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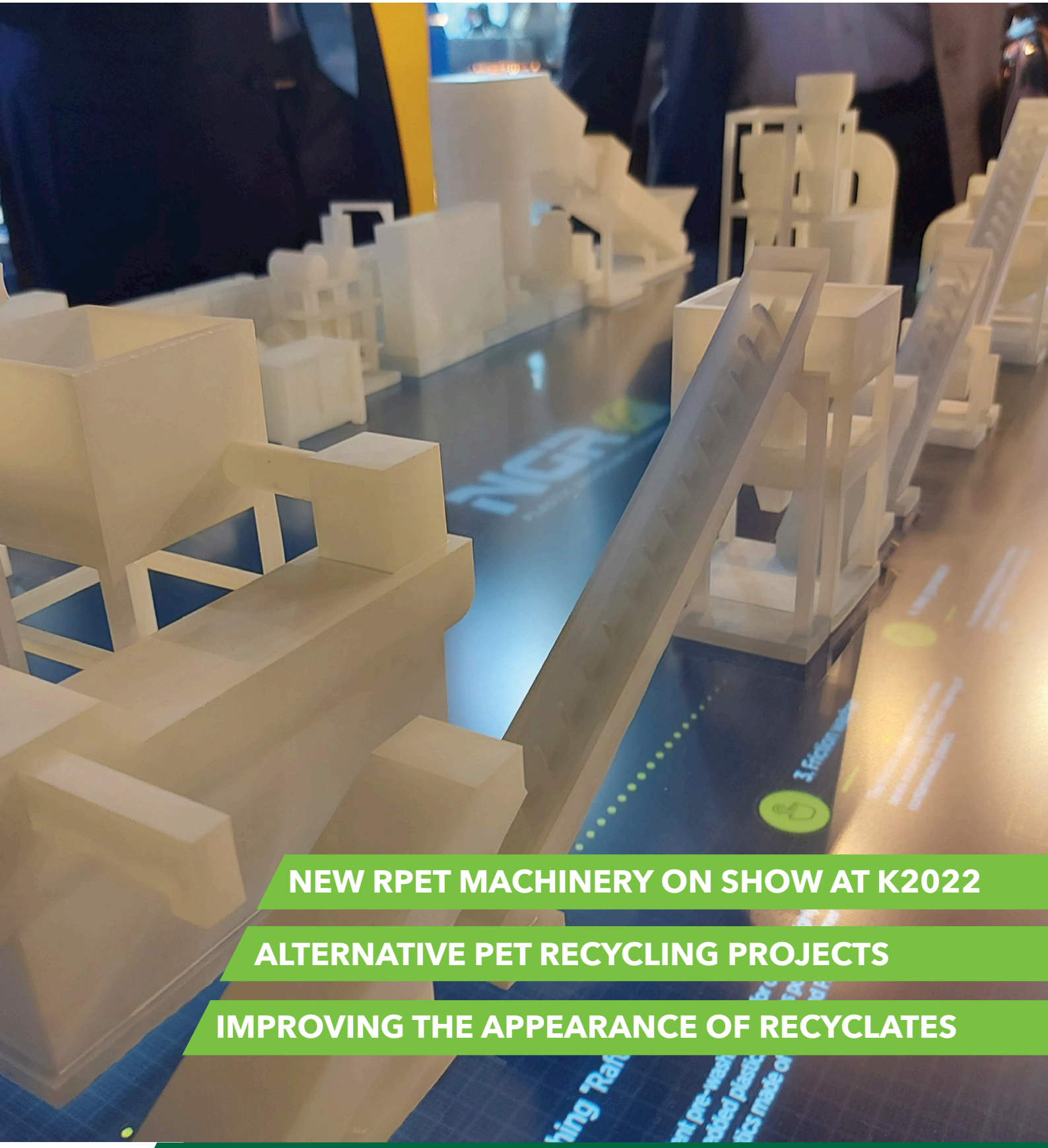
# Plastics Recycling WORLD



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# Plastics Recycling WORLD













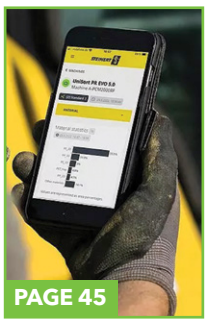




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# Major consumer companies set to miss sustainability targets

A new report by the Ellen MacArthur Foundation and the United Nations Environment Programme reveals that some of the world's largest consumer goods companies are almost certain to miss sustainability targets, having pledged that 100% of plastic packaging would be reusable, recyclable or compostable by 2025.

The report shows that for the third year in a row, the share of reusable, recyclable, or compostable plastic packaging increased slightly across the group, to 65.4% in 2021 from 63.2% in 2019.

While more than half of brands and retailers cut their use of virgin plastics, they used as much fresh plastic combined as they did in 2018 because plastic use is going up and recycled material only makes up for a fraction of the increase. For example, PepsiCo alone used 2.5m tonnes of plastic packaging in 2021. The company has increased its use of virgin plastics since 2020 and slightly cut the proportion of packaging that is recyclable, reusable or compostable to 76%.

The study also shows that some are using more virgin plastic. Companies producing some of the world's best-known drinks and snacks, including Nestle, Unilever, PepsiCo, Coca-Cola and Mars are continuing to use difficult-to-recycle items like sauce sachets and it is this aspect that is preventing them from making good on their pledge, according to EMF and UNEP.

The report came as UN members were preparing to meet in Uruguay to start negotiations on the first ever global plastics treaty, which is aimed at limiting and controlling waste pollution. While the plastics promise is voluntary for now, a global legally binding UN treaty is in the works. If approved, it could mean additional regulatory risk and scrutiny for businesses.

› **https://ellenmacarthurfoundation.org**
› **www.unep.org**

## Resilux invests in Serbia

Belgium-based Resilux Group has acquired 70% shares of the Serbian PET recycling company Greentech through its recycling division Poly Recycling Switzerland.

According to the group, the move gives Resilux significant additional recycling capacity as well as enhanced post-consumer bottle collection and sorting capability and is part of the company's ongoing expansion across Europe.

› **www.resilux.com**

## LyondellBasell in India venture

LyondellBasell and Shakti Plastic Industries, one of India's largest plastic recyclers, have signed a Memorandum of Understanding to establish a joint venture to build and operate an automated mechanical recycling plant in India. The plant is intended to process post-consumer rigid packaging waste and will have a capacity of 50,000 tonnes/yr of recycled PE and PP.

The new facility is expected to be the largest mechanical recycling plant in the country and aims to start production at the end of 2024.

› **www.lyondellbasell.com**
› **www.shaktiplasticinds.com**

## Bühler and Pellenc ST join forces

Swiss-based Bühler and French company Pellenc ST have come together to offer PET plastic recyclers a complete front and back-end solution for plastic bottle and flake sorting, with a North American agent agreement already signed.

The new partnership features Bühler's PET flake sorting solutions the Sortex N PolyVision and the Sortex A GlowVision, as well as Pellenc ST's Mistral+ Connect bottle sorter.

Carlos Cabello, Sales Director of Digital Technologies and Lead of Bühler in Northern Europe, said: "This alliance has been set up to streamline the sorting process for PET plastics recyclers, providing one port of call for our companies' collective customer-base. We look forward to the collaboration between the teams on both sides."

› **www.pellenc.com**
› **www.buhlergroup.com**

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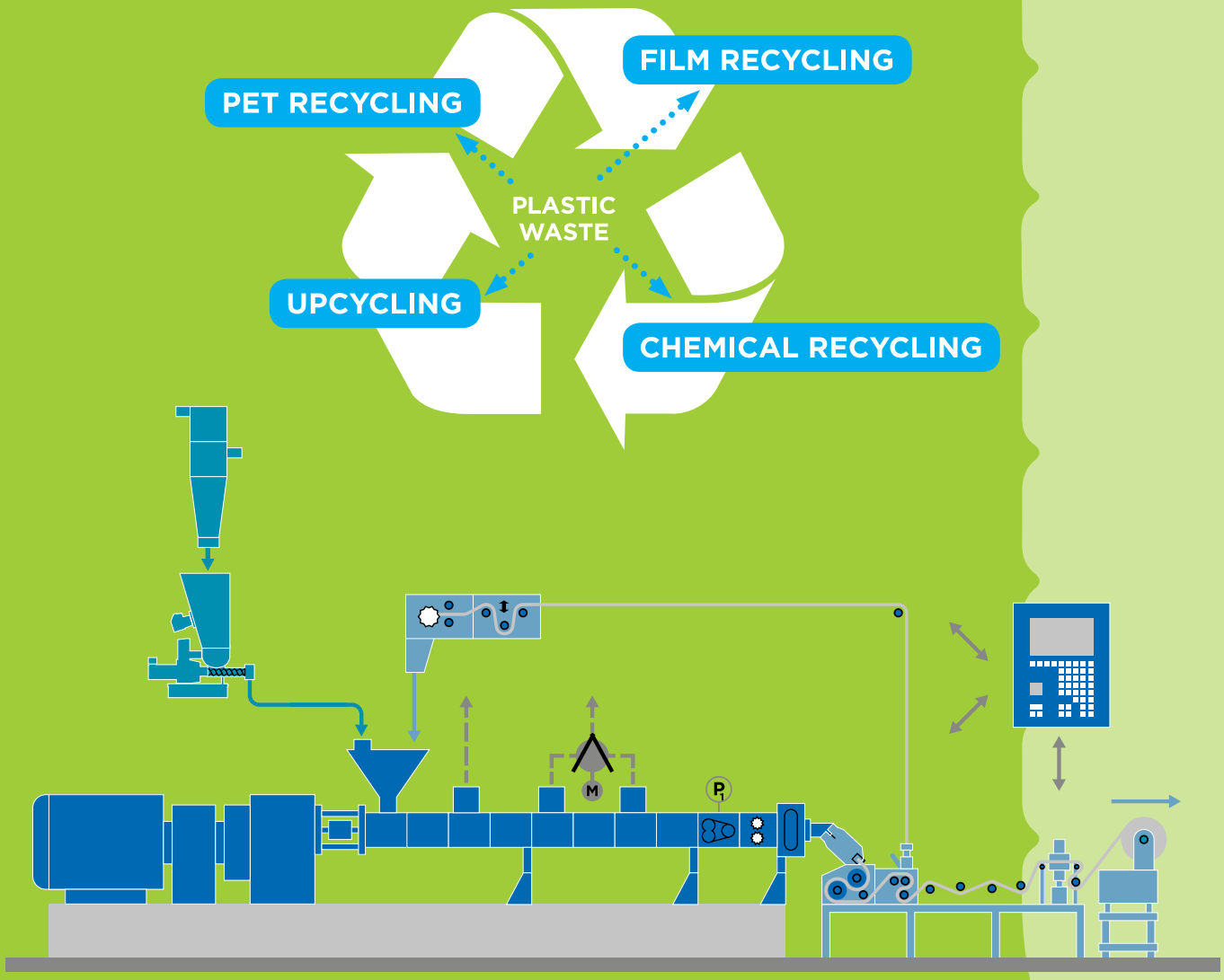


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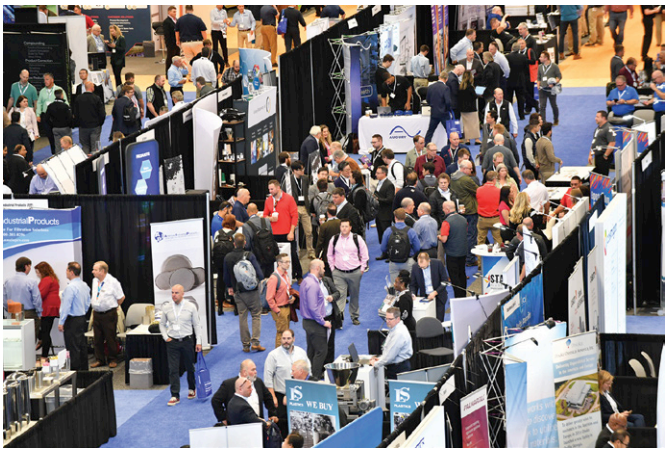
# AMI's Cleveland expos attract record numbers

The AMI Plastics World Expos took place in Cleveland, Ohio, USA for the third time on 9-10 November 2022 and attracted record numbers of exhibitors and visitors. The event brought together four focused tradeshows – the Plastics Recycling World, Compounding World, Plastics Extrusion World and Polymer Testing World Expos.

"We were delighted to welcome over 300 exhibitors and more than 4,600 attendees to this year's exhibitions, representing year-on-year increases of 36% and 53% respectively," said Kelly DeFino, Exhibition Sales Manager at AMI, which also publishes *Plastics Recycling World*. "The numbers were also well ahead of our pre-pandemic launch expos in 2019, showing a strong return to live events and an enthusiasm for doing business face-to-face."

The five conference theatres hosted more than 100 speakers and were a major attraction once again, with standing-room-only for some talks and panel discussions. The evening networking party also proved



popular, with more than 450 people joining in the fun and games at the Punch Bowl Social Cleveland.

Visitors welcomed the information exchange and collaboration that the expos encouraged. Daniel Mata, Process Engineer at flooring manufacturer Mohawk Industries, said: "I would definitely like to come back. I think it's a great opportunity for anyone and everyone that would like to learn. There's a lot of information here." Manfred Hackl, CEO of the Erema Group, appreciated the complementary nature of the focused expos, stating: "The combination of recycling, compounding, analytics and extrusion is the high value of the show."

Exhibitors were very positive about the size and quality of the audience. Slayton Altenburg, Application Specialist at TPEI, said: "The show is super well-attended, and the quality of conversations has been great." Christian Tittensor, Director of Sales and Marketing at Zeppelin, said: "It's really important for people to attend these kinds of expos to get face-to-face. We've had a lot of success here."

The AMI Plastics World Expos will next take place in Essen, Germany on 14-15 June 2023, and they return to Cleveland, Ohio, USA on 15-16 November 2023.

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

## Greenpeace report is slammed

The Plastics Industry Assn in the US has responded strongly to a new Greenpeace report condemning recycling as a "dead-end street" and concluding that "most plastic simply cannot be recycled."

The report also claimed that while US households generated an estimated 46m tonnes of plastic waste in 2021, only 2.2m tonnes was recycled and no type of packaging in the US can be considered recyclable.

Matt Seaholm, President & CEO of the Plastics Industry Assn, said: "The activists at Greenpeace cannot call themselves environmentalists while simultaneously discouraging recycling as part of the solution to our world's waste problems."

He said: "Recycling is real, and the claims that it can't ever work, made in this document, will likely result in unnecessary waste and public reaction that could actually cause greater environmental harm."

**› www.greenpeace.org**
**› www.plasticsindustry.org**

# SCG ups Sirplaste capacity in Portugal

SCG Chemicals has invested in new technologies and machinery at Sirplaste, the Portuguese plastics recycler it acquired a 70% stake in back in April. The investment expands production capacity for recycled HDPE by 9,000 tonnes/yr. It will take Sirplaste's total PCR production capacity to more than 45,000 tonnes/yr.

"SCGC has a clear business strategy for the green polymer that fulfils the market's need for sustainability," said Tanawong Areeratchakul, CEO and President of SCG Chemicals. "The decision to invest in new technologies and machinery at Sirplaste at this time is to strengthen the business and expand the commercial potential to become more competitive in the global market."

**› www.scgchemicals.com**
**› www.sirplaste.pt**

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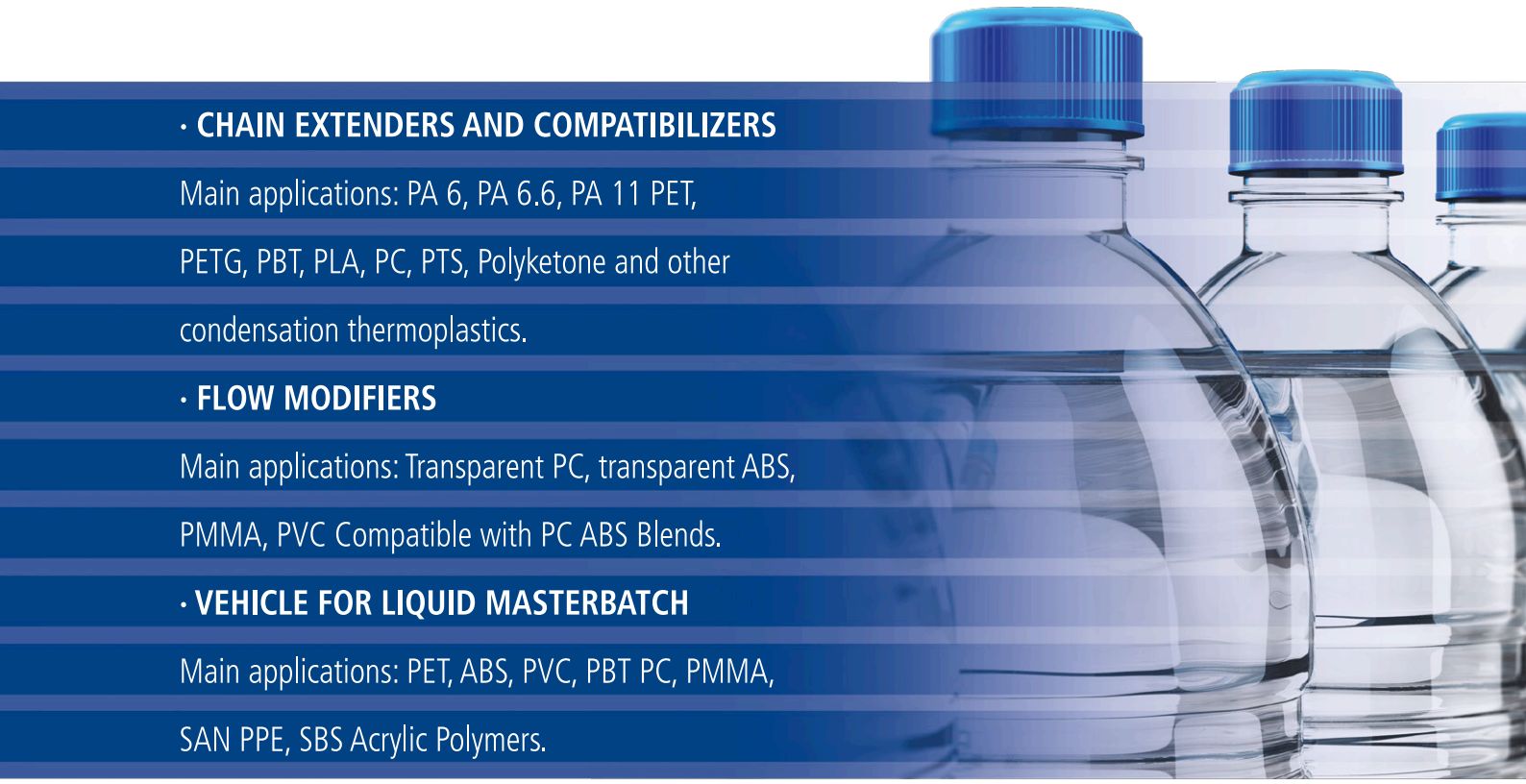

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## Ascend buys PA recycler

Ascend has purchased a majority stake in Circular Polymers, a US recycler of post-consumer polymers including PA 6 and 66, PP and PET. This will provide a consistent supply of high-quality PCR materials for Ascend's ReDefyne sustainable polyamides, which it launched at K2022.

Circular Polymers, which will be renamed Circular Polymers by Ascend, reclaims and processes post-consumer carpet via a unique technology and has redirected approximately 38,550 tonnes of waste from landfills into new goods since 2018.

› **www.ascendmaterials.com**

# GCR to build 200 ktpa PO recycling plant

IMAGE: GCR

**Above: GCR plans to build a 200,000 tonne/yr recycling plant in Spain**

Spanish compounder GCR has announced plans to open a dedicated recycling plant in Castellet i La Gornal, close to Barcelona in Spain, to meet increased demand for its Ciclic range of recycled polyolefins.

Ciclic polyolefins are based on up-cycling of fully-traceable waste to deliver similar material properties as virgin plastic. It claims a carbon footprint reduction of 60-80% lower compared to virgin alternatives.

The company says that when fully operational in 2025 the 200,000 tonne plant will be one of the largest of its kind. The facility will lift its masterbatch and compounds capacity to 500,000 tonnes combined.

› **www.gcrplasticsolutions.com**

## CKF acquires rPET packaging firm Packright

Scotia Investments portfolio company CKF has acquired thermoformed rPET rigid packaging supplier Packright, based in Langley, BC, Canada.

The company will continue to operate in the market as Packright with Colin Chiu being appointed Director, New Market Development, Plastics.

CKF now operates five plants in Canada – Hantsport, NS; Rexdale, Ont; two in BC: Langley and Delta; and two plants in the US in Clinton, IA and El Paso, TX.

CKF said customers will have access to a wider product line, expanded production capacity from CKF's Delta plant and a vertically integrated supplier when CKF's extrusion facility in Rexdale, Canada, is operational in December 2022.

› **www.ckfinc.com**

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AMI | Events

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Amcor

**Thomas Kahl**
Head of Sustainable Packaging Solutions FMCG & Industrial Channels
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**Other speaking companies include:** CEFLEX, CIRCPACK by Veolia, Erema Group, Borealis, EXPRA and many more.

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# Borealis to build plant in Austria

Polyolefin producer Borealis is designing a commercial-scale mechanical recycling plant to be located in Schwechat, Austria.

The plant will use Borealis' Borcycle M technology, which transforms polyolefin-based post-consumer waste into high-performance polymers suitable for demanding applications and has the capacity to produce over 60,000 tonnes/yr of advanced mechanical recycled polyolefin materials.

The front-end engineering design (FEED) stage will be carried out by green chemistry specialists Nextchem, upon successful completion of which Borealis expects to take a final investment decision in the second half of 2023 with a view to starting construction by the end of 2023. The first volumes of recycled polyolefin products are expected in 2025.

The plant will support Borealis in delivering on its sustainability commitments, which target a supply capacity of 600,000 tonnes/yr of circular products and solutions globally by 2025.

"With our purpose to reinvent essentials for sustainable living, Borealis is committed to rapidly increasing the share of recycled content across a wide range of high-performance polyolefins. Proof-in-point of the EverMinds mindset, this step demonstrates how innovative technology continues to advance circularity," said Lucrèce Foufopoulos-DeRidder, Borealis Executive Vice President of Polyolefins, Circular Economy Solutions and Innovation & Technology.

Borealis said mechanical recycling plays a key role in its approach to achieving circularity. It acquired plastic recyclers MTM Plastics in 2016, and Ecoplast Kunstofrecycling in 2018.

› **www.borealisgroup.com**

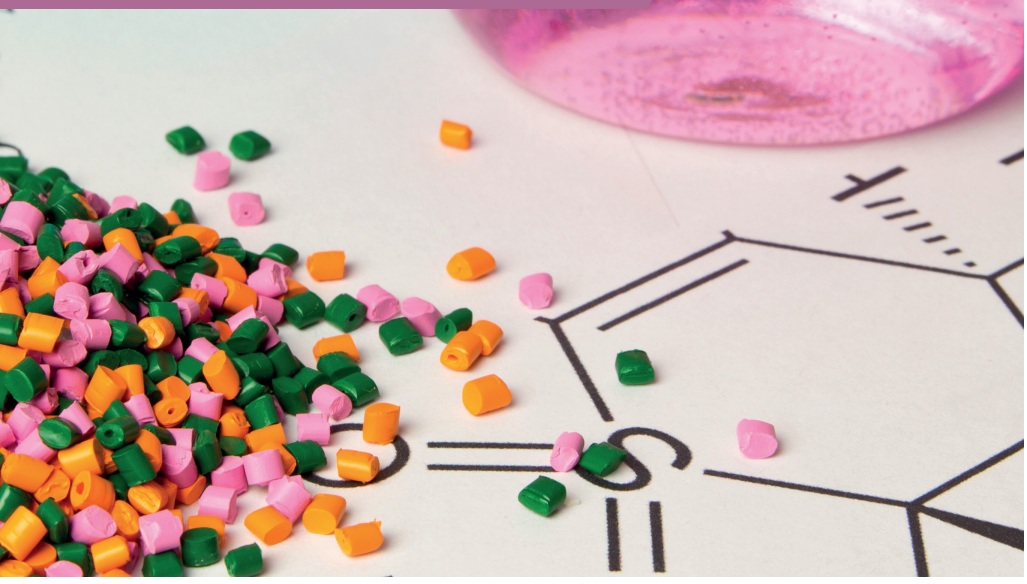
AMI | Events

# Chemical Recycling

March 20-22, 2023 | Houston, TX, USA

**New for 2023:**
Site visit at ExxonMobil's Baytown Complex

Explore the landscape of chemical recycling, it's potential impact, as well as progress made across the value chain to incorporate the technologies into the North American recycling industry



## Speakers include

**Silke Einschuetz**
Senior Consultant, Recycling & Sustainability
AMI

**Craig Cookson**
Senior Director, Plastics Sustainability
AMERICAN CHEMISTRY COUNCIL

**Dr. Jan Henke**
Director,
ISCC, MEO CARBON SOLUTIONS

**Matthew Marks**
Leader, Circular Economy, Americas
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# Plastics industry returns to K fair; numbers exceed expectations

The doors closed on K2022 on 28 October and it was without doubt a successful event. "K in Düsseldorf has once again fulfilled highest expectations. It continues to be the most international, complete and innovative trade fair of the global plastics and rubber industry," said Erhard Wienkamp, Managing Director at K organiser Messe Düsseldorf.

The verdict from Ulrich Reifenhäuser, Chairman of the Exhibitor Advisory Board at K 2022, was equally positive: "After hardly any trade fairs could take place worldwide, K 2022 was all the more eagerly anticipated as the world's number one trade fair of the plastics and rubber industry and succeeded in providing fresh impetus in all sectors of our industry."

K2022 marked the 70th anniversary of the fair, which in its last pre-pandemic edition in 2019 drew in around 224,000 visitors. The 2022 edition, which took place in a global environment where the shadow of Covid continues to impact on international travel, attracted 22% fewer at 176,000.

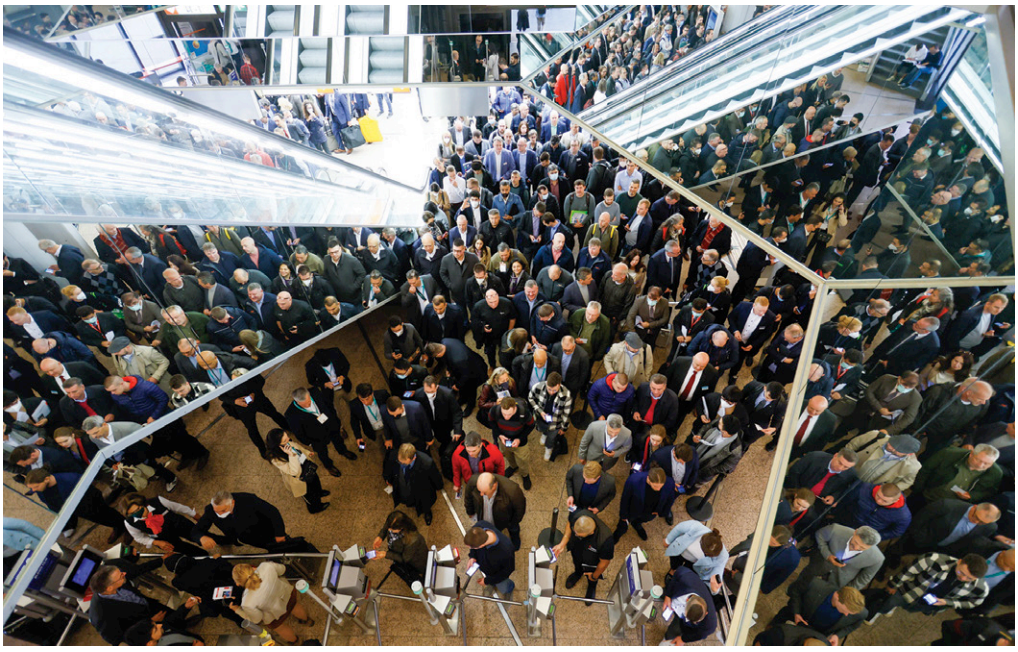

IMAGE: MESSE DUSSELDORF

**Above: Visitors wait to enter the K2022 fair in Dusseldorf last month**

The organisers had not publicly given an indication of their expected attendance but the *Plastics Recycling World* team understands the result to be at the highest end of private expectations – certainly on some days the centre seemed to be as busy as previous K shows.

More than 70% of visitors to the show came from outside of Germany, with the Netherlands, Italy, France, Belgium, Poland and Spain the most represented European visitor nations. According to Messe Dusseldorf, 42% of visitors came from beyond Europe. It said Covid quarantine regulations had depressed attendance from south-east Asia but the US, Brazil and India were well represented.

Over the following four pages we present some of the newest business initiatives and announcements made at the show.

› **www.k-online.com**

# KM adds to BluePower extruder line-up

KraussMaffei extended its ZE BluePower range of twin-screw extruders with the introduction of a large 186mm screw diameter model.

The new ZE 186 BluePower extruder is designed for maximum productivity in high throughput applications, says the company. "The modular design enables optimum adaptation to different processes. Typical areas of application include reaction, degassing and compounding as well as recycling processes," a company spokesperson said.

At the other end of the size range, the company demonstrated a ZE 28 BluePower extruder in a circular economy production cell demonstration. This started with a PX 200-1400 injection moulding machine producing pen caps from virgin PP. The caps were subsequently shredded to regrind, which was transferred into the ZE 28 BluePower to produce a compound with glass fibre reinforcement and additives. In the final process step, the recompounded material was used to injection mould automotive door handles.

The ZE28 on show was equipped with the company's UltraGlide feature, which allows the screws to be removed automatically from the processing section for cleaning or product changeover.

› **www.kraussmaffei.com**

# Erema pursues strategy that takes in chemical recycling

Erema Group showed technology for a wide spectrum of recycling operations at K2022, at its stand and its outdoor pavilion with partner companies. The fact that the group now has technology for mechanical and chemical recycling, post-consumer and post-industrial lines, packaging and fibre applications, shows its growth strategy is being pursued along a broad front.

"We would like to increase our portfolio in different applications and different technologies," said Manfred Hackl, CEