cabs and unmanned drones in urban air traffic, with production volumes of 5,000-30,000 components per year. These are significantly higher figures compared to parts production for larger aircraft, which is around 1,000 units per year. Due to their long curing times, the thermosets primarily used in aircraft construction to date would be unable to meet the short cycle times required in this application.

The recycling capability of thermoplastics also

Main image: Door module carriers manufactured with Krauss-Maffei's FiberForm process. Due to the use of continuous fibre-reinforced thermoplastic organic sheets, reduced wall thicknesses and an integral design, the module saves 1.6 kg in weight per vehicle

IMAGE: ENGEL

Above: Engel has developed a fully integrated production cell that starts with a UD-tape laying cell and finishes with overmoulding in an injection moulding process

makes them more sustainable compared to thermoset fibre composite materials. Georg Käsmeier, Managing Partner with **Forward Engineering**, pointed out that the European Union is looking to make the circular economy the norm as part of its Green Deal. He said that it is now the right time to shift from linear to circular thinking in product development and consider the recycling process as early as in the product design stage. As part of a study, his company compared the CO_2 footprint in the production of a brake pedal based on primary thermoplastics, bio-based materials and recycled thermoplastics. The savings potential of using thermoplastics with recycled content was found to be significant.

Due to the increasing importance of thermoplastics in lightweighting, Engel adds that it has invested in further development of technologies and systems for processing thermoplastic composites in recent years. Engel is the first company to be able to offer a fully integrated production cell that starts with a UD-tape laying cell and finishes with overmoulding in an injection moulding process, said Paul Zwicklhuber, Development Engineer, Composite Processing, in his presentation. The tape laying cell relies on the pick-and-place principle. This means that tapes can be deposited and spot-welded together at 3 to 4s intervals. Since the quality of the stack depends largely on the accuracy of the tape positioning, Engel has equipped the laying cell with a measuring system with high resolution camera technology. Downstream there is a unit that consolidates the thermoplastic tape fabrics in the injection moulding cycle. Consolidation can be seamlessly integrated into the overall process, which significantly increases efficiency in the production of tailor-made tape solutions. Engel organomelt is the core of the integrated process. Thermoplastic fibre composite prepregs such as UD-tapes and organic sheets are formed and functionalised. Functional elements, such as reinforcing ribs or assembly elements, can be overmoulded immediately after thermoforming using a thermoplastic from the matrix material group. This enables a highly integrated and fully automated production process, while at the same time the process simplifies recycling of the parts at the end of their useful life. The organomelt process is also used in Brose's door module production.

Switzerland-based **Svismold** showed that lightweight thermoplastics can also still have advantages even if weight is not an issue. The company was able to convince a manufacturer of surfboards to replace the previous thermoset fins with a fin made of thermoplastic fibre composites based on UD-tapes. The new fin offered unparalleled steering precision characteristics. One reason for this is the precisely calculated force flows in the part, which can be reproduced exactly in the part as the use of UD-tape ensures fibre alignment, while at the same time reducing production costs.

The opening of an extension building in November 2021 has strengthened the R&D capability in lightweight applications using thermoplastic composites for the **Fraunhofer Pilot Plant Centre for Polymer Synthesis and Processing (PAZ)** in Schkopau. The two production cells for the integrated and fully automated production of fibre composite functional components are now available for customer projects. Engel has supplied the Fraunhofer PAZ plant with two machines which make it possible to combine thermoplastic-based composite processes with a variety of injection moulding technologies, such as foaming.

From monomer to polymer synthesis and plastics processing on a pilot scale to the tested series component, Fraunhofer PAZ develops new production processes and technologies along the entire value chain of lightweight components. Engel delivered two production cells using V-Duo and Duo injection moulding machines as integrated and fully automated system solutions, capable of flexible deployment. The Engel V-Duo 700 vertical machine was combined with an Easix articulated robot and a large infrared oven – also from the company's in-house development and production. The second production cell comprises an Engel Duo 900 injection moulding machine with a horizontal clamping unit and two Easix robots. A vertical IR oven is located above the clamping unit, allowing particularly fast hot handling of thermoplastic sheets and blanks made of UD-tapes. Engel has also integrated injection moulding technology packages, for example, for physical foaming. Fraunhofer PAZ chose two machines of different

types, both of which are widely used in the global automotive industry, to make it possible to individually evaluate for each component which machine type and technology enables the most efficient and cost-effective production process.

One area of development in which Engel has recently been involved is precise software control of IR ovens. IR heating technology has become established as the standard in the processing of thermoplastic composite materials. It makes it possible to heat flat thermoplastic sheets of up to about 3 mm thickness within the cycle times characteristic for injection moulding processing. The focus is on process control. On the one hand, it is important that the heating process is fast, and on the other hand, the material must not be overheated. It is also important to achieve excellent temperature homogeneity. Simultaneous processing of blanks with different thicknesses is a particular challenge. In the established one-step process for the production of thermoplastic composite components, the materials in the form of plate-shaped blanks are located in magazines. They are removed from the magazines by a robot and conveyed to an IR oven. After heating, the now malleable composite material is picked up again by the robot and deposited in the mould of the injection moulding machine. It is reshaped and reconsolidated by the mould closing movement; immediately afterwards, detailed geometries are added by injection moulding. After completing the cooling phase, which is required above all for the injection moulded areas, the ready-to-fit composite part is removed from the mould. One of the most important advantages of thermoplastic composites is that the cycle time for producing a technical component is only 40-80s. A thermoset composite solution would require at least a few minutes for this.

IR ovens might be set up to provide optimum temperature homogeneity for a specific operating point, for example, when it is loaded with 70% of the nominal payload area in the form of a rectangle. However, since the real operating point usually deviates significantly, this is not meaningful. A system with a very good basic characteristic in terms of thermal homogeneity is more useful. The software of the Engel IR ovens is therefore capable of optimally controlling a large variety of operating states and influencing variables, which enables excellent thermal homogeneity over a wide range of applications.

IMAGE: FRAUNHOFER IMWS

Above: Engel has supplied the Fraunhofer pilot plant centre in Germany with two machines for lightweight construction development. (From the left) Claus Wilde, Managing Director of Engel Deutschland, Prof. Peter Michel, Head of the Polymer Applications Business Unit at the Fraunhofer IMWS and responsible for polymer processing at the Fraunhofer PAZ, and Franz Füreder, Vice President Automotive at Engel Austria

Precise control of the IR heating process is an essential part of process control in the manufacture of thermoplastic composite parts. In Engel system solutions, the IR oven control is therefore integrated into the injection moulding machine control unit. This allows the process parameters and measured values of the IR oven to be documented along with the production data from the injection moulding process.

Due to the multitude of possible causes for thermal inhomogeneities, each control zone has a different heating characteristic in practical applications. In the case of a control zone that reaches its temperature setpoint early at full radiator power, the radiator power must be reduced early in the heating phase. Automatic reciprocal optimisation and coordination of the control zones means that the radiator power of all affected control zones is continuously adjusted to keep the

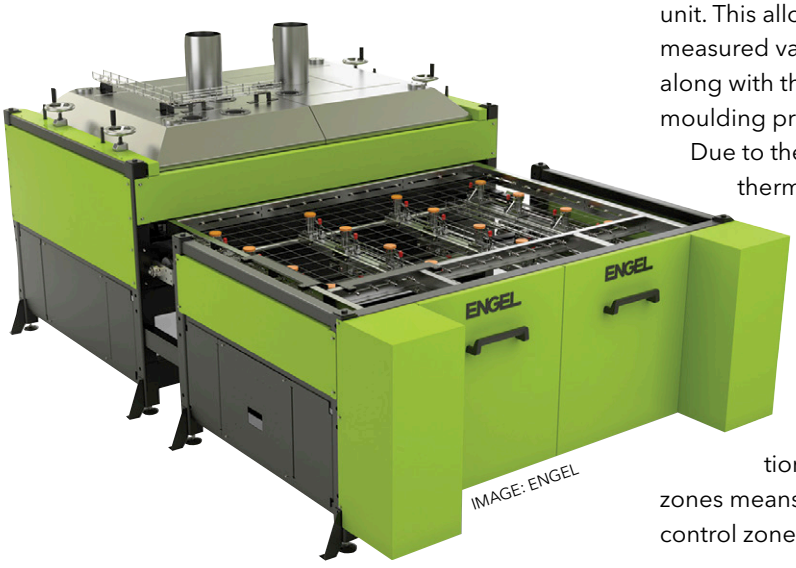


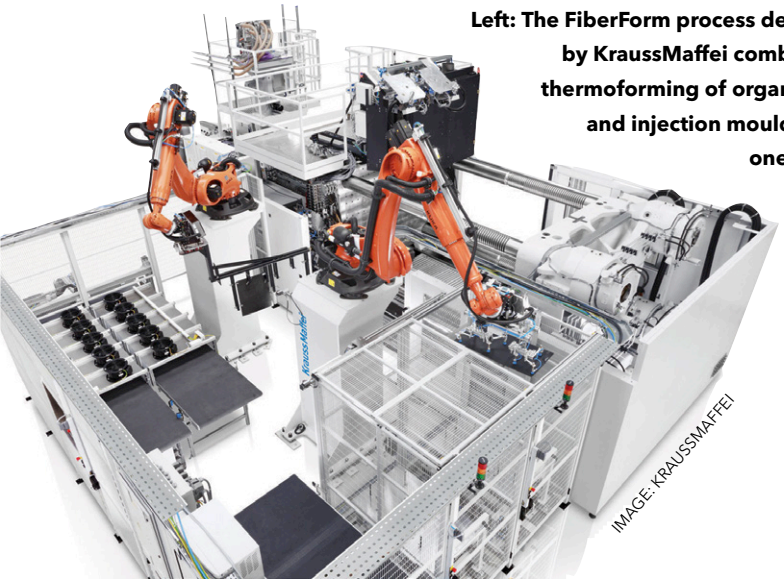
IMAGE: ENGEL

Left: Three thermoplastic sheets of different thickness are heated in two IR ovens in the production of a door structural part

deviations within an adjustable narrow tolerance band. This results in a uniform heating rate for all control zones and all control zones reach the temperature setpoint at the same time. What is of particular importance is that the process control strategy does not require a lead control zone. The values measured by all the pyrometers are permanently considered and a highly dynamic heating process is implemented in all control zones; the process is adapted to the specific behaviour of the matrix material during heating, melting and further heating of the material in the melt phase.

When the surface temperature approaches the temperature setpoint, further granular adjustment during process control must prevent the surface temperature from overshooting. High temperature consistency in the soaking phase – the heat required to melt the core area – ensures that the target temperature in the core area is reached at a precisely predictable time. Heating up of the thermoplastic composite can therefore be terminated after a defined, and shortest possible duration; this in turn contributes towards protecting the material. Especially in the soaking phase, it is crucial to keep temperature deviations low to avoid local overheating and degradation of the material. For this purpose, the control parameters must be adjusted in the best possible way. For example, if the material, the blank size or the thickness of the material is changed, the control parameters for the soaking phase also need to be readjusted. A separate measuring cycle can be utilised to automatically optimise the control parameters. Doing so delivers information on the existing control behaviour and based on these, the control parameters are recalculated and adjusted.

KraussMaffei reports that there is rising demand for technologies that allow efficient use of materials and other resources for cost-effective manufacturing of thermoplastic composites. Complete production cells are in demand, including injection moulding, tape laying and consolidation, automation and oven technology. "After the Covid-19 crisis, we are now registering increasing demand, particularly from the automotive industry, for FiberForm applications," says Michael Fuchs, Global Application Owner, Surface & Lightweight. "The FiberForm process developed by KraussMaffei combines the thermoforming of organosheets and injection moulding into one process. This process results in fibre-reinforced plastic components that are particularly lightweight yet feature a high level of strength."



Left: The FiberForm process developed by KraussMaffei combines the thermoforming of organosheets and injection moulding into one process

One major trend for thermoplastic composites in injection moulded applications is sustainable production to meet the needs of the circular economy. "For the production of thermoplastic composites, this means less raw materials usage and energy consumption as possible in order to produce long-lasting, sustainable products with a low CO_2 footprint," adds Fuchs. "Another technical trend is load-path orientated carbon fibre reinforcements in the component. In addition, there is increased use of UD-tapes instead of large organosheets."

The company adds that the FiberForm process offers a number of advantages. Substituting steel and aluminium with fibre-composite construction provides a high degree of weight reduction and complex structures can be produced with no need for re-work. The use of continuous fibre-reinforcement within the composite sheets achieves high strength levels. The process is suitable for large series production with cycle times corresponding to typical injection moulding processes.

The process allows reproducible transfer of the composite sheets into the injection mould through highly precise gripping. It is a one-step process due to the integrated re-shaping process in the mould, which is fully automated as a compact production cell. Short composite sheet transfer times are achieved by positioning the infrared heating station near the mould. Integration of additional functional parts is possible during the injection moulding process.

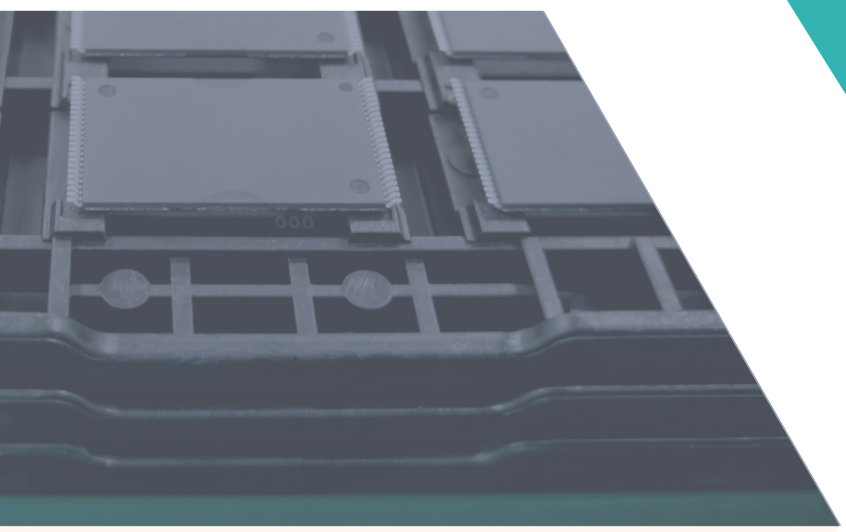
Current challenges include long heating times that need to be improved, as well as different wall thicknesses of organosheets due to load-path-oriented tapes that require new heating concepts. To meet these needs KraussMaffei has recently developed an intelligent control for the FiberForm oven. In addition, the company has integrated complete control of the FiberForm cell in the KraussMaffei MC6 control panel. This makes operation and control easier. Other developments have included a decrease in temperature difference between the top and bottom of the oven from 15°C

AMI | Events

Conductive Plastics

14-15 September 2022 | Düsseldorf, Germany

Developing technologies and applications for electrically and thermally conductive plastics



TAKE PART THIS SEPTEMBER

Save €300*

if you book your delegate place before 18 March 2022

Book your place

*VAT may apply. Discount cannot be retrospectively applied or used in conjunction with any other offer. Valid off full price.

CONTACT US

Joe Huckings
Delegate Service Executive

T +44 (0) 117 314 8184
E joe.huckings@ami.international

AMI

To speak, sponsor or exhibit

please get in contact

AMI | Events

Thin Wall Packaging

June 14-15, 2022 | Chicago, IL, USA

Identifying opportunities and maximizing returns in the lightweight plastic tubs, pots and trays industry

RECIEVE YOUR INDUSTRY UPDATE

- **Discuss** the latest material, technical and machinery innovations
- **Keep up to date** on the latest trends in global thin wall packaging markets
- **Learn** about sustainability goals and regulations effecting the TWP supply chain
- **Understand** developments in recycling technology that effect the TWP industry
- **Network** in person with industry experts and build professional contacts

Secure your place here

SAVE $300*
when you book before March 18, 2022

CONTACT US

Agata Swietek
Senior Conference Organiser

T +1 610 478 0800
E agata.swietek@ami.international

AMI

Media supporter:

Film and Sheet EXTRUSION

*this discount cannot be retrospectively applied or used in conjunction with other offers

to 5°C, as well as a reduction in cycle times of up to 25% depending on the material and size of the organosheet. KraussMaffei is also currently involved in the early phase of a German governmental funded project on a completely new development concerning FiberForm technology, the start of which will be in early 2022. Developmental work on recycling and reuse of some or all parts of a thermoplastic composite component is also ongoing.

The Fibre Direct Compounding (FDC) process developed by **Arburg** enables inline compounding on an injection moulding machine, which allows the use of long-fibre materials, as well as combinations with continuous reinforced fibres. The company adds that the process allows improvement of the mechanical properties of the component, especially strength and toughness, while saving material costs. One further benefit is that the material can be customised to the application. The fibre length, fibre content and material combination can be selected to match specific needs. In addition, recycled materials can be used. Mechanical properties are improved by overmoulding continuous reinforced fibre materials. These can be organosheets, tapes or a combination.

According to Arburg, the right combination of materials is needed to achieve the necessary solution to substitute other materials. A successful substitution will only be possible with a holistic approach. It is not only necessary to focus on weight reduction, but also consider improving the mechanical properties, as well as producing economically and sustainably. That means not only the use of recycled material, but also manufacturing products designed for recycling. Material substitution is primarily driven by demand from customers. However, Arburg also actively cooperates with universities and industry partners with the common aim to develop new possibilities for design and to meet the technical requirements.

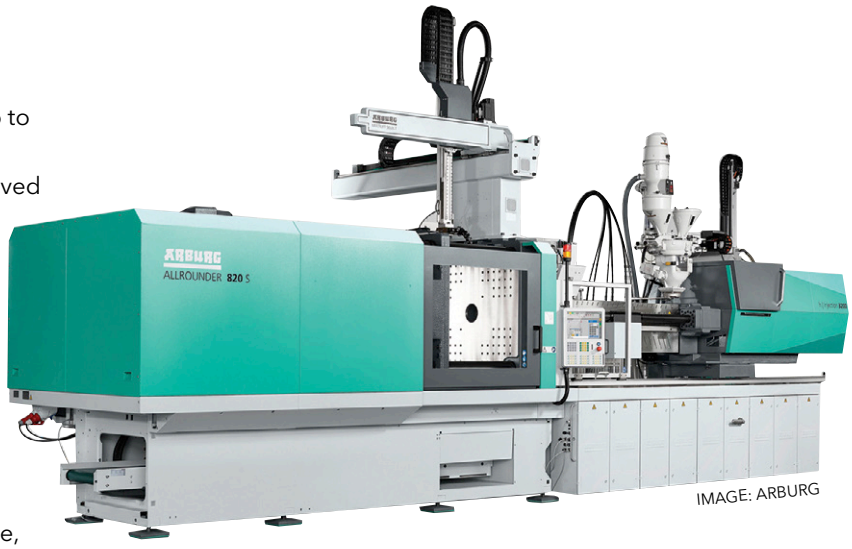


IMAGE: ARBURG

Above: The Fibre Direct Compounding process from Arburg enables inline compounding on an injection moulding machine, which allows the use of long-fibre materials, as well as combinations with continuous reinforced fibres

Lanxess and **Kautex Textron**, a Textron Inc company, have been collaborating to research whether battery housings for electric vehicles can be designed and manufactured from technical thermoplastics. Together, they have developed a near-series technology demonstrator in a feasibility study. With a length and width of around 1,400 mm each, the system is a technically sophisticated, large-format all-plastic housing part with a weight in the mid-double-digit kilogramme range.

The goal of the project was to demonstrate the advantages of thermoplastics over metals in terms of weight and cost reduction, functional integration and electrical insulation behaviour. Felix Haas, Director Product Development at Kautex Textron, says that as a first step, it has completely dispensed with the use of metallic reinforcement structures while proving it can commercially produce these complex large components. Dr. Christopher Hoefs, Project Manager e-Powertrain at Lanxess, adds that going forward, Kautex and Lanxess want to use the results of the cooperation to enter into development projects for series production with automotive manufacturers.

The demonstrator was developed based on the battery housing of a C-segment electric vehicle. It consists of a housing tray with crash structure, a housing cover and an underrun (underbody) protection. The housing components can be produced in a single-stage Direct Long Fibre Thermoplastic (D-LFT) moulding process. Lanxess has optimised Durethan B24CMH2.0 polyamide as the material for the D-LFT moulding compound. Kautex Textron compounds the PA6 for the process with glass fibre rovings. The local reinforcement of the housing

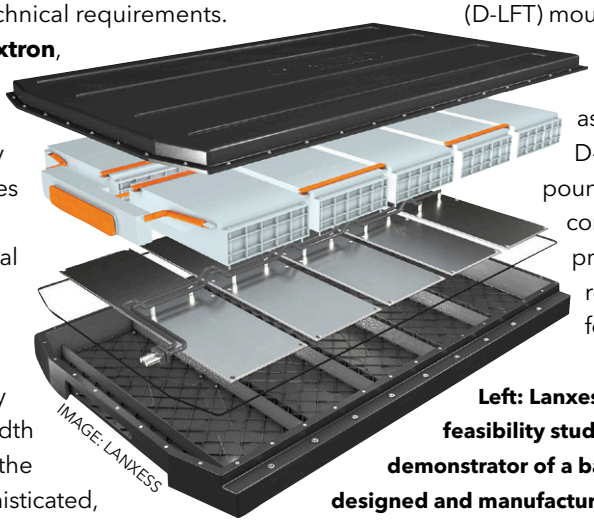


IMAGE: LANXESS

Left: Lanxess and Kautex Textron have collaborated in a feasibility study to develop a near-series technology demonstrator of a battery housing for electric vehicles that can be designed and manufactured from technical thermoplastics

structure is carried out using continuous fibre-reinforced thermoplastic composites of Lanxess' Tepex Dynalite brand. The process enables shorter and more economical cycle times than the processes in which steel or aluminium are processed.

Housings for high-voltage batteries are currently primarily made of extruded steel or aluminium profiles. Depending on the vehicle class, the housing length and widths can be well over 2,000 and 1,500 mm, respectively. The size, the number of components and the numerous manufacturing and assembly steps make metal housings very cost intensive. For example, complex structures made from strand press profiles require many secondary work steps such as welding, punching and riveting. In addition, the metallic components must be protected against corrosion in an additional process step by cathodic dip coating.

"Plastics, on the other hand, can fully exploit their design freedom," says Hoefs. "By integrating functions, such as fasteners and thermal management components, the number of individual components of a battery housing can be greatly reduced. This simplifies assembly and logistical effort, which reduces production costs." Plastics are also corrosion-resistant, as well as electrically insulating which ensures that there is a reduced risk of the system short-circuiting. The low density of plastics and their potential for lightweight construction lead to significantly lighter housings, which benefits, among other things, the travel range of electric vehicles.

High-voltage battery housings must meet a variety of highly demanding technical requirements. For example, they must be stiff and strong and yet be able to absorb a significant amount of energy in the event of a crash. This is tested through mechanical shock and crush tests. The housings must also be flame-retardant in the event of a vehicle fire or thermal run-away of the electrical cells. Finally, the housings must be integrated into the vehicle structure.

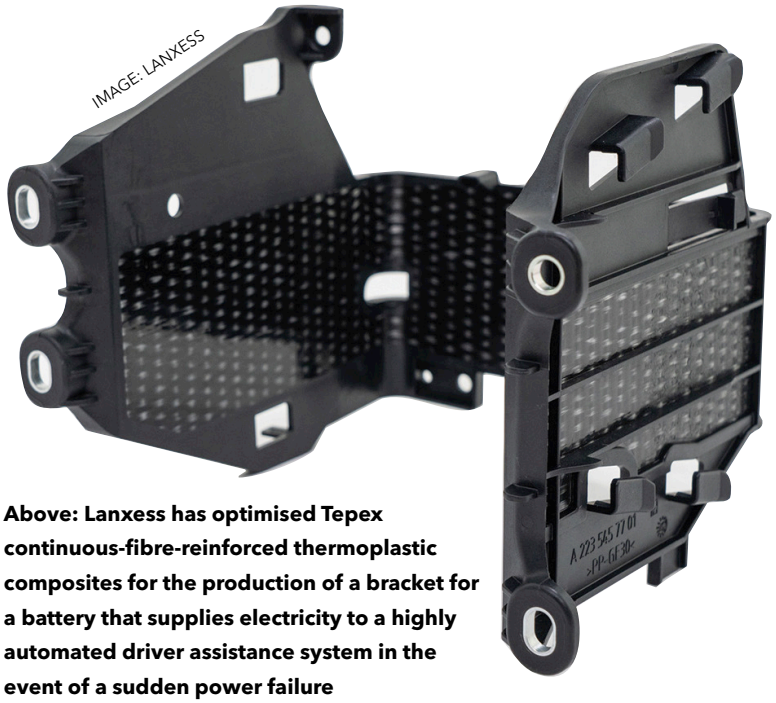
Lanxess has also optimised Tepex continuous-fibre-reinforced thermoplastic composites for the production of structural components that form part of driver assistance systems. One example is a bracket for a battery that supplies electricity to the highly automated driver assistance system 'Intelligent Drive' in the Mercedes-Benz S-Class in the event of a sudden power failure. The bow-shaped

bracket is made by **Poeppelmann Kunststoff-Technik** in Lohne, Germany, formulated with polypropylene-based Tepex Dynalite 104-RGUD600(4)/47%. The manufacturing method is a two-stage process combining forming (draping) the composite with injection moulding. "The composite design means that the finished product can be as much as 40% lighter than a version made from metal," says Joachim Schrapp, an expert in lightweight design at Poeppelmann. "The injection moulding step also enables functions to be integrated that not only make it much easier to install the bracket but also cut down on the logistical workload. All this has a beneficial effect on manufacturing costs."

The bracket's job is to hold the battery – which weighs around 10 kg – firmly in place in the rear compartment of the vehicle by clamping alone, even when subjected to the considerable acceleration forces that occur in a collision. The bracket is designed to ensure that most of the forces are transferred from the points of application via the continuous glass fibres of the composite material. This makes the most of the excellent strength and stiffness provided by the Tepex blank. "The advantage of our composite is that unlike fibre-reinforced injection moulded compounds, for example, it does not suffer creep under high sustained stresses and therefore does not deform. This ensures that the battery is held in place permanently," says Philipp Maas, Sales and Project Manager for Tepex at Lanxess. The blank also boasts a high degree of fatigue strength, which ensures that the material does not become brittle and crack over time as a result of frequent or heavy vibrations such as those caused by potholes.

The functions integrated in the bracket during the injection moulding stage include guides for cables, as well as mounts and fasteners for two control units. These two pieces of equipment are simply clipped into place during installation. The PP matrix of the Tepex material is reinforced with four layers of continuous glass fibres, most of them arranged in one direction. The injection moulding compound, which is reinforced with short glass fibres, is also PP-based. "Since the bonding matrix and the injection moulded material match, this creates a very strong bond between them. Coupled with the high specific stiffness of the composite, this leads to gains in both strength and stiffness," says Maas.

Another benefit of the composite semi-finished product is that it is resistant to corrosion, which makes transportation and storage easier than would be the case for metal coils. The electrical characteristics of the structural material also play a key role. "It is electrically insulating to the body and



Above: Lanxess has optimised Tepex continuous-fibre-reinforced thermoplastic composites for the production of a bracket for a battery that supplies electricity to a highly automated driver assistance system in the event of a sudden power failure

the metal components of the battery, which significantly reduces the risk of short circuits. A component made from metal, however, would require additional measures to protect against short circuits," says Schrapp.

The **Thermoplastics Composites Research Center (TPRC)** in the Netherlands has started a new overmoulding project that offers potential solutions for complex continuous fibre reinforced thermoplastic parts by combining two processes. Firstly, a continuous fibre reinforced thermoplastic composite blank is shaped in a stamp forming step. Secondly, additional features, such as ribs or inserts, are overmoulded onto the stamp-formed part. This way, overmoulding combines the high specific strength and stiffness of the continuous fibres with the design freedom and flexibility of a short fibre reinforced injection moulding grade. The process can also be easily automated and is well suited for high volume production.

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.engelglobal.com**
- **www.brose.com**
- **www.facc.com**
- **www.forward-engineering.com**
- **www.svismold.ch**
- **www.polymer-pilotanlagen.de**
- **www.kraussmaffei.com**
- **www.arburg.com**
- **www.lanxess.com**
- **www.kautex.com**
- **www.poeppelmann.com**
- **www.tprc.nl**

INJECTION MOLDING & DESIGN EXPO

FROM CONCEPT TO DELIVERY

MAY, 25-26 2022
DETROIT, MI, USA

REGISTER AS A FREE VISITOR HERE

Companies already confirmed to exhibit include:

MILACRON · CONAIR · tederic SMART INJECTION · mastip hot runner solutions · AVIVE Marketing for Manufacturers · ZERMA

Frigel · Wittmann Battenfeld · AMPACET Plastics Reimagined · iMFLUX FEARLESS INNOVATION · CH America

StackTeck · Chroma Color Corporation · ACCEDE · Cavalier Tool & MANUFACTURING LTD. · RJG MOLD SMART · JEM

PCS COMPANY Turn To The Industry Experts · Sumitomo SHI DEMAG · YIZUMI 伊之密 WE WALK ALONGSIDE THE WORLD · Moldex3D MOLDING INNOVATION · NU-ICE · OPTICOLOR INC

EAS CHANGE SYSTEMS · ACS GROUP · DME · ALPHALASER · KONGSKILDE Air solutions / your success · DINAMEC systems

Krauss Maffei Pioneering Plastics · GP GENERAL POLYMERS THERMOPLASTIC MATERIALS · CAE AUTODESK Reseller · ChasePlastics Redefining Resin Distribution · benpac packaging · STAR PLASTICS Navigating Custom Compounds

cumberland · aec · PROGRESSIVE COMPONENTS · STERLING · SLIDE

GLOBELUS A SOLUTIONS COMPANY · Rehmann EMPOWER YOUR PURPOSE · Paulson Training Programs, Inc. · TST Tooling Software Technology, LLC · RAMPF discover the future

Brought to you by: Plastics News · Injection WORLD

Organized by: AMI · CRAIN COMMUNICATIONS GLOBAL POLYMER GROUP

Headline sponsor: MHolland

MEET YOUR BUSINESS GOALS AT NORTH AMERICA'S FOCUSED MEETING PLACE FOR THE INJECTION MOLDING INDUSTRY

CPT CINCINNATI PROCESS TECHNOLOGIES
Beaumont Revolutionizing Injection Molding
DIJET
ENTEC
BAUER COMPRESSORS PLASTICS TECHNOLOGY GROUP
POLYMAX TPE
Routsis Training Hands-on. Online. Ongoing.
FRIGOSYSTEM COREMA
MHolland
Beacon INDUSTRIES World Class Manufacturing
sāco AEI polymers
Purgex Purging Compounds
SIGMASOFT Virtual Molding
polykemi BRINGS OUT THE BEST IN PLASTICS
Shibaura Machine
ZEIGER Industries
ASS Automations-Systeme
Filtroil
2R AUTOMATION
iD iD Additives
EPS FloTek Plastic Flow Analysis Services and Software
ABS ADVANCED BLENDING SOLUTIONS LLC
ESM EQUIPMENT SOLUTIONS OF MICHIGAN
AMCO POLYMERS
LENZKES Clamping Tools
CLEAN PLAST PURGE FAST
Spark Industries
ACTION MOLD & MACHINING
DOMO caring is our formula
intouch i4 cloud
optris infrared measurements
HAITIAN ABSOLUTE
MATSUI
INCOE HOT RUNNER SYSTEMS
CRÉATIONS foam CREATIONS Inc.
RAINBOW COLORS inc. Solutions for Every Color Under the Rainbow
BUNTING

and many more...

CLICK HERE TO FIND OUT MORE ABOUT EXHIBITING

www.injectionmoldingexpo.com

AMI | Databases

Injection Moulders Europe, Middle East and Africa

Target your market with confidence by accessing data on over 10,000 processing sites

We provide a unique level of detail

- Commodity and engineering polymers used
- Polymer throughput range
- End use markets supplied
- Machinery data
- Company specialisations and contact information
- Managerial contact details

Injection Moulders Switzerland

Published January 2022

Get your sample database

IMAGE: SHUTTERSTOCK

The Covid pandemic has brought many challenges to the market for medical plastics. James Snodgrass reports on the industry's hopes for 2022 and a range of new products from materials developers

Looking for a return to stability in medical sector

At the beginning of 2022, the market for medical plastics, much like this time last year, looks unpredictable. But it is, at least, more predictable than the preceding two years. In 2021, the pandemic, the semiconductor crisis and global logistical problems brought challenges to the medical manufacturing industry the like of which most people had never faced before. Also among the challenges were peaks and troughs in supply and demand of medical materials.

In 2020 the medical industry saw unprecedented demand for nonwoven PP face masks as countries sought protection from a virus for which there was still no approved vaccine. In 2021, once vaccines had been approved – and their global rollout prepared – demand for the medical grade PP (and PE) needed for injection moulded syringes grew, although this demand was for empty syringes. While pre-filled syringes have become the norm for most inoculations in recent years, the AstraZeneca SARS-CoV-2 vaccination, for instance, was distributed in glass vials of 10 doses, which was then drawn into disposable syringes which did not have a capacity equal to the volume of the vial divided by 10.

There was a sound reason why large glass vials were chosen, however: the robotic volumetric dosing required to produce pre-filled syringes was too slow a process to make them quickly enough. Multi-dose vials accelerated the production process, and the time saved on the production line was a benefit to the final dosing process, when the nurses and volunteers actually administered the vaccines to patients.

IMAGE: ICHO

Main image: Demand for syringes went up in 2021 as vaccine programmes were rolled out

Left: Icho therapy ball has an injection moulded outer skin made with Hexpol Mediprene TPE

Supply-demand see-saw

A spokesperson for trade body **MedPharmPlast-Europe (MPPE)** told *Injection World*: "The pandemic and related supply chain issues around the world have wors-

IMAGE: PVCMED ALLIANCE

Above: PVCMed Alliance is working on projects for hospitals to recycle used PVC products

ened the supply situation across all industries and certainly the medical industry had more attention than in the past for the polymer suppliers delivering in this field. Generally speaking, polyolefins and commodity polymers (ABS, etc.) had a higher demand, while technical polymers were more readily available to the medical sectors because of the crisis in the automotive industry."

Other factors also affected polymer markets in 2021. Restricted movement of peoples and an unseasonably wet summer through much of Europe led to a dip in demand for bottled drinks and which particularly affected the PET market. The rising cost of oil (a 55% hike from Q1 to Q4 2021) has caused pain to manufacturers and consumers alike.

Automotive's woes should have been medicine's gain in 2021, at least in terms of polymer availability, but there were significant price increases for technical polymers that were not entirely attributable to the oil price increase. Instead, although lower demand from automotive freed up supply, the demand from the medical sector itself was simply too high for there not to be inflationary pressure.

There is an often-repeated cliché that the Chinese word for "crisis" is also the Chinese word for "opportunity". The translation is inaccurate, but the sentiment may be correct. Has the pandemic been a catalyst for innovation in the industry?

"Probably yes," the MPPE spokesperson said, "but it is too early to evaluate this phenomenon reliably. Additive manufacturing has shown impressive capabilities in emergency situations, typically coming from small- and mid-sized companies, but also regulatory approach towards innovation in a pandemic situation has shown interesting changes. We should keep the pace and leverage the current situation to innovate even more and quicker. The industry has been strong in finding creative solutions for the supply chain issues, production increases, etc. within the appropriate regulatory frame."

Did the market for medical polymers exceed forecasts in 2021? Again it's a tough call, according to the MPPE: "Some medical devices were needed more – a huge increase – and others less, due to less work in the hospitals". So there was a see-saw effect: unprecedented demand for products that might slow or curtail the spread of Covid was tempered by a weakening demand for products needed for routine operations that were cancelled as a result of the pandemic.

Pricing and supply chain issues aside, the MPPE thinks the acceleration of regulation necessitated by the global threat of Covid has given us a pointer towards better ways of working. "Good relationship management and long-term contracts showed advantages for all parties throughout the years 2020 and 2021, and it will be interesting to see if and how the regulatory approach can be streamlined beyond the pandemic," said the spokesperson.

Now that large swathes of the global population are vaccinated and the Omicron variant appears less of a danger than it did towards the end of 2021, the public is expecting an imminent return to normality. Minor medical procedures, postponed for so long, will start again. Patients, having spent two years learning about infection, disease and prevention, are expected to increase demand in the home healthcare market. As a result, according to research from **Fact.MR**, reported by Bloomberg, the medical polymers market is set to expand 250% between now and 2031, with commodity polymers continuing to dominate, accounting for 87% of total medical polymer sales. The research group estimates the value of the global medical polymers market was $8.19bn in 2020 and it projects the market to reach $20.1bn in 2031. Add to this a growth of medical polymer applications within medicine, and the overall market is projected to show a compound annual growth rate (CAGR) of 8.2% between 2021 and 2031.

PVC continued its reign as the top polymer for single-use medical devices, according to research published in September 2021 by Global Market Insights, because of its ease of recycling and, because it is versatile, and can be used as both a rigid and flexible plastic in medical devices that require both rigidity and flexibility, making multi-part devices easier to recycle than ones made of mixed polymers. GMI expects PVC will continue to be the dominant single polymer in the medical market until at least 2027.

PVCMed Alliance project manager Ole Grøndahl Hansen said: "Covid-19 has highlighted the crucial role played by single-use plastic medical devices in the prevention and control of infection in

AMI | Events

Fire Retardants in Plastics

April 26-27, 2022 | Houston, TX, USA

SAVE $300* if you book before February 24, 2022

Exploring trends and technical developments in the international fire retardant industry

The event brings together industry professionals to evaluate and discuss the latest trends, legislative/regulatory developments, new applications, developments in formulation and technology in the fire retardant industry.

Secure your discounted place

Sponsored by:

Nabaltec

ALBEMARLE®

Budenheim

Media supporter:

Compounding WORLD

Industry-leading speakers include:

Maurizio Longhi
Materials Technology Regulatory GSME,
WHIRLPOOL CORPORATION

Laurent Tribut
Plastic Materials, Distinguished Technical Expert,
SCHNEIDER ELECTRIC

Benjamin Gann
Chemical Products & Technology,
AMERICAN CHEMISTRY COUNCIL

Jakub Lison
Technical Manager Americas,
ICL GROUP

Maggie Baumann
Vice Chairman / Business Manager North America,
PINFA NA / FRX POLYMERS

Dr Subra Narayan
Technical and Business Development Manager,
CLARIANT

*this discount cannot be used in conjunction with other offers

AMI

VIEW THE AGENDA TODAY AT www.ami.ltd/attend-fire-USA

AMI Plastics World Expos NORTH AMERICA

BOOK YOUR BOOTH

November 9-10, 2022

CLEVELAND, OHIO, USA

Co-located exhibitions:

- COMPOUNDING WORLD EXPO
- PLASTICS RECYCLING WORLD EXPO
- POLYMER TESTING WORLD EXPO
- PLASTICS EXTRUSION WORLD EXPO

Get your products in front of the right people with our focused expos

HIGHLIGHTS FROM 2021

3,000+
attendees

220+
exhibitors

44
states represented

55%
of attendees have an annual budget of over $1M

Brought to you by: AMI

Proudly supported by:
Compounding WORLD
Film and Sheet EXTRUSION
Pipe and Profile EXTRUSION
Plastics Recycling WORLD

hospitals. The negative side-effect of this success has been growing amounts of hospital plastic waste. We believe recycling is part of the solution. Fortunately, the most used plastic in healthcare is also the most recyclable plastic, and we therefore urge hospitals to start their recycling activities with PVC."

Addressing the objection to traditional plasticisers used in PVC, Hansen said: "For almost all applications, alternative plasticisers for PVC are available and are being used. Four of these are now included in the European Pharmacopeia, which sets the safety and quality guidelines for medical products in Europe and beyond."

But the war on PVC continues, with a paper published by European NGO Health Care Without Harm urging EU policymakers to phase out PVC use entirely. Hansen said: "The paper contains so many errors that we must urge European policymakers and hospitals to disregard it. Many hospitals around Europe are currently investigating how to implement circular initiatives for their plastic waste. Paradoxically, if they decide to follow the recommendations from NGOs, hospitals will do more harm than good for the environment."

Right: Avient has expanded its Mevopur line of medical-grade materials for pharmaceutical packaging and medical devices

He said: "When I started in the PVC industry more than 25 years ago, Greenpeace rightly pointed to issues related to PVC and its additives. With scientifically based arguments, Greenpeace succeeded in influencing policymakers to regulate, and industry to invest and innovate. Today's NGOs, as seen in the present paper, unfortunately do not employ the same scientific rigour when it comes to PVC."

With restrictions on events easing in 2021, the trade show calendar had fewer crosses on it than it did in 2020. One show that was able to open its

Ampacet has introduced its ProVital and ProVital+ range of masterbatches for healthcare applications

IMAGE: AMPACET

doors in 2021 was Pharmapack Europe, in Paris in October. Sustainability continues to be a focus, and selling point, among newly launched products.

New products

Here **Avient** announced two additions to its Mevopur line of medical-grade materials for pharmaceutical packaging and medical devices, which it claimed could help customers reach sustainability goals more quickly. The medical-grade materials are produced according to ISO13485-2016 protocols and supported by testing to ISO 10993-1, USP, European Pharmacopeia and ICH Q3D guidelines.

Avient also demonstrated colour and additive masterbatches based on a PE carrier that is manufactured using non-fossil feedstocks with a bio-based content up to 95% but which can be processed the same way, and recycled in the same recycling channels, as conventional fossil-based polyolefins. For customers who prefer ready-to-use solutions, Avient also announced Mevopur pre-coloured formulations, also based on bio-derived PE.

In 2021, masterbatch manufacturer **Ampacet** introduced its ProVital and ProVital+ range of masterbatches for healthcare applications. ProVital+ is formulated with raw materials pre-tested to European Pharmacopeia section 3.1 and with biocompatibility according to ISO 10993 standards. In 2022, Ampacet has added ProVital+ Colors to its portfolio: a range of medical-grade colours specifically designed for pharmaceutical packaging, medical devices and in-vitro diagnostic equipment.

Arkema has introduced a new polyamide 11 for medical applications which also boasts sustainability credentials. Rilsan MED PA 11, part of Arkema's Advanced Bio-Circular materials portfolio, is based on the company's amino 11 chemistry, which is derived from castor bean oil. Rilsan MED PA 11 is formulated with 65% glass fibre, giving it a tensile modulus of 18.5 GPa. The company suggests that this tensile strength might make the material a suitable candidate to replace metal in surgical tools.

Arkema claims its Rilsan MED PA 11 withstands repeated gamma, steam, E-beam, and EtO sterilisation cycles and exposure to harsh chemicals. Biocompatibility has been assessed according to USP Class VI and ISO 10993-4, -5, and -10 standards. Rilsan MED PA 11's sustainability credentials include a climate-change impact as much as 50% lower than competitive fossil-based polymers and a reduction in the depletion of fossil fuels, says Arkema. The polymer is recyclable, most effectively when it is processed through Arkema's closed- or open-loop Virtucycle program.

Also new in the field of engineering polymers for medical applications in 2021 was a portfolio of materials from **DSM**. The family of medical-grade polymers includes Arnitel Care polyester-based thermoplastic elastomer (TPC), Arnite Care polybutylene terephthalate (PBT), and ForTii Care polyphthalamide (PPA). The materials are intended for use in a range of non-invasive medical devices and meet or exceed FDA food-contact requirements, ISO-10993, and USP Class VI guidelines, according to the manufacturer.

Arnitel Care L225E, L140E and L345E are grades that offer breathability, durability and chemical resistance and are therefore intended for applications including films, tubing and soft touch wearable medical devices. Arnitel Care T1U has high purity, mechanical strength, low moisture uptake and offers chemical resistance. This is suggested for durable medical device components including inhalers and minimally invasive surgical tools.

ForTii Care P1G6 offers mechanical strength, stiffness, high-temperature performance and chemical resistance, and is intended for metal replacement particularly in minimally invasive surgical tools.

"Improving health and quality of life around the world is a core pillar of our business," said Shruti Singhal, President of DSM Engineering Materials "With our customers increasingly leveraging our advanced material solutions to improve the performance and sustainability of various medical devices, we are now taking the next step as we launch a portfolio of materials rigorously tested to adhere to the highest global quality and safety standards for medical applications."

In November 2021, **Covestro** launched a group of durable materials for medical device housings

and hardware. MakrolonM6011 FR, a medical PC, and Makroblend M5005 FR, a medical PC/polyester blend, exhibit properties that improve chemical resistance and increased flame retardancy.

The company claims that while hospital acquired infections rise and the Covid pandemic persists, the two new materials provide improved disinfectant resistance that respond to today's challenging market requirements for medical device housings. The PC materials conform to UL rating UL 94 V-0 and offer enhanced impact strength, increased rigidity, as well as UV resistance and improved flowability.

"The value proposition for these new durable materials is two-fold," says Irving Paz Chagoya, Covestro's Healthcare Segment Manager in EMEA. "First, these products use next-generation phosphorous based flame retardants. Second, these new polycarbonate materials comprise a variety of attributes – improved chemical resistance, impact strength, heat resistance, and so on – in a single solution."

Kraiburg TPE has launched the Thermolast H range of TPEs designed exclusively for Asia Pacific's healthcare applications market. The TPEs comply with Cytotoxicity ISO 10993-5, GB/T 16886.5, as well as various global food contact and relevant medical standards. Typical applications include medical and healthcare devices, resealing caps, medical and healthcare packaging and tubing.

Aiming to meet the exponential growth in demand for syringes to supply the Covid vaccination programme, South Korea's Poonglim Pharmatech, chose medical PP from **Lotte Chemical** to produce its low dead space (LDS) syringes. PP is commonly used for syringes because of its resistance to heat and shock, clarity, and high fluidity. PP certified for medical use is widely used for products including IV bags and bottles and syringes.

The LDS syringes – distributed throughout Korea and abroad – needed to be of high-clarity so that people administering the vaccine could accurately gauge the amount of liquid drawn from the vial. The syringes were mostly composed of Lotte Chemical's SJ-170M medical PP grade, apart from the metal needles and PVC (or elastomer) gaskets.

In addition to producing SJ-170M, Lotte also supplied J-560M, a high-clarity product, containing Milliken's NX8000 additive, that is suitable for sterilisation by gamma rays.

J-560M has been mass-produced since 2011 and acquired USP Class VI and FDA DMF certifications in 2013. While, at the start of the vaccination programme, the vaccine was largely distributed by vial, Lotte has a PP grade, J-560M1, specifically developed for pre-filled syringes.

IMAGE: STANISLAV UVAROV

Above: Covestro offers a broad portfolio of materials for medical devices, such as PCR test equipment

In the related market for therapy products, **Hexpol TPE** has highlighted its collaboration with Icho Systems which works on interactive therapy and systems for people with cognitive diseases. The Icho therapy ball was developed to promote cognitive and motor skills in a playful way. Depending on the application, the ball can react with coloured lights, vibrations, sound or music.

The therapy ball has an injection moulded outer skin which houses the lights, speaker, sensors and electronics. Hexpol Mediprene TPE was selected due to its soft-touch haptics and good light permeability. The material also needs to be easily cleaned and Mediprene TPEs are resistant to the most common cleaning fluids used in the healthcare environment.

As the Icho ball was developed for use in a medical context, a medical-grade material was required. Representative Mediprene TPE materials have been tested for cytotoxicity according to ISO 10993-5 and for biocompatibility according to ISO 10993-10 (Intracutaneous Reactivity)/-11 (Acute Systemic Toxicity) and USP Class VI. Mediprene materials are latex-free, which reduces the risk of allergic reactions.

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.medpharmplasteurope.org**
- **www.factmr.com**
- **https://pvcmed.org**
- **www.avient.com**
- **www.ampacet.com**
- **www.arkema.com**
- **www.dsm.com**
- **www.covestro.com**
- **www.kraiburg-tpe.com**
- **www.lottechem.com**
- **www.hexpol.com**

INJECTION MOLDING & DESIGN EXPO

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

Speakers announced for Detroit moulding expo

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

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

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

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

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

Industry leaders

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

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

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

Troy Nix
Manufacturers Association for Plastic Processors

Carla Bailo
Center for Automotive Research

Alper Kiziltas
Ford Motor Company

Diane Marret
Berry Global

Jeff Stout
Yanfeng Automotive Interiors

Katie Roco
Faurecia Interiors

David Clark
Amcor

Laurie Harbour
Harbour Results

Gene Altonen
iMFLUX

Megan Tsanoukakis
Sussex IM

Mark Gomulka
Westfall Technik

Patricia Miller
Matrix 4

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

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

Design debates

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

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

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

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

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

AMI | Events

Single-Serve Capsules

20-21 September 2022 | Barcelona, Spain

Connecting industry professionals to explore the latest developments and trends in the single-serve capsules industry

www.ami.ltd/attend-capsules

BOOK YOUR PLACE TODAY!

Join us at the fifth edition of this international event for the single-serve capsules industry.

- Gain insight into the latest industry trends and product innovations
- Discover dynamic new applications from food companies looking at the capsule format
- Learn about the latest developments in recycling opportunities
- Explore different approaches to sustainability from material innovations to end-of-life choices

Save €300* off your delegate place

CONTACT US

Agata Swietek
Event Organiser
T +44 (0) 117 314 8111
E agata.swietek@ami.international

Media supporters:

Film and Sheet EXTRUSION

Injection WORLD

*Valid until 25 March 2022. Discounts cannot be used in conjunction with any other offers.

IMAGE: SHUTTERSTOCK

Working to make the cut

With the drive to circularity, moulders are looking to granulators to incorporate high-quality regrind. Peter Mapleston looks at some of the latest granulator developments and how Covid-19 has affected business

The granulator is more or less a staple of any injection moulding operation. No matter how good the production, no matter how many moulds have hot runners, sooner or later there will be some scrap that can be reused. Granulating in-house is the best option, making it possible to feed material straight back to the injection machine hopper, or to a central collection station.

Granulators are pretty simple devices, and the core technology hasn't changed much over the years, but improvements do continue to be made, mostly when it comes to things like sound-proofing, controls, and communications. Technology groups have reported on new product developments and how Covid-19 has affected business.

CMG Granulators has launched a new series of small high-performance beside-the-press granulators. It says the G17 units "contribute to obtaining the highest degree of productivity, regrind quality (homogeneous particle dimensions and absence of dust), efficiency of operation and the best application flexibility." In their standard configuration, the G17 granulators are applicable for use in injection moulding and blow moulding operations; modified ET1 and ET2 versions are suitable for extrusion operations. Output capacities range from 5 to 90 kg/h.

The G17 granulators can produce fine regrind, with dimensions similar to those of virgin pellets. Giorgio Santella, Managing Director at CMG, says this has the advantage of enabling mixing higher percentages of the regrind into virgin material with no influence on the quality of the finished product. "Small capacity systems, injection moulding machines or extruders, are equipped with small diameter plastification screws, unable to process granules with dimensions exceeding

IMAGE: CMG

Left: CMG's G17-38 has a throat measuring 380 x 310mm

those of the virgin granule," the company notes.

Another notable feature is the possibility to configure G17 units with either a staggered rotor or an open one, to best fit the application. Rotor blades and stationary blades are all adjustable.

The entire G17 unit can be accessed, cleaned and put back into operation in a few minutes. All parts are accessible with no need for tools. The units have a new sound insulation shell, which CMG says is designed to obtain noise levels well below those industrially acceptable (EN12012-1).

CMG also has a new series of low-speed screenless granulators, with similar attributes in terms of output quality, ease of operation and maintenance, and sound levels. The SL range consists of four models, for capacities ranging from 5 to 30 kg/h. CMG says that unlike conventional screenless granulators, the new types do not fracture or crush parts. The sector grinding elements are available in three different sizes.

SL units have a metal trap positioned in the feeding zone: metal contaminants are captured by a high-intensity magnetic plate. All hoppers are equipped with sight glass for visual inspection of the grinding operations.

All SL models are designed to be accessible from one side and do not require to be moved away from the injection moulding machine to perform maintenance or cleaning.

With its new MGL2-TPE model, **Matsui** claims it has the only low-speed granulator in the world designed to cut all soft plastics.

Below: Matsui's MGL2-TPE unit is a slow-speed granulator for soft materials

IMAGE: MATSUI

Low-speed granulators, which use rollers, torque, and teeth to get the job done, rather than blades, speed, and screens, are normally used for harder plastics. Low speed provides high quality regrind, low dust, and higher homogeneity, says Matsui. Granulators use less power, they are safer in that they stop more quickly, running costs are low, as are noise levels, and they are cleaner.

"Until this day, fast speed granulators were the best way to grind thermoplastic elastomers, polyethylene, and the like," says Matsui. "Indeed, slow speed grinders couldn't have a clean cut and would only stretch the material therefore giving an uneven regrind quality while the fast speed granulators could give better clean cut."

The MGL2-TPE changes that. The company says it has designed a special cutter to make it possible to use low speed cutting to granulate soft plastics. The company gives little away about what exactly is special, saying only that "it is all due to the S-cutter (the big knives) and the roller teeth." The unit is protected by several patents.

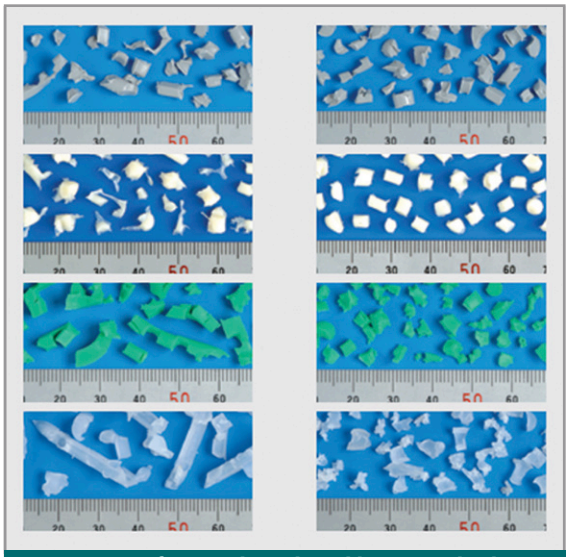


IMAGE: MATSUI

Comparison of regrind produced by a standard low-speed cutter (left) and Matsui's new unit. From the top: Grilux TPE-E from DIC (Shore A hardness 85-95); Hytrel TPE-E from DuPont (93-98), Milastomer TPV from Mitsui Chemicals (55-65); Rabalon TPE-S from Mitsubishi Chemical (35-37)

The Fakuma show in Friedrichshafen, Germany, was back as a live event in October 2021, and several granulator makers were there to ply their wares again. **Hellweg**, for example, took the opportunity to highlight the fact that its entire range of granulators is now equipped with its digital Smart Control System, which premiered two years earlier at K 2019. Monitoring is now an option for all sizes, starting from the 150 series machine-side granulators for small parts and sprues right up to the heavy-duty 600 series designed for the toughest applications.

The control system detects not only parameters such as power consumption, motor speed and bearing temperatures but also the state of blades, screens and V belts. Hellweg adds that the recent implementation of the Ethernet-based OPC UA (Unified Architecture) cross-platform open-source standard for data exchange means the machines can now be integrated into control centre systems.

In addition to providing component monitoring and interconnection with other machines, the control system also has a boost mode for adapting grinding capacity to production-related fluctuations. "Adaptation of operating parameters to defined plastics means that even temperature-sensitive grades can be straightforwardly processed without water cooling," says Managing Director Mark Hellweg. The eco operating mode adjusts machine speed to the prevailing input volume, reducing power consumption.

Hellweg says Smart Control is meeting a long-felt

need in the sector. "Our customers particularly appreciate the ability to monitor the mills' mechanical components and schedule maintenance accordingly, so avoiding disruptive and costly production downtime," he says. "High levels of demand have meant we have been able to adapt the Smart Control System to all our series much sooner than originally planned."

Tria's latest developments for injection moulders were also on display at Fakuma 2021. These included the new version of the company's JM 15 Series. Innovations include a hopper with a larger inlet to better collect the material coming from the press; a reduced height to make it easier to position units under the press; a reduced footprint; and a high efficiency motor to reduce consumption. Noise levels are also lower than before, without the use of a soundproof box for both in-line and off-line use.

IMAGE: HELLWEG

The new version of JM 15 Series is available in two versions, the JM 2115 and JM 4215. They sit alongside existing models, which continue to be available.

Wittmann too has been upgrading existing units. G-Max compact beside-the-press granulators are for closed-loop material recycling of sprues and runners coming from injection moulding machines up to 5,000 kN. They grind soft to medium-hard pieces made typically from polyolefins, ABS, and TPUs.

The design of the G-Max series has now been standardised, based on the design of G-Max 13. This means that the larger G-Max 23 and G-Max 33 units now come with larger hopper openings, and customers are now given a choice between a fixed and a rotatable version of material outlets.

All units are driven by a Poly-V belt transmission. Wittmann says that in the realm of small beside-the-press granulators, it is alone in offering a belt drive with an automatic tensioning system.

Left: Hellweg 600 Series unit

Upgrading granulators: points to consider

A good granulator can keep on performing for decades. But at **Conair**, Size Reduction General Manager Dave Miller wants to remind processors about possible performance and safety concerns posed by older size reduction equipment. "If a granulator has served you well – and it's paid for – it can be easy to overlook rising energy and maintenance costs due to accumulated wear and tear on the motor and drivetrain," he says. But the lack of modern safety features on a granulator can be of greater concern, particularly as older experienced workers give way to new personnel.

Miller recently led a three-year industry review of equipment safety standards used by US size-reduction equipment makers. This has resulted in a new standard from ANSI, the American Standards National Institute, *ANSI/Plastics B151.11 Safety Requirements for Granulators, Strand Pelletisers and Dicers Used for Size Reduction of Plastics*, published in April 2021.

The standard sets out a mix of required and optional safety improvements. "So, for example, if your personnel are used to removing and sharpening rotor knives on older equipment by wedging in blocks of wood, you'll be relieved to know that the new standard requires newer granulators to offer interlocks that prevent access to cutting chamber and screen to prevent access when equipment is on or when blades are moving – a job typically done with the help of use of time-delay safety switches or zero-speed sensors," says Miller.

The new standard also mandates feed-hopper designs of a size to receive the largest part being granulated without the need for pre-cutting, with internal dimensions that prevent operators from reaching an armour hand into the cutting chamber area. It also recommends new procedural safeguards, including guidance for adopting lock-out, tag-out rules to ensure proper shut-off during maintenance and repairs.

Miller goes on: "Safety conscious processors may also benefit from sound-dampening and sound-enclosure recommendations, as well as recommendations/requirements for the use of dust collection equipment. If your personnel are operating granulators that lack modern safety features, it may be a wise time to consider a change, along with training and preventative maintenance to ensure the safety of your size-reduction operations for years to come."

The material screens of the G-Max series are available with screen perforation in different sizes, which can be chosen to suit different materials and throughputs. The tiltable material hopper simplifies cleaning and servicing of the appliance enormously. For instance, a screen change can be carried out without tools, and the time required for servicing is reduced.

Getecha was in Friedrichshafen with its sound-proofed 45-kW RS 45090. Designed for throughputs of up to 900 kg/h, it is primarily intended as a central granulation station. Two stator knives and three or five rows of rotor knives operate in the cutting chamber. The drive is positioned higher than usual, and integrated into the housing, making the granulator more compact and reducing floor space requirement. The version exhibited at Fakuma was an example of the customisation possible on the RS 45090. It can be expanded with various bypass funnels to increase its versatility. With the appropriate design, a single RS 45090 can replace the working volume of three different applications, Getecha says.

The company also showed a GRS 180 Series granulator suitable for cleanroom use. "Thanks to an airlock funnel, integrated extraction technology and special sealing measures, these granulators release hardly any particles (<1.0 µm)," it says. The sluice funnel prevents regrind from being thrown out and also reduces the noise level.

At **Rapid Granulator**, which showed its OneCut Pro in different variations at Fakuma, together with granulators from its 150 and 400 series, Sales and Marketing Director Anders Martensson says that overall, the market is "super strong, and despite predictions we get from financial advisors, it seems set to continue through at least the first half of 2022". Where is that strength most manifested? "We see remarkable growth in the production of toys for children – and if something is related to Covid, that is for sure one of them. Quality toys are definitely booming. Producers of those toys buy quality machinery, so we benefit from that."

Indeed, in general people buy more quality products today, says Martensson. "At least in Europe it seems like people are thinking more about reuse. If products can

IMAGE: WITTMANN

Right: Wittmann G-Max 23 beside-the-press granulator

AMI | Events

Polymer Sourcing and Distribution

28-30 June 2022 | Hamburg, Germany

Headline sponsor

Biesterfeld
Competence in Solutions

Take part in next year's edition

Save €200*

if you book your delegate place before 1 April 2022

Secure your place today at:
www.ami.ltd/Polymer-Sourcing-event

*VAT may apply. Valid off full price. Discount cannot be retrospectively applied or used in conjunction with any other offer.

To speak, sponsor or exhibit contact

Maud Holbrook
Conference Portfolio Manager
E/ maud.holbrook@ami.international
T/ +44 (0) 117 314 8111

SPREAD THE WORD

Let the world know about the good things your company is doing by advertising in *Injection World* magazine. Download the media pack to find out about our forthcoming features, global readership, and cost-effective advertisement packages.

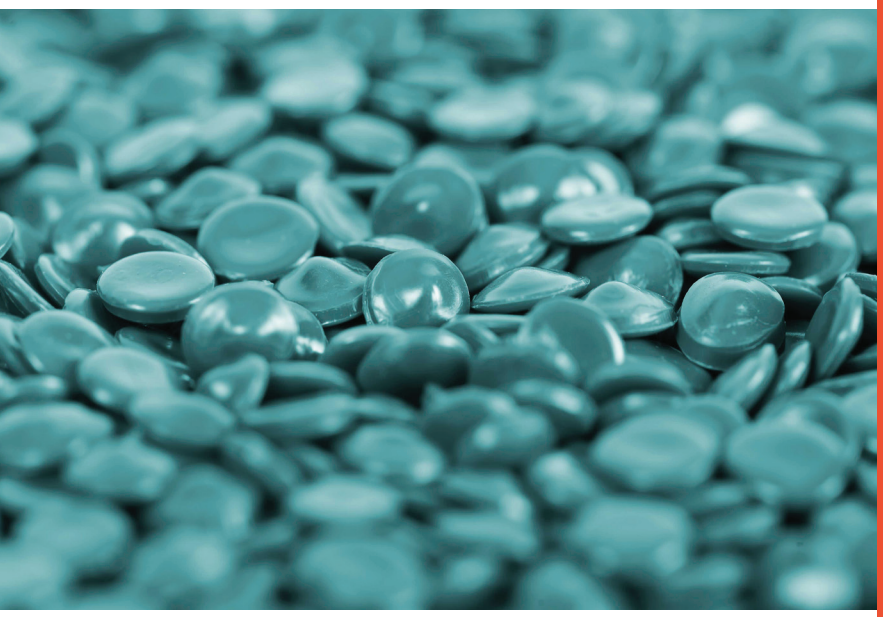
CLICK HERE TO DOWNLOAD

AMI | Events

Compounding World Congress

7-8 June 2022 | Cologne, Germany

Identifying new business strategies, innovative additives, and process optimisation for thermoplastics compounders



BACK BY POPULAR DEMAND

- Gain insights into global market trends and business strategies
- Debate key technical and commercial issues
- Explore new additive and materials technologies
- Learn practical tips for optimising the production of compounds
- Network with key industry professionals

Save €300* off your delegate place - ends 6 February 2022

Book your place

Other ways to get involved

Speak: Share your expertise on any aspect of compounding.

Sponsor or exhibit: Enhance your image and make a lasting impact on event attendees.

To find out more, contact us.

Organised by: AMI

Media supporter: Compounding WORLD

*VAT may apply. Discount cannot be retrospectively applied or used in conjunction with any other offer.

be sold on the second-hand market, consumers today are willing to spend more money on them. Circular thinking is finally getting a good foothold."

Rapid has production in Sweden and also in the US, where Martensson says the company continues to gain market share. He claims Rapid has the broadest offering of any producer in North America.

Cumberland, a division of ACS, is an established leading company in North America, with offerings in beside-the-press and centralised granulating, and for all sorts of processors. Joe Platek, Business Development Manager for Cumberland granulators, says the company has also experienced a big uptick in orders from customers producing DIY goods and products for home, gardening, and camping use – another effect of the Covid pandemic.

Teel Plastics in Baraboo, Wisconsin, a key customer, has adopted Cumberland's FX granulators in its injection and extrusion operations to make a major dent in its waste output and its carbon footprint. It has been significantly expanding its moulding operations to produce swab stick handles for Covid-19 test kits. Nine new fully automated lines are already in operation, and several more are due for installation, each one with its own FX712 granulator that is fed sprues by a pick-and-place robot. All the granulators are linked by vacuum lines to a centralised conveying system – something possible since they are all running with the same material.

ACS Group has two main manufacturing facilities: one located in New Berlin, Wisconsin, where final assembly, QC and shipments are carried out; and (in common with some other Western brands) a facility in China producing some components, mostly sub-assemblies and larger elements. That brings costs down, but price competition from major all-Asian brands like Shini (headquartered in Taipei, Taiwan and with manufacturing on the island and in mainland China) is still very tough, especially when it comes to beside-the-press units; Platek acknowledges that such equipment can be attractive for small trade moulders operating on tight budgets.

The Cumberland strategy is to emphasise the quality and longevity of its products. "There are still machines from us in the market that were built in the 60's," he notes. Rotors, for example, are machined to tight tolerances, eliminating the need for adjustable rotor knives and welded-on counterweights on lower-cost rotors.

Pallmann has traditionally been known for its large equipment, which includes not only granulators but also mills, shredders, and agglomerators, not only for post-consumer and post-industrial plastics but also for (especially) wood, pharmaceuticals, and various chemical products. In the Americas, however, it has also partnered with an unidentified company manufacturing equipment in Mexico on a toll basis. The arrangement, enabling **Pallmann Industries** in the US to offer smaller machines, was first put in place in 2017.

One of the reasons for the different local arrangements has to do with sales reps in North America preferring to take on complete ranges of equipment within particular sectors. There is also the fact that Pallmann Industries in the US (as well as Pallmann do Brasil) is owned by a member of the Pallmann family based in Germany, whereas Pallmann Maschinenfabrik in Germany has since 2017 been owned by Siempelkamp, a systems supplier of plant and equipment for the wood-based panel industry (as well as for metal forming and composites).

IMAGE: PALLMANN INDUSTRIES

Left: PP2060 beside-the-press granulator from Pallmann Industries for small parts and runners

Jeff Taylor, VP of sales for Pallmann Industries, says: "We are still best known for the large machines, even in the USA, but we are taking on more regional reps and raising our profile in smaller granulators too. Our approach is to offer complete solutions, entire size reduction systems."

Pallmann Industries' rebadged machines include the PP2060 for beside-the-press granulation of sprues, runners, and small parts; and the TXX60160 for centralised size reduction.

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.cmg-granulators.com**
- **www.matsuiamerica.com**
- **www.hellweg-granulators.com**
- **www.triaplastics.com**
- **www.wittmann-group.com**
- **https://en.getecha.de**
- **www.rapidgranulator.com**
- **www.cumberlandplastics.com**
- **www.acscorporate.com**
- **www.pallmannindustries.com**
- **www.conairgroup.com**

Download these new product brochures

Simply click on the brochure cover or link to download a PDF to your PC or smartphone

MASTIP HOT RUNNER SOLUTIONS

This 8-page brochure details Mastip's solutions in hot runner technology, including valve gate tip options, manifold valve gate actuators, nozzle range, its VeriShot technology, Nexus pre-assembled systems and GTV8 Integrated Sequential Control System.

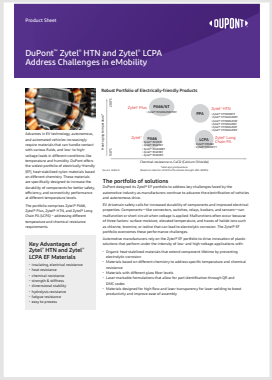
❯ CLICK HERE TO DOWNLOAD

POLYKEMI: CUSTOM COMPOUNDS

This 12-page brochure provides an introduction to Polykemi and its range of custom engineered plastic compounds. It includes details of production locations, subsidiaries, R&D capabilities and quality certifications.

❯ CLICK HERE TO DOWNLOAD

DUPONT: E-MOBILITY POLYMERS



DuPont's Zytel HTN and Zytel LCPA polyamides are electrically-friendly (EF) materials designed to increase the durability of components in e-mobility applications. Find out about the features of DuPont's EF materials in this company brochure.

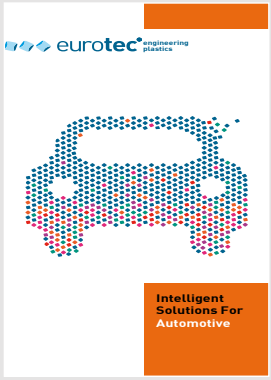
❯ CLICK HERE TO DOWNLOAD

TISAN: ENGINEERING COMPOUNDS

Tisan Engineering Plastics has more than 40 years of experience developing injection moulding compounds for applications in automotive, home appliances, E&E and other sectors. Find out more about Tisan's wide range of materials in this brochure.

❯ CLICK HERE TO DOWNLOAD

EUROTEC: AUTOMOTIVE COMPOUNDS



This brochure presents the full range of Eurotec's engineering polymer compounds for automotive applications, including interior, exterior and under the hood. Read all about Eurotec's innovative products and tailor made services.

❯ CLICK HERE TO DOWNLOAD

STRUKTOL: CREATIVE RECYCLING

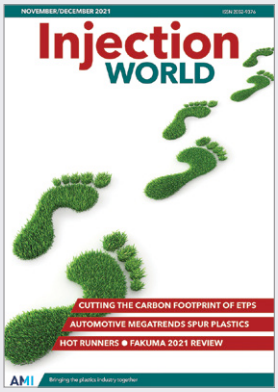
Struktol Company of America offers a range of polymer additives designed to simplify the process of recycling plastics. Learn about its latest options for viscosity modification, odour control and compatibilisation.

❯ CLICK HERE TO DOWNLOAD

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

Keep informed: read our latest editions

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



Injection World November/December 2021
The November/December 2021 edition of Injection World magazine looks at the steps engineering plastics producers are taking to reduce carbon footprint. It also explores hot runner innovations and developments in automotive moulding.

› CLICK HERE TO VIEW

Injection World October 2021
The cover feature of the October issue of Injection World looks at how in-mould technologies are bringing surfaces to life. The issue also has features on E&E moulding, smart machine functions and highlights of the Fakuma 2021 fair.

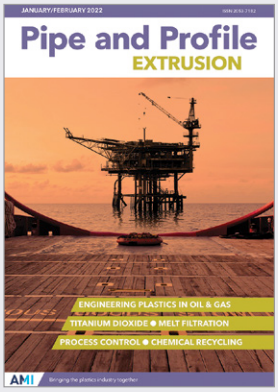
› CLICK HERE TO VIEW

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

› CLICK HERE TO VIEW

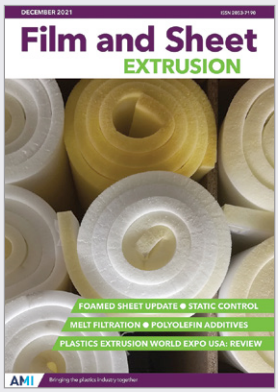
Plastics Recycling World November/December 2021
The November-December edition of Plastics Recycling World has a lead feature on progress in chemical recycling projects around the world. Other features cover PET depolymerisation and quality measurement in mechanical plastics recycling.

› CLICK HERE TO VIEW



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

› CLICK HERE TO VIEW



Film and Sheet December 2021
The December edition of Film and Sheet Extrusion looks at the latest innovations in foaming technolgy. It also reviews developments in melt filtration systems, web static management, and additives for enhancing performance of recycled resins.

› CLICK HERE TO VIEW

Take out your own FREE subscriptions to any of the magazines. Click on the logos below to simply register on-line.

Compounding WORLD
Film and Sheet EXTRUSION
Pipe and Profile EXTRUSION
Injection WORLD
Plastics Recycling WORLD

GLOBAL EXHIBITION GUIDE

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

AMI CONFERENCES

29-30 March 2022	Chemical Recycling, Houston, TX, USA
29-31 March 2022	Single-Serve Capsules Virtual Summit
26-27 April 2022	Fire Retardants in Plastics, Houston, TX, USA
7-8 June 2022	Compounding World Congress, Cologne, Germany
7-9 June 2022	Plastics Closure Innovations, Barcelona, Spain
14-15 June 2022	Chemical Recycling Europe, Cologne, Germany
14-15 June 2022	Thin Wall Packaging, Chicago, IL, USA

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

www.ami.international

DON'T MISS A SINGLE ISSUE

Register now for your free subscription at:

www.injectionworld.com

And don't forget to tell your colleagues, customers and suppliers about the magazine. You can use the share button above (the ⍐ symbol in the browser) to help spread the word.

Chemical Recycling

GLOBAL INSIGHT 2022

Download your own standalone PDF version of Chemical Recycling Global Insight 2022

SPECIAL PUBLICATION FROM AMI MAGAZINES

INDUSTRY OUTLOOK ● COMPANY PROFILES

TECHNOLOGIES EXPLAINED ● GLOBAL PROJECTS

AMI | Market Intelligence

Inform your strategic thinking

Discover how the plastics recycling and sustainability market is growing and who the key players are

Dr. Hanne Jones

Market report: Chemical Recycling Global Status

Understand current and future market infrastructure and uncover where most value is created.

Author: Dr. Hanne Jones, AMI Consulting

Other products include:

Market report
Mechanical Plastics Recycling Europe 2022

Market report
The Recycling of Flexible Polyolefin Films Europe 2021

Database
Plastics Recyclers in Europe 2021

www.ami.international/plastics-recycling

Chemical Recycling
GLOBAL INSIGHT 2022

Letter from the Editor

Welcome to Chemical Recycling Global Insight 2022, a special publication written and produced by AMI Magazines, with support from AMI Consulting. The development of chemical recycling is a response to the global problem of waste plastics in the environment. Its advocates see chemical recycling as complementary to mechanical recycling which is itself growing in importance.

In this publication, we look at the market prospects for chemical recycling and how the industry is taking shape.

The articles cover not just the scope of the waste plastics problem, but also influencing factors such as legislation and targets for use of recycled content. There is an article on the various technologies that come under the chemical recycling umbrella term, offering a guide to their differences and relative advantages.

You will find our article on what's new in chemical recycling projects very helpful in staying up-to-date with the many facilities being built around the world. Some of the players in this fast-moving industry are featured in a series of company profiles.

We hope you find this publication informative and useful.

David Eldridge – Editor
AMI Magazines

CONTACT US

AMI

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

DOWNLOAD MEDIA DATA

EDITORIAL

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

Editor: David Eldridge
de@amiplastics.com

Technology Editor: Peter Mapleston
editorial@plasticsrecyclingworld.com

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

ADVERTISING

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

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

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

Chemical Recycling

March 29-30, 2022
Hilton Houston Post Oak by the Galleria
Houston, TX, USA

Headline sponsor:

American Chemistry Council

Explore the advances in chemical recycling technologies and their integration into the North American recycling supply chain

- **Discover** the potential of chemical recycling
- **Learn** about processing and application challenges
- **Discuss** the various technologies and outputs available
- **Gain** real business insight
- **Network** with industry experts

Book your place today

Industry-leading speakers include:

Hanne Jones
Business Unit Manager
AMI Consulting

Craig Cookson
Senior Director,
Plastics Sustainability,
American Chemistry Council

Dr Mario Reyes
CTO
GSF

Marcus Trygstad
Chief Technology Officer
Aduro Clean Technologies

Dr Christoph Koffler
Technical Director Americas,
Sustainability Consulting
Sphera Solutions

Maurizio Longhi
Principal Engineer, Materials Technology - Global Materials Regulatory SME
Whirlpool

Also sponsored by:

GSF AVEVA MURA TECHNOLOGY erema group

Media supporter:

Plastics Recycling WORLD

AMI

www.ami.ltd/attend-chem-recycling-usa

The need for more plastics recycling

The problem of plastics waste has come to dominate the outlook for the plastics industry. Many polymer producers and technology companies are now turning to chemical recycling as a possible solution

IMAGE: SHUTTERSTOCK

Main image: Mixed plastics waste is the source of feedstock for many plastics recycling companies

The circularity of plastics has risen rapidly up the agenda for the global plastics industry. It is now the top talking point at any conference, forum and exhibition at which industry companies gather. Campaign groups have tried to highlight the problem of plastic waste in the environment for many years, but it only cut through to the public as a mainstream issue in 2018. The blanket media coverage of plastic pollution in oceans and on beaches has receded since then, but the problem of what to do about waste plastics remains just as strong.

The European Union responded quickly with actions to tackle plastic packaging waste, including its Plastics Strategy, setting medium-term targets for reducing plastics waste, and more immediate action to ban plastics in certain single-use items. But it's not just in Europe that the issue has achieved such prominence. The challenge has been recognised in all regions of the world and many countries have implemented or are planning to implement regulations, notably China's ban on most plastic waste imports, which was followed by other Asian countries imposing similar import bans.

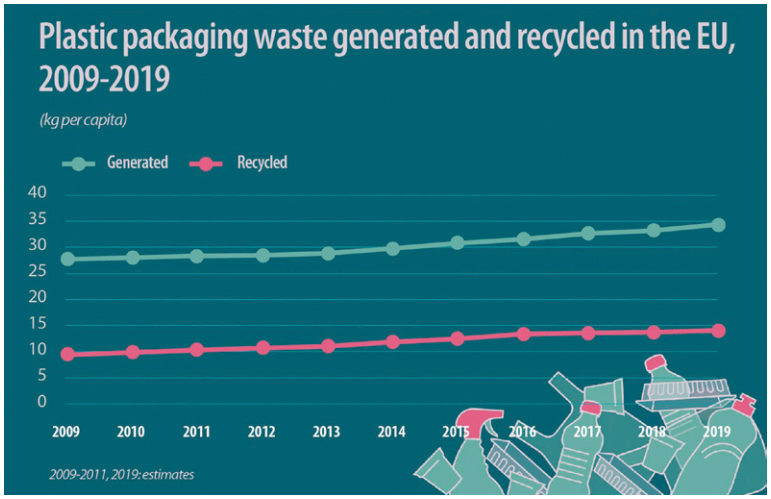
A key approach to the problem is circularity, which encompasses reduction in material usage and the recycling of materials so that loops are created in material production and use, thereby cutting the amount of waste. Multinational brand-owners have become active in reducing virgin plastics and increasing recycled plastics in packaging of their products.

Ellen MacArthur Foundation has been at the forefront of the drive towards a circular economy in plastics packaging, along with other areas such as fashion and food. In November 2021, it published the third annual progress report on its New Plastics Economy Global Commitment. It said signatory businesses, accounting for 20% of all plastic packaging produced globally, have progressed towards their 2025 targets to create a circular economy for plastics.

The report was nonetheless critical of companies in terms of reducing packaging: "There is very little evidence of ambitious efforts to reduce the need for single-use packaging in the first place."

Chemical and mechanical recycling can be used for plastics waste that arises in all sorts of industries, including automotive, electronics and others. But it is plastics packaging that is the major focus for many companies in the plastics industry, because of the huge volumes of packaging waste and because this is where social concern is the greatest.

Plastics packaging recycling has actually been increasing in the EU for more than a decade. A study published by Eurostat in October 2021 indicated a 41% EU recycling rate for plastics



SOURCE: EUROSTAT

packaging waste in 2019. Between 2009 and 2019, the recycling volume of this waste increased by 50%. However, a burgeoning plastics packaging market in the decade meant that the volume of waste generated per inhabitant over the decade increased by 24%.

Recycling of plastics packaging waste has not kept pace with the growth in the EU packaging market. So the pressure is on the plastics industry to deal with the problem and plastics producers have turned to chemical recycling as a solution.

Mechanical recycling is a more established transformation route for waste plastics, and it has the advantages of being a cheaper and less energy-intensive process than chemical recycling. But current small capacities for mechanical recycling are not enough to deliver the huge tonnage of recycled plastics that are necessary to meet regulatory and corporate targets. This is where large-scale polymer producers believe they can step in and help.

In May 2021, PlasticsEurope, the representative body for polymer producers in Europe, announced a significant increase in planned chemical recycling investment, from €2.6bn in 2025 to €7.2bn in 2030. Its member companies are aiming to increase their investment in chemical recycling to produce 1.2m tonnes of recycled plastics in 2025 and 3.4m tonnes in 2030. Advocates of chemical recycling state that this growth will not impact on the further development of mechanical recycling, as the focus would be on mixed plastics waste and other types of hard-to-recycle waste streams.

PlasticsEurope said: "Chemical recycling allows us to recycle plastic waste which is otherwise incinerated or sent to landfill. It delivers significant quantities of recycled material with virgin plastic properties. It is complementary to mechanical recycling and has a huge potential for creating quality jobs and contributing to a climate neutral and competitive Circular Economy in Europe."

The American Chemistry Council is supporting US-based polymer producers involved in projects to increase capacity for chemical recycling, or advanced recycling as it is more commonly called in the USA. A chemical recycling report from ACC in 2019 estimated the US could support investment in 260 new facilities converting plastics waste to products such as feedstocks for new plastics and chemicals.

ACC's polymer producing members have set a goal for 100% of US plastic packaging to be reused, recycled or recovered by 2040. To help reach that goal, ACC has drawn up its Roadmap to Reuse which highlights six key areas for plastics makers and the value chain to focus on to help solve plastic waste challenges.

Increased plastics recycling capacity will certainly be needed as plastics usage is set to grow over the next decade in all regions of the world. According to a forecast by AMI Consulting, China accounted for almost one-third of commodity polymer demand in the world in 2019. By 2030, China is forecast to account for 38%. This contrasts with slower virgin polymer demand growth in Europe (0.2% annually to 2030) and in North America (1.1% annually) and South America (also 1.1% annually). South East Asia and the Middle East/Africa are both forecast to grow by 3% per year. The Indian Subcontinent will be a hotspot with its polymer demand forecast to grow by 5.3% per year up to 2030.

In its *Chemical Recycling Global Status 2020* report, AMI Consulting presents its expectations for the global chemical recycling market in 2025 and 2030. It is forecasting a compound annual growth rate (CAGR) for global chemical recycling of 28.0% up to 2030. Europe is expected to grow fastest and have a lead over North America by 2030 due to the more advanced legislative agenda of the European Union. But North America will not be far behind, and Asia is likely to also experience good growth.

Of the four types of chemical recycling technologies – pyrolysis, gasification, depolymerisation and dissolution – pyrolysis will be the dominant one in terms of total waste recycled (also see separate technology article). This is due to a few factors: the greater number of pyrolysis projects currently being developed; less complexity than other processes; fewer concerns about the scale required to achieve commercial viability.

Mixed polyolefins can readily be recycled in large amounts using pyrolysis. Depolymerisation technologies will mainly be used for PET waste types, such as coloured material, that mechanical recycling is not targeting. Polystyrene waste will be recycled by different technologies, especially dissolution and depolymerisation. ■

IMAGE: SHUTTERSTOCK

Explaining chemical recycling processes

Chemical recycling is an umbrella term that includes a variety of technologies, each with their own process characteristics, input requirements and outputs. We explain the technologies

Few in the plastics industry will not have heard of chemical recycling but that simple term covers a huge range of quite different technologies. Today's chemical recycling technologies can be classified into three broad concepts: dissolution, depolymerisation, and thermal cracking. These three approaches differ, at a conceptual level at least, in the type of materials they can handle, the amount of "chemistry" involved, and the product that results.

Dissolution technologies use carefully selected solvents to dissolve the polymer from the mixed waste, allowing insoluble contaminants such as fillers and pigments to be filtered out. The dissolved polymer can then be precipitated and recovered from the solvent, which is reused. This is a physical process – the chemical composition and structure of the polymer is unchanged. As a result, many of its proponents consider it to be closer to mechanical than chemical recycling and promote it accordingly, using terms such as solvent-based purification or physical or material recycling.

The key to success in dissolution is the selection of a solvent that recovers only the target polymer. This means it is best suited for use with relatively homogenous waste streams. A number of pilot projects are already well advanced – Purecycle Technologies in the US, for instance, is targeting polypropylene with a technology licensed from P&G while Canada's Polystyvert is focusing its efforts on polystyrene.

The need for a relatively homogenous waste stream does not necessarily mean that dissolution technologies are suitable only for mono-material plastic waste. Germany's APK, for example, is developing its technology to recover LDPE and PA from multi-layer films. ›

Main image: Some chemical recycling involves changes in chemistry, but not in the case of dissolution

In theory, at least, dissolution exposes the polymer to less thermal and physical stress during the recovery process than conventional mechanical recycling. However, the recovered polymer is likely to require compounding or pelletising to make it suitable for further use, which may mitigate that benefit to some extent. In addition, the cost of the numerous processing steps – pre-treatment, dissolution, filtration, precipitation, solvent removal and reformulation – is likely to make dissolution most attractive for processing of mono-material waste streams with a relatively high level of contaminants that would be difficult to remove mechanically otherwise.

Depolymerisation is certainly a chemical recycling process, typically using heat (and often a catalyst) to convert a polymer back to its building block monomers – for this reason it is sometimes referred to as monomer recovery. It is most suitable for use with step-growth polymers such as PET, which are polymerised by polycondensation.

A number of companies are developing various processes to depolymerise PET, with pilot projects underway at Carbios in France, CuRe Technology and Ioniqa in the Netherlands, Rittec in Germany, and BP Infinia, Eastman and Loop Industries in North America.

Depolymerisation of polycondensation polymers typically involves reintroducing the molecular component that was eliminated during the original polymerisation process. Several solvolytic processes are being investigated to do this, including hydrolysis, glycolysis, methanolysis and transesterification. These are all multi-step processes that include pre-treatment of the waste, followed by depolymerisation, monomer recovery, repolymerisation, and finally extrusion and pelletising.

Solvolytic depolymerisation techniques are not suitable for use with polymers produced by chain-growth or polyaddition reactions, such as PE, PP and PS. However, some companies – including Pyrowave in Canada and Agilyx in the US – are working with alternative thermal depolymerisation technologies that are capable of converting PS polymer back to styrene monomer.

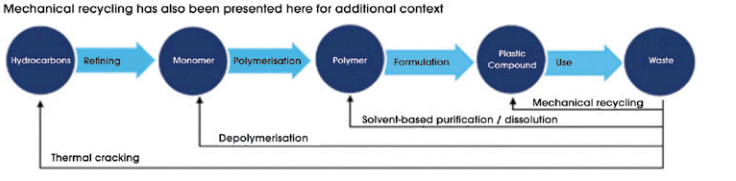
By converting polymers back to the original monomers, depolymerisation can lead to new polymers of virgin quality. However, it uses highly specific chemical processes so the incoming waste stream has to be consistent in terms of polymer composition, meaning considerable cost may be incurred in pre-sorting. Energy requirements can also be quite high.

Thermal cracking converts waste plastic – and many of the contaminants the waste may carry – back to basic feedstock components such as hydrocarbons and syngas (a gaseous mixture of CO, CO_2, H_2 and CH_4). Two processes are used to thermally crack – or feedstock recycle – polymers: pyrolysis cracks the polymer chains at high temperature in the absence of oxygen; gasification heats the polymer with a controlled but limited amount of oxygen. Both yield a different mix of end products with targeted applications ranging from fuels to chemical feedstocks.

Conventional pyrolysis thermal cracking is a relatively simple technology. Waste goes through a pre-sorting and shredding process and is then pyrolysed at high temperature – typically 400-600° – to create vapour and gas, which is then purified to create a range of hydrocarbons. These hydrocarbons can include gas, wax, oils and char. Yields of each can be controlled to some extent by adjusting temperature, pressure, and residence times, as well as through the use of particular catalysts and thermal profiles.

As pyrolysis occurs in the absence of oxygen, the process is only really suitable for polymers with a limited oxygen content, such as PE, PP and PS. Polymers containing high levels of oxygen or halogens – particularly PVC and compounds containing brominated flame retardants – must be sorted and removed from the waste input stream.

Oxygen and halogen concerns aside, pyrolysis can handle waste streams with a mixed polymer composition that would be highly challenging for either mechanical or dissolution and depolymerisation chemical recycling methods. That said, it is an energy intensive process and the quality and mix of the output materials is still dependent to some extent on the input materials. In addition, much of the gas and oil output from pyrolysis plant is likely to be burnt as fuel, either to provide energy for the process itself or because of the need for additional purification steps to upgrade it to be used as a cracker or chemical plant feedstock. Under most regulatory and accreditation regimes, the use of



	Mechanical recycling	Solvent-based purification / dissolution	Depolymerisation	Thermal cracking
Feedstock	PET, POs, PS, PVC, mixed plastics	POs, PS, PVC, PET	PET, PS	Mixed plastics, POs, PS
Output	Plastic compound	Polymer	Monomer, oligomer	Hydrocarbon mix
Status	Industrial scale	Pilot stage	Pilot stage	Pilot, industrial

Four types of plastics recycling
Source: AMI Consulting

outputs as a fuel is not recognised as recycling.

Major players in the development of pyrolysis-based technologies include Luxembourg-headquartered Clariter, Enval, Recycling Technologies, Renew ELP and Plastic Energy in the UK, Fuenix Ecogy in the Netherlands, OMV in Austria, Quantafuel in Norway, Brightmark, Encina, Nexus Fuels and Alterra Energy in the US, GreenMantra Technolgies in Canada, and Licella in Australia.

Gasification thermal cracking differs from pyrolysis in that the process takes place in the presence of a controlled but limited amount of oxygen. It can handle almost any organic material – including plastic waste and biomass – and can take on polymers containing oxygen and halogens. The end result is syngas that, depending on its composition and purity, can be used as a production feedstock.

The gasification process involves fewer steps than pyrolysis: pre-treatment of the waste (including water removal); gasification; and cleaning of the gas to remove tars and other contaminants. That final purification step is required to remove impurities such as ammonia, H_2S, alkali metals, NO_x and tars.

Gasification is not a new technology. Texaco developed and licensed its TCP (Texaco Gasification Process) technology back in the 1980s to handle hazardous waste organics. It is a non-catalytic, partial oxidation process capable of converting organics to syngas and chars. However, the TCP process does not produce feedstocks suitable for reintroduction into plastic-to-plastic or other value-added chemical synthesis chains.

A number of companies are investigating gasification processes to crack plastic waste to heavy oil and non-condensable gases and condensable gases. The non-condensable gases are used as process fuel while condensable gases and heavy oils can be gasified with oxygen and steam. These processes typically involve use of high temperature gasification at more than 900°C, which is energy intensive, followed by additional purification steps.

Gasification thermal cracking technologies are under development by a number of companies, including Enerkem in the Netherlands, Eastman in the US, and Showa Denko and Sekisui/Sumitomo in Japan.

Chemical recycling is still a very young technology. However, it seems clear from the work carried out to date that hopes that it will solve the challenge of handling mixed waste streams may be misplaced. The reality is that most of the technologies currently under development will need some level of homogeneity in waste feedstock. That means that, initially at least, chemical recycling is likely to draw on the waste sources and supply infrastructure developed for mechanical recycling.


IMAGE: BASF

Above: BASF's Andreas Kicherer holding a jar containing pyrolysis oil

Drawing on the same collection and sorting infrastructure does not necessarily mean that chemical recycled material will compete directly with mechanical recycled material. Compared to mechanical recycling, all chemical recycling processes are more complex and are likely to be more costly. So, where high quality waste streams are available, mechanical recycled polymer is likely to win out simply on economics.

Chemical recycling, on the other hand, begins to look a lot more attractive where waste streams are less homogenous than is preferred for mechanical recycling, or where volumes of recycled material exceed the capacity for reuse in new applications (either for reasons of regulation or for deterioration in material properties).

There may be some competition for feedstocks, but even that is likely to be limited. In its most recent *Chemical Recycling Global Status* report, AMI Consulting says that while the potential exists for competition to develop between the two recycling technologies in some areas – it cites the example of PET bottles and trays – it is also quite conceivable that separate markets may emerge. PET waste with the lowest levels of contamination, for example, could be sought out by mechanical recyclers while PET waste streams with higher contamination levels may be processed by depolymerisation, the report authors say.

Looking at feedstocks for the thermal cracking processes – either pyrolysis or gasification – that are expected to account for the majority of chemical recycling in volume terms, the AMI consultants say the fact that mechanical recycling can only offer a "downcycling" solution for mixed plastics waste makes it a prime stream for the chemical route. The study authors conclude that the likelihood of feedstock competition "is minimal for the vast majority of chemical recycling." ■

PLASTICS RECYCLING WORLD EXPO

November 9-10, 2022

CLEVELAND, OHIO, USA

The must-attend show for 2022

Raise your company profile and generate new sales leads at this targeted expo

Secure your perfect booth location. Contact us today:

exhibition_sales@ami.international
+1 610 478 0800

Brought to you by: AMI

Colocated with: COMPOUNDING WORLD EXPO · PLASTICS RECYCLING WORLD EXPO · POLYMER TESTING WORLD EXPO

Proudly supported by: Film and Sheet EXTRUSION · Pipe and Profile EXTRUSION


IMAGE: GR3N

What's new in chemical recycling projects

The number of companies getting involved in chemical recycling of plastics waste has been growing rapidly. This article provides an update of recent developments in projects around the world involving chemical recycling of mixed waste, plus ones focussed on PS and PET

Announcements of new plastics chemical recycling projects have been coming out regularly in recent months, along with progress reports on previously announced projects. Most operations are set for the 2022/23 time frame. What follows is a non-exhaustive review of projects in various states of construction and operation around the world, mostly related to mixed plastics waste but also for individual polymer streams (PET and polystyrene).

Plastic Energy, probably the most prominent independent technology company operating in chemical recycling, already has two commercial chemical recycling plants in operation, in Almeria and Seville, Spain. They have been running since 2015 and 2017 respectively. Each has a capacity of 5,000 tonnes/yr. The technology uses a thermal anaerobic conversion (TAC) process to produce what Plastic Energy brands as Tacoil. The Spanish facilities take waste, mostly film, collected by a waste management company that would normally send the material to landfill.

Main image: Swiss company Gr3n has constructed a demonstration plant for its PET recycling technology

Plastic Energy says it is continuing to increase its portfolio of European projects, with a 20,000 tonnes/yr plant currently under construction in the Netherlands with partner **SABIC** in a joint venture called SPEAR (SABIC Plastic Energy Advanced Recycling), and a 25,000 tonnes/yr plant that has recently started construction in France, along with a collaboration offtake agreement with ExxonMobil.

The company also has a joint venture with **TotalEnergies** (previously Total) for a 15,000 tonnes/yr recycling plant at the latter's Grandpuits "zero-crude platform" site in France, with construction expected to start soon. This will be France's first chemical recycling plant using pyrolysis to produce Tacoil.

The plant in the Netherlands is expected to become operational in 2022, with SABIC building a treatment facility to purify the pyrolysis oil coming from this joint venture, before feeding the oil into its own processes. Both plants in France should be operational in 2023.

This October, Plastic Energy also announced a partnership with Freepoint Eco-systems and its first recycling project in the US, with plans to build a 33,000 tonnes/yr plant in Texas, and a collaboration offtake agreement with TotalEnergies; it should be operational by mid-2024. In addition to this, Plastic Energy has an MoU with Petronas for a recycling project in Malaysia, and says it is working towards expanding in other parts of Asia.

SABIC is also exploring opportunities in other regions. It is for example working with Saudi Investment Recycling Company (SIRC). The two companies are cooperating in Saudi Arabia to build the first chemical recycling facility in the country, producing feedstock for SABIC's local polymer units. SABIC is also doing something similar in Asia and in the Americas, but no announcements have yet been made.

In March, **BP** and SABIC signed a new agreement to work together to drive a circular economy in the petrochemical activities at the Gelsenkirchen chemical complex. The two companies have a long history of cooperation on the site, dating back to when the SABIC operations were owned by DSM.

Below: BP and SABIC are working to drive a circular economy in petrochemical activities at the Gelsenkirchen chemical complex

IMAGE: SABIC

Pyrolysis oil will be processed at BP's Gelsenkirchen refining site and then used by SABIC in its Gelsenkirchen polymer plants to produce certified circular products, which SABIC brands as Trucircle. After successful trials in December 2020, polymer production using the alternative feedstock started at the site early this year.

BP and **Brightmark**, a global waste solutions company that has proprietary chemical recycling technology, have signed a Memorandum of Understanding (MoU) to jointly evaluate opportunities for development of the next generation of plastic waste renewal plants in Germany, the Netherlands, and Belgium. BP is already the offtaker for Brightmark's 100,000 tonnes/yr pyrolysis plant in Ashley, Indiana, USA, which is currently undergoing final commissioning. The Ashley facility produces plastics-to-fuel and waxes. "Moving forward, all facilities will be designed for circular end products," says a representative.

In January, Brightmark and **SK Global Chemical**, headquartered in South Korea, signed an MoU to create a partnership to build a commercial scale pyrolysis plant in South Korea with a 100,000 tonnes/yr capacity. Both parties are currently carrying out a feasibility study. By the end of this year, they should have completed evaluation of the most optimal methods to operate, scale and develop the technology within South Korea.

In September, Shell Ventures and BlueAlp Holding announced a strategic partnership to develop, scale and deploy BlueAlp's pyrolysis technology. Shell has taken a 21.25% equity stake in BlueAlp as part of the agreement.

Shell and **BlueAlp** will form a joint-venture company to build two new conversion units in The Netherlands, which are forecast to convert more than 30,000 tonnes/yr of plastic waste. The units are planned to be operational in 2023 and will supply 100% of their pyrolysis oil as feedstock to Shell crackers in The Netherlands and Germany. Shell is exploring licensing a further two units for deployment within Asia to supply the Shell Energy and Chemicals Park Singapore.

In October Shell Chemicals Europe also announced a strategic cooperation and offtake agreement for pyrolysis oil made by Rotterdam-based company **Pryme** from recycled plastic waste. Pryme will supply Shell from its first plant located in Rotterdam. Currently under construction, the plant

is scheduled to become operational in 2022 and is forecast to convert 60,000 tonnes/yr of plastic waste into pyrolysis oil by 2023.

The agreement also includes provision for future supply to be delivered from Pryme's proposed second plant in the region. This will have an estimated annual pyrolysis oil production capacity of 350,000 tonnes.

Eastman has two chemical recycling technologies that tackle different feedstock streams. Polyester Renewal Technology processes polyester feeds (see section on PET below), while its Carbon Renewal Technology can recycle most other thermoplastics, with the exception of PVC. In late 2020, Eastman said it expected to use up to 50m pounds (close to 27,000 tonnes) of waste plastic in Carbon Renewal Technology operations in 2020, with projects underway to significantly expand that amount. No update was available at the time of writing.

In early November, **Aduro Clean Technologies**, a Canadian developer of patented water-based technologies to chemically recycle plastics and transform heavy crude and renewable oils into new resources and higher-value fuels, announced a pending partnership with Brightlands Chemelot Campus in Limburg, The Netherlands.

Aduro says the objective of this partnership is to complete an installation that applies Aduro Hydrochemolytic technology (HCT) to demonstrate, on a tonnes per day scale, the conversion of polyethylene waste to useful feedstock for chemical processes, including production of new PE.

Ofer Vicus, CEO of Aduro, says: "This year we plan on doing our proof of concept. This is nearly done and we are working on the data to submit it to a third party," says Vicus. "Our next step in the road map is to work on the pilots – this is happening now with Brightlands and possibly others."

He says: "Traditional methods rely on high temperatures from 400°C to as high as 1,100°C, and on hydrogen produced by conversion of fossil fuels at between 700°C and 1,000°C. Aduro Hydrochemolytic processes operate at only 240-390°C."

Marc van Doorn at the Brightlands Chemelot Campus says: "We are at the early stages and it still needs quite a lot of development, but lab results were quite interesting. Aduro is planning to scale the process up to pilot plant level at our campus, where we have a number of other things going on in chemical recycling."

Another chemical recycling process that relies on water – super-critical steam in this case – has been developed by **Mura** in the UK. In April, it announced a partnership with Dow Chemicals to support the rapid scaling of its HydroPRS (Hydrothermal Plastic Recycling Solution) process. Dow will also take recycled materials from the first plant, in Teesside, UK. The first of four 20,000 tonnes/yr lines is expected to be operational in 2022. Dow and Mura are looking to co-operate on offtake at a number of additional European projects, currently in Mura's development pipeline.


IMAGE: EASTMAN

Above: Eastman has two chemical recycling technologies that tackle different feedstock streams

Alongside its first plant in the UK, Mura also has four 100,000-tonnes/yr sites under development in Germany and four of the same capacity in the US – Washington State has just been announced as the first location. It also recently announced the sale of the first HydroPRS licence to Mitsubishi (MCC), which has plans to develop the process to commercial operation by 2023 at its Ibaraki site, Japan. It will have the capacity to handle 20,000 tonnes of plastic waste per year – with MCC studying the possibility of increasing capacity in the future. Initially, the project will aim to use post-industrial plastics.

"Our ambition is to have 1m tonnes of plastic recycling capacity in operation or development by 2025," says a representative.

Dow says it is actively pursuing a number of commercial partnerships with customers and brand owners to scale chemical recycling technology. Two years ago, for example, it announced its partnership with Fuenix Ecogy Group for the supply of pyrolysis oil feedstock made from recycled plastic waste, to be used in the production of new polymers at Dow's production facilities in Terneuzen, The Netherlands. It has since announced additional investments in Fuenix to help scale this advanced recycling technology further. Most recently, in October 2021, Dow and Fuenix announced the construction of a second plant in Weert, which will process 20,000 tonnes of waste plastic.

As well as its partnership with Mura Technology, Dow has also established a multi-year agreement with New Hope Energy, based in Tyler, Texas, USA to supply it with pyrolysis oil feedstocks derived from plastics recycled in North America, which Dow


IMAGE: RENASCI

Above: Renasci's ISCC PLUS-certified recycling centre in Oostende, Belgium

will use to produce circular plastics.

BASF is working with several partners to further develop pyrolysis technology. In 2019, it invested €20m in **Quantafuel**, a Norwegian company specialised in the pyrolysis of mixed post-consumer plastic waste and the purification of the resulting oil. In September 2020, Quantafuel started up its first pyrolysis plant with a capacity of approximately 20,000 tonnes/yr in Skive, Denmark. "Together, we are also working on further developing and improving the process," says BASF. "Developing suitable catalysts for the new process technology is an important aspect of this. These catalysts aim to ensure that high-purity pyrolysis oil is always produced, even when the composition of the plastic waste varies."

In late August, Quantafuel said the Skive plant would undergo upgrades before the end of the year, allowing for stable, long-term commercial production. "We are working on removing the last known obstacle," said Quantafuel's interim CEO Terje Eiken. In September, it announced plans to expand into the UK, with a plant in Sunderland that could be up and running "in a few years." Additional sites are also being considered by Quantafuel UK. The Sunderland plant will be designed to process more than 100,000 tonnes/yr of waste plastics, to be sourced from across the north of England.

In June, **Borealis** announced an exclusive agreement with **Renasci** which has enabled Borealis to offer commercial volumes of chemically recycled base chemicals and polyolefins since May. (Borealis has a10% share of Renasci.) Borealis obtains chemically recycled material from Renasci Oostende Recycling in Belgium. Projected output is 20,000 tonnes/yr. Feedstock will be subsequently processed in the Borealis steam crackers, initially at its production location in Porvoo, Finland.

Earlier, in April, Borealis announced a feasibility study for a chemical recycling unit to be established at the Borealis production location in Stenungsund, Sweden is being carried out with project partner Stena Recycling, and could lead to operations beginning in 2024. Borealis will also co-operate independently with Fortum Recycling and Waste on a project involving the sourcing of plastic waste to the chemical recycling unit.

In October, **ExxonMobil** announced plans to build its first, large-scale plastic waste advanced recycling facility in Baytown, Texas, USA, which is expected to start operations before 2023 with a planned capacity of 30,000 tonnes/yr. A smaller, temporary facility, is already operational and producing commercial volumes of certified circular polymers that will be marketed by the end of this year.

ExxonMobil's initial trial of its proprietary process recycled more than 1,000 tonnes of plastic waste and has demonstrated the capability of processing 50 tonnes per day.

The company says it is developing plans to build approximately 500,000 tonnes/yr of chemical recycling capacity globally over the next five years. As mentioned earlier, it is collaborating with Plastic Energy on a plant in Notre Dame de Gravenchon, France, which is expected to process 25,000 tonnes/yr of plastic waste when it starts up in 2023, with the potential for further expansion to 33,000 tonnes/yr. ExxonMobil is also assessing sites in The Netherlands, the US, Canada, and Singapore.

At the beginning of November, **Honeywell** announced the commercialisation of its UpCycle Process Technology, which incorporates pyrolysis. Sacyr, a Spain-based global engineering and services company with operations in more than 20 countries worldwide, will be the first to deploy the Honeywell technology. The two companies will form a joint venture to operate a facility in Andalucía, Spain, with a capacity of 30,000 tonnes/yr of mixed plastics waste. Production is expected to begin in 2023.

Arcus Greencycling uses a pyrolysis process that can handle a wide range of polymers found in mixed waste, from PP, PE, and PS to more difficult polymers like PVC and ABS. The company has a co-operation agreement regarding pyrolysis technology with Karlsruhe Institute of Technology.

Arcus is currently building a 4,000 tonnes/yr industrial-scale pilot plant in Frankfurt am Main, Germany. The company expects this to start operations in the second quarter of 2022. "This plant will offer customers a highly robust process at an industrial scale to either test the suitability of a wide variety of waste streams for chemical recycling and/or utilise the facility to produce commercially usable pyrolysis oil," it says.

Clariter says its chemical recycling technology

enables it to make end products, not a feedstock like pyrolysis oil. The company has developed a three-stage process for recycling mixed plastics waste. First it uses thermal cracking which generates a wide range of hydrocarbons. Stage two is a hydro-refining process developed to remove impurities and form naphthenic and paraffinic hydrocarbons. The third distillation stage results in three product families, waxes, solvents and oils for industrial and consumer use which are sold to its customers.

Clariter's technology has been proven through an operational pilot plant in Gliwice, Poland, and a demonstration plant in East London, South Africa. In 2021, it has announced collaborations with DSM and Mitsubishi. In addition, South African chemicals group AECI has made a €2.5m investment in Clariter and is exploring construction of full-scale plants in South Africa, Germany and USA.

Recycling Technologies, in Swindon, England, has developed thermal cracking technology that it says can be installed at existing waste sites anywhere. Its RT7000 machine produces pyrolysis oil branded Plaxx. A demonstration plant and testing facility has been operating at Swindon Borough Council's recycling facility since 2017. The first commercial-scale unit will be installed at Binn Eco Park in Perth, Scotland, in collaboration with Binn Group and Zero Waste Scotland.

Polystyrene

Chemical recycling of polystyrene is well-advanced. This April, Recycling Technologies was selected by **Ineos Styrolution** as the technology provider for commercial scale recycling of PS back to styrene monomer. Prior to building the commercial scale recycling plant, a PS recycling pilot plant will be built in Swindon, UK. It uses the same basic technology as the RT7000 but the machine to recycle polystyrene will have a different name.

Ineos Styrolution plans to build its full commercial scale recycling facility in Wingles, France, but has not given a date; capacity should be 15,000 tonnes/yr. **Trinseo** has said it plans to build a dedicated 15,000 tonnes/yr plant at its Tessenderlo, Belgium location, to come into operation in 2023.

In May, Trinseo announced that it could supply recycled polystyrene (rPS) for food contact applications with the launch of the first yogurt pot integrating rPS (again from Yoplait), now on shelves in France. Styron CO2RE CR55 contains 55% recycled content resulting from depolymerisation.

In September, Trinseo and Indaver, a leader in sustainable waste management in Europe, signed an offtake agreement for recycled styrene monomer. Trinseo said it would buy a minimum of 50% of the monomer produced at Indaver for a 10-year period, following start-up of the plant planned in 2023.

Indaver will collect post-consumer polystyrene, such as yogurt pots and single-use packaging, and produce new styrene monomer through a proprietary depolymerisation technology at its Antwerp, Belgium site, for repolymerisation at Trinseo's Tessenderlo, Belgium site.

At the end of last year, Total (now TotalEnergies), sheet extrusion company Intraplás, and yoghurt producer Yoplait said they had successfully run a pilot test aimed at using certified chemically recycled polystyrene in yogurt pots. Total said that by converting mixed plastics waste in its steam cracker in Antwerp, it can produce certified chemically recycled polystyrene.

Canadian technology company **Pyrowave** is involved in a major polystyrene chemical recycling project in a partnership with Michelin in Europe. Pyrowave manufactures modular equipment that uses microwave technology to depolymerise polystyrene and it licenses its use. Michelin will operate the equipment at a location yet to be decided. It will acquire several units from Pyrowave. Michelin will use the styrene monomer as a feedstock to make rubber for tyres.

At the end of last year, the two companies said they would work together to fast-track the industrialisation of Pyrowave technology with a view to a certification and commercial roll-out in international markets. The joint development agreement will ultimately account for an investment of more than €20m. Michelin and Pyrowave are working together to develop an industrial demonstrator, funded and operated by Michelin, by 2023.

PET

Eastman is building the world's largest polyester chemical recycling facility at its site in Kingsport, Tennessee, USA, employing its Polyester Renewal Technology (PRT) which uses methanolysis. Eastman expects the facility to be mechanically complete in late 2022. "Our goal is to recycle 250m pounds (around 113,000 tonnes) annually by 2025 and 500m pounds annually by 2050," says a representative.

"We pioneered the technology decades ago when we were formerly part of Eastman Kodak and used methanolysis to recycle polyester including Kodak films. We've retained that R&D knowledge and actually improved on it in the decades since."

Aquafil Engineering designs polyamide and polyester polymer plants based on its own patented technology and production know-how. It also offers several recycling solutions under the brand

IMAGE: CARBIOS

Abve: The Carbios demonstration plant

name EverPET for internal, industrial or post-consumer waste. It has recently been building a recycling unit to produce 100% PCR PET on a small scale for customer and test samples for different PET customer applications (bottle, film, yarn, multi-layer packaging).

In the chemical EverPET process, the raw materials (oligomers, monomers and BHET) are recovered from previously cleaned polyester wastes, which can be re-processed into a high-quality polyester by downstream polycondensation.

Carbios, which has developed an enzymatic recycling technology (C-Zyme) for depolymerising PET using hydrolysis, brought its first demonstration plant onstream in September. The plant includes a 20 m^3 depolymerisation reactor capable of processing 2 t of PET per cycle, which is the equivalent of 100,000 bottles. It is co-located with a Michelin tyre production plant in Clermont-Ferrand, France; Michelin is a major shareholder in Carbios, and is interested in using various recycled or renewable materials in its tyres.

Martin Stephan, the company's Deputy CEO, says Carbios will also build and operate a 40,000 tonnes/yr reference unit, the first industrial plant. Its intention is to start up the plant in 2025 and that the plant will be adjacent to an existing PET production line. Carbios has Expressions of Intent with at least one PET supplier.

Swiss company **Gr3n** has another technology that uses alkaline hydrolysis. A demonstration plant should be fully operational early next year. Fabio Silvestri, Head of Marketing and Business Development, says the first industrial plant, with a capacity of 30,000 tonnes/yr, could start up before the end of 2024. He says the company has had confirmation that its technology can depolymerise textiles. Gr3n has an MoU with Kolon Industries to accelerate the commercialisation and the implementation of its technology throughout Asia.

Ioniqa, a clean-tech spinoff from the Eindhoven University of Technology in The Netherlands, has a 10,000 tonnes/yr plant producing BHT monomer from bottles using glycolysis, which it currently supplies exclusively to Indorama. Maarten Stolk, the company's Business Developer, says that it plans also to use fibre as a feedstock. The company is currently in discussions with a plant engineering firm so that it can sell licensed packages.

In June, **Loop Industries** in Terrebonne, Quebec, Canada, announced a strategic partnership and equity investment from SK Global Chemical (now called SK Geo Centric); Loop and SKGC intend to form a joint venture with exclusivity to build recycled PET resin and polyester fibre manufacturing facilities using Loop's depolymerisation technology throughout Asia. SKGC currently has a 10% shareholding in Loop. In August, plans were announced for the first Infinite Loop Asian facility in Ulsan, South Korea, to begin preparation in 2022.

Loop recently completed the conversion of its Terrebonne, Québec pilot plant to a small production facility. In September of this year, together with French mineral water company Evian, Loop unveiled the Evian Loop bottle, made from Loop's 100% recycled PET coming from waste plastic and fibre. The bottles will be rolled out at commercial scale in South Korea in 2022, with the goal of launching in other markets later. ■

CLICK ON THE LINKS FOR MORE INFORMATION:

- **https://plasticenergy.com**
- **www.sabic.com**
- **https://totalenergies.com**
- **www.bp.com**
- **www.brightmark.com**
- **http://eng.skglobalchemical.com**
- **www.shell.com**
- **www.bluealp.nl**
- **https://pryme-cleantech.com**
- **www.eastman.com**
- **https://adurocleantech.com**
- **https://muratechnology.com**
- **www.dow.com**
- **www.basf.com**
- **www.quantafuel.com**
- **www.borealisgroup.com**
- **www.renasci.be**
- **https://corporate.exxonmobil.com**
- **www.honeywell.com**
- **www.arcus-greencycling.com**
- **https://clariter.com**
- **https://recyclingtechnologies.co.uk**
- **www.ineos-styrolution.com**
- **www.trinseo.com**
- **www.pyrowave.com**
- **www.aquafileng.com**
- **www.carbios.com**
- **https://gr3n-recycling.com**
- **https://ioniqa.com**
- **www.loopindustries.com**

Aquafil

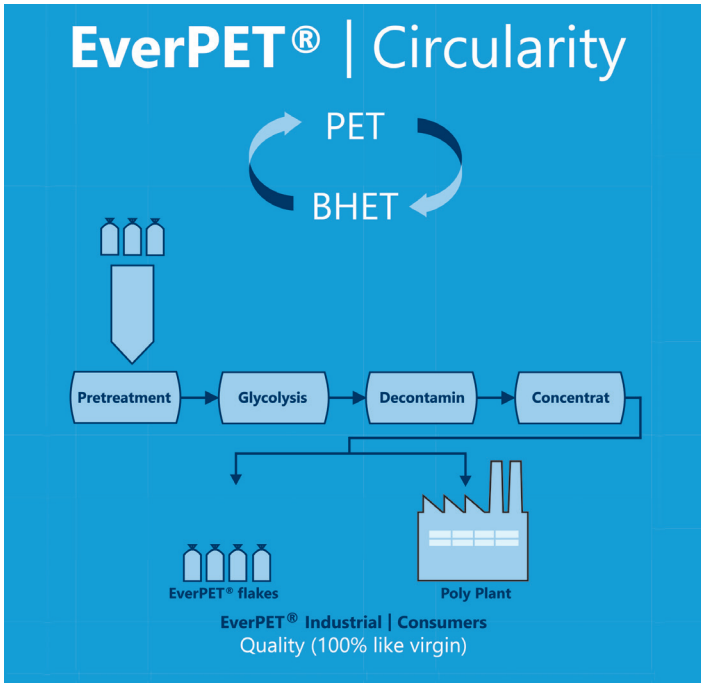
Aquafil Engineering: Experts in polyester and polyamide recycling plants

Aquafil Engineering, an independent company of Aquafil Group, is located in Germany, and is one of the worldwide leading companies in technology and equipment design for polyamide, polyester and recycling plants. The plant design is based on patented technology and production know-how which provides customers with state-of-the-art technology combined with high quality, flexibility, efficiency and sustainability.

Aquafil Engineering understands itself as provider for customised solutions for fibre, film, technical and bottle applications.

The EverPET™ technologies are the newest developments in polyester recycling. EverPET™ is the brand name for a collection of different recycling systems and includes solutions for mechanical (extrusion) as well as for chemical (glycolysis) recycling.

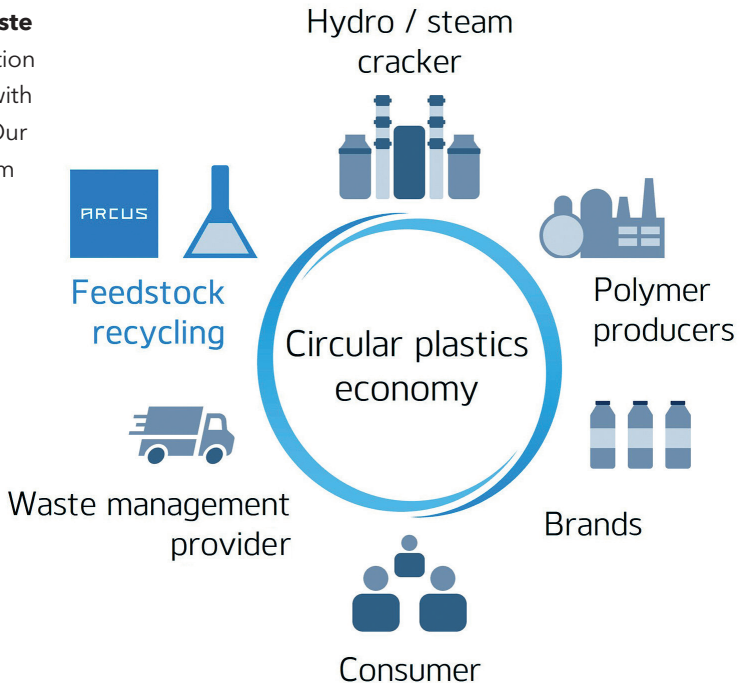
› **www.aquafileng.com**



Arcus

Leading the way to recycle mixed and dirty plastic waste
Arcus leads the way in providing a chemical recycling solution for currently non-recyclable mixed plastics waste streams with as little as possible prior sorting or cleaning of the waste. Our process successfully handles a wide range of polymers from PP, PE, and PS to difficult to process PVC, ABS, or PET.

First industrial scale plant of its kind in Germany
Arcus is currently building a fully authorised (BImSch approved, REACH registered, end-of-waste status acknowledged as well as ISCC, RedCert2, and EfbV certified) 4,000 tonnes per year industrial-scale pilot plant in Frankfurt am Main, Germany, which will go live in the second quarter of 2022. This plant will offer customers a highly robust process at an industrial scale to either test the suitability of a wide variety of waste streams for chemical recycling and/or utilise the facility to produce commercially usable pyrolysis oil.
› **www.arcus-greencycling.com**



The ARCUS Greencycling solution: Closed loops are the model for a world without plastic waste and lack of resources

- Variable and truly mixed inputs (incl. PP, PE, PS, PVC, PET, etc.)
- High-value feedstock for the petrochemical industry (incl. REACH registration)
- Longstanding operations and research track record
- Fully approved and certified testing plant in Germany

Greencycling ...

Recovers raw materials | Closes the material loop | Is eco-nomical | Preserves natural resources

www.arcus-greencycling.com

Click here for more

Clariter

clariter
A Clean Slate

Clariter takes plastic waste no one wants and transforms it into products everybody needs. While the recycling industry is turning plastic waste into new plastics, fuels, or intermediates that require further processing and blending, Clariter's innovative technology transforms most plastic waste streams, even those with the lowest value, into pure, ready-to-use industrial products: aliphatic solvents, mineral oils, and snow-white waxes.

According to the latest Life-Cycle Analysis, Clariter's process is preferable to landfill, incineration, and other pyrolysis-based solutions. This is a real paradigm shift and a resource efficient approach to meet circularity standards in the EU and beyond.

The company unlocks the value of the circular economy without compromising on profitability or sustainability. Clariter's short-term plan is to build and operate full-scale plants in Israel, Poland, and the Netherlands.

Each plant will recycle 60,000 tons of plastic waste and produce 50,000 tons of clean products annually.

Clariter's solution bridges the world of recycling and the petrochemical industry by replacing crude oil with upcycled plastic waste, thus saving significant amounts of CO_2, cleaning the earth of plastic waste, and making sustainable products for the market with 1000+ end applications, e.g. paints, shoe polishes, degreasers, detergents, inks and even ski waxes.

› **https://clariter.com**

Watch the video Clariter in Brief

Above: Clariter's Industrial-scale plant has been in operation in East London, South Africa since 2018

Left: Clariter's technology transform plastic waste into aliphatic solvents, mineral oils and paraffinic waxes

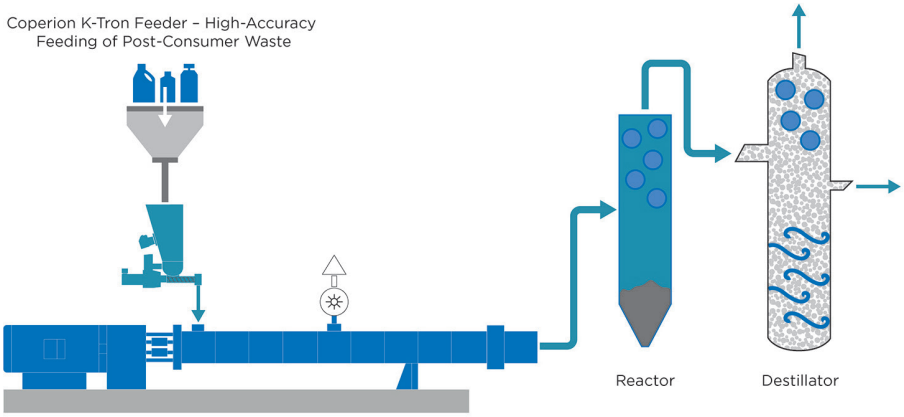
coperion
confidence through partnership

First class technology for chemical recycling

Chemical recycling is a promising process for recycling mixed plastic waste into chemicals, waxes or liquid energy carriers. Coperion provides process know-how and superior technologies for chemical recycling.

Coperion K-Tron feeders ensure high-accuracy feeding of raw materials into the extruder. Coperion's ZSK twin screw extruders enable a very efficient energy addition to the material in shortest time. Within 30 seconds, ZSK extruders produce a homogeneous, highly devolatilised melt with high temperatures. Throughputs of up to 20 tonnes per hour can be realised.

COPERION PROCESS FOR CHEMICAL RECYCLING



Next the melt is further processed to the reactor and destillator to transform it into marketable products such as oil, heavy fuel, or waxes.

Contact: Jochen Schofer
Business Segment Manager
jochen.schofer@coperion.com
› **www.coperion.com**

›extruders ›feeders ›components ›pneumatic conveying ›complete systems

COPERION PLASTICS RECYCLING TECHNOLOGY.
EFFICIENT. SUSTAINABLE. RESPONSIBLE.

Discover our first-class technology solutions:
+ for compounding, extrusion, feeding, conveying and bulk material handling
+ fulfilling highest quality standards and maximum reliability

coperion K-TRON

Join us on the responsible path to a successful future. Benefit from our comprehensive know-how and first-class technology solutions for various plastics recycling processes. www.coperion.com/recycling

coperion
confidence through partnership

MAAG Group

MAAG Group
a DOVER company

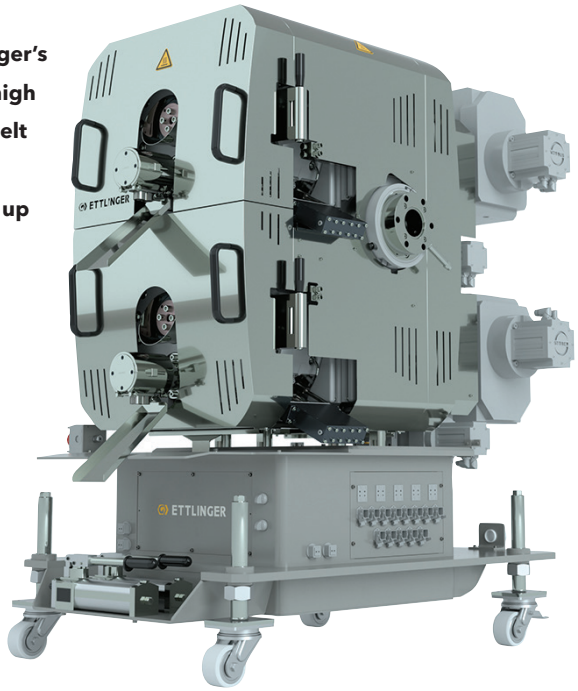
Next level solutions for recycling applications
MAAG Group systems play a key role in enabling a more circular economy for plastics. Our equipment and solutions cover the entire plastics value chain and help to introduce used plastics back into high quality products.

As a specialist for polymer filtration and recycling systems, we have developed custom melt filtration and pelletising systems that meet the strict requirements of our customers. Our systems provide solutions to process the most demanding material streams and turn them into valueable resources.

Our goal is to preserve material properties and produce pellets that are equal in quality to virgin materials when processing post-consumer and post-industrial plastic materials.

› **https://maag.com**

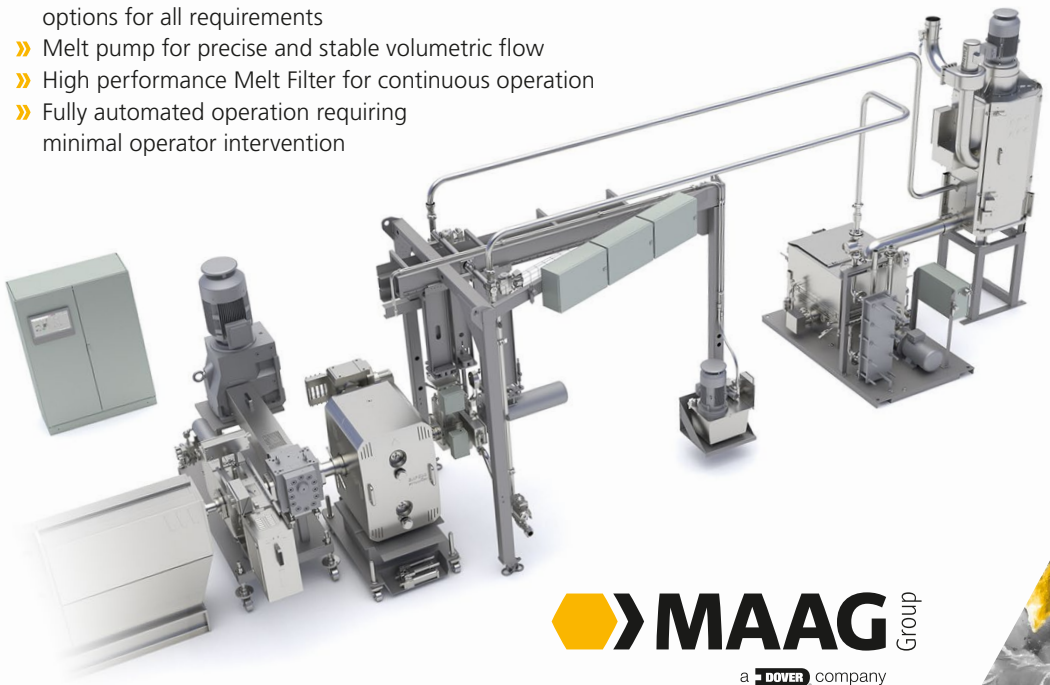
MAAG Group company Ettlinger's new ECO 500 high performance melt filter achieves throughputs of up to 4,000 kg/h



PUMP & FILTRATION SYSTEMS ›
PELLETIZING & PULVERIZING SYSTEMS ›
RECYCLING SYSTEMS ›
DIGITALIZATION ›

An Optimized System for challenging Recycling Applications

- High quality pellets with low residual moisture level
- Purpose-built for recycling applications and flexible options for all requirements
- Melt pump for precise and stable volumetric flow
- High performance Melt Filter for continuous operation
- Fully automated operation requiring minimal operator intervention



MAAG Group
a DOVER company

maag.com

Pryme

Pryme contributes to a meaningful solution to the global plastic waste problem by enabling the circularity of plastic. We convert plastic waste into valuable petrochemical products using a proven pyrolysis process that is enhanced with proprietary characteristics and has a low carbon footprint.

Our R&D team has worked long to take the pyrolysis process to a higher level, so we teamed up with a reactor manufacturer that boasts over 80 years of experience in this area. As a result, our reactor ensures a very precise and controlled application of heat at lower temperatures, which makes the recycling process more energy-efficient.

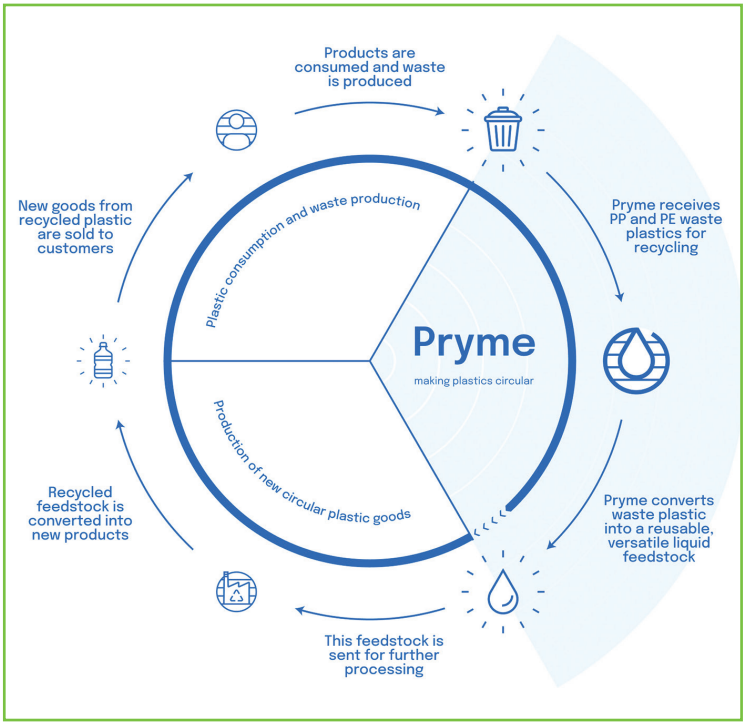
In addition, we have enhanced the process in order to remove contaminants such as chlorine, which we know oil majors don't want in recycled oil because it is highly corrosive. Moreover, we can process more waste than our competitors do, giving us an extremely high conversion rate: 100% of the plastic waste that we treat is converted to value-added streams.

Thanks to our tweaks to the process and installation, we can ensure a high input and output capacity and can rapidly scale the technology, which is key for market feasibility. Pryme's first plant will start production in 2022 in Rotterdam. This plant will have an initial intake capacity of 40,000 tons of plastic waste per year and produce 30,000 tons of feedstock in its first year. That tonnage will grow by 50% by 2023.

Pryme is an ambitious and innovative company, so if you're interested in our business, technology or job opportunities, be sure to contact us via our website.

› **https://pryme-cleantech.com/**

Above: Sander Schiereck, Michiel Kool and Joeri Dieltjens at the site of the new Pryme plant



Above: Pryme provides a sustainable, circular solution to converting waste plastics into valuable feedstock

IMAGE: SHUTTERSTOCK

Realising the opportunity

How will the chemical recycling industry develop? We look at factors that have a major influence on the industry's progress, including legislation and the mass balance concept

The chemical recycling industry has started on a growth path as the drive for greater plastics recycling volumes stimulates demand. As well as supply-demand dynamics, there are other important factors that are helping to shape the chemical recycling industry, such as legislation.

In Europe, regulatory impetus in plastics recycling comes from the European Union's Strategy for Plastics in a Circular Economy which the European Commission announced in 2018. This set out a series of targets focussed on packaging recycling: a target for recycling 65% of packaging waste by 2025 and 70% by 2030, and a specific target for plastic packaging recycling of 50% by 2025 and 55% by 2030.

Another aim is for all packaging to be recyclable by 2030, which would not only help grow mechanically recycled volumes but would also benefit chemical recycling by reducing contamination in waste feedstock.

Going hand-in-hand with legislation is funding support from the EU. Among collaborative R&D projects is Demeto, in which 13 partners are developing a PET depolymerisation process using microwave-based process intensification, and which receives funding from the EU's Horizon 2020 research and innovation programme. Other EU projects are not looking at packaging but focus on other areas, such as the Plast2BCleaned project in WEEE plastics recycling, and the Circular Flooring project which is investigating the CreaSolv process as a means for recycling PVC flooring.

Associations have been set up to provide collaborative platforms as the chemical recycling industry grows. The European Coalition for Chemical Recycling was founded in early 2019 by Cefic and PlasticsEurope, which supports the work of the EU Circular Plastics Alliance and its aim to ensure that 10 million tonnes of recycled plastics find their way into new European products by 2025. Chemical Recycling Europe's members are companies fully focused on chemical recycling technology rather than production of plastics, although it does hope to involve petrochemical companies as well.

Voluntary commitments are also acting as a focal point for mechanical and chemical recycling companies. Many polymer producers are among the corporate signatories of the Global Alliance set up by Ellen MacArthur Foundation, which has also led the way for individual countries to formulate specific recycled plastics content targets within its Plastic Pacts initiative. Sector-specific recycling is supported by Extended Producer Responsibility (EPR) schemes in different countries. But the extent to which EPR schemes proliferate remains to be seen after some poor results and scheme failures.

The chemical recycling industry in the USA is also being influenced by legislation. In the past couple of years, federal bills formulated by often cross-party sponsors have targeted aspects of plastics waste, recycling and environmental improvement. The Break Free from Plastic Pollution Act envisages a producer responsibility scheme involving a 10-cent beverage container deposit

Main image: Mass balance aims to measure the waste plastics contribution from chemical recycling in a much larger manufacturing process and allocate that to the end product

IMAGE: RECYCLING TECHNOLOGIES

Above: Recycling Technologies makes its Plaxx pyrolysis oil from waste plastics at its plant in Swindon, UK

program to operate nationally, minimum recycled content targets, phasing out some single-use plastics items, and a temporary halt to new polymer production plants being built. The RECOVER Act focuses on allocating federal grants to states and municipalities to invest in improving their recycling programs and infrastructure.

In addition to federal and state legislation, the Environmental Protection Agency has developed a National Recycling Strategy with a goal of achieving a 50% recycling rate for all materials by 2030. The American Chemistry Council, representing petrochemical and polymer producers, has been proactive and developed its own Roadmap to Reuse to support its members' aim for all US plastics packaging to be reused, recycled or recovered by 2040.

In the ACC's opinion, crucial to the US achieving its plastics sustainability ambitions is the need for official recognition of chemical recycling and its contribution to the country's efforts. Placing chemical recycling on a par with mechanical recycling is also desirable for plastics producers working in Europe. The risk for the chemical recycling industry is that its processes are not defined as recycling if the European Commission holds the position that the waste plastics input can be converted to fuel either for processing purposes or in the creation of new fuel products. After much lobbying of the European Commission, it has still not officially announced if its definition of plastics recycling includes chemical recycling processes.

Mass balance

A counter approach is being followed by chemical recycling companies with regard to the input-output of their plants and its use in the production of new plastics: it's called the mass balance approach. Tracking use of recycled material is relatively straightforward in the mechanical recycling supply chain but not so easy in chemical recycling, where outputs typically take the form of basic hydrocarbons that subsequently make their way through multiple and complex cracking and polymerisation processes. The solution for the chemical recycling industry is to follow the principles of mass balance.

Already applied in sectors as varied as electricity marketing and Fair Trade agriculture, the mass balance concept aims to determine and measure the contribution of a particular component in a much larger manufacturing process and allocate that accordingly to each unit of end product. In the case of chemical recycling, it aims to ensure that the amount of recycled feedstock entering a production plant equates to any claims made about the recycled content of a product leaving it.

While this may sound a simple task, the reality is much more complex as different approaches can be taken with regard to what and where to allocate. For instance, the entire output of a chemical recycling process could be allocated as a contributor to any polymer or chemical production process – so called free-attribution. Alternatively, it may be decided to allocate only the non-fuel components. Or, at its strictest, only those components used as a non-fuel contributor to production of a polymer.

Chemical Recycling Europe leans toward the free-attribution approach. In a recent white paper it said: "Our position is that all mass-balance interpretations should ensure that the full recycled output from chemical recycling finds a credible value and recognition though the system."

Others, however, favour more restriction. Zero Waste Europe, together with several other environmental NGOs, this year published 10 recommendations to ensure that mass balance does not undermine circularity goals. These include only allowing post-consumer waste streams, not allowing trading of recycled content credits, and ensuring allocations are restricted only to processes where there is a direct link between feedstock and final product (an approach being followed by Sweden's Perstorp with its traceable mass balance scheme).

Mass balance will be essential in the development of chemical recycling as an industrial process and to that end must be seen to be transparent and trusted – consumers, for example, must understand the claims made and, more importantly, have confidence in them. A number of organisations are already running certification programmes, of which the best known are International Sustainability and Carbon Certification (ISCC)and RedCert (both headquartered in Germany). In addition, last year the International Organisation for Standardisation (ISO) announced it had started work on a global mass balance standard. ■

AMI | Events

Plastics Recycling Technology

13-15 September 2022 | Vienna, Austria

Exploring the future of plastics recycling - new ways to boost productivity, quality and profitability

Save €300* - Book your place today!

Media supporter: Plastics Recycling WORLD

*Discounts cannot be used in conjunction with other offers. Offer valid until 11 March 2022. Price may be subject to VAT.

DEVELOP YOUR KNOWLEDGE

Themes for 2022:

- **Innovation** in machinery and processing for increased recyclet quality and throughput
- **Traceability** as a key to high value and quality supply chains
- **Compounding and additives** for recycling
- The impacts of changing **legislation and regulation**
- **Feedstock security** as a growing industry challenge

AMI | Events

Chemical Recycling

14-15 June 2022 | Cologne, Germany

Explore the potential of chemical or advanced recycling to turn waste plastics into new materials

www.ami.ltd/attend-chem-recycling

Discover how chemical recycling is assisting the transition to a circular economy, and the impact on your business

Save €200*
if you book your delegate place before 18 March 2022

Book your place today

*VAT may apply. Discount cannot be retrospectively applied or used in conjunction with any other offer.

Sponsored by:

MURA TECHNOLOGY

GSF The Upcycling Leap!

erema group

To sponsor or exhibit, please get in contact:

Joe Huckings
Sales Executive
E/ joe.huckings@ami.international
T/+44 (0) 117 314 8111

AMI Bringing the plastic industry together.

Media supporter: Plastics Recycling WORLD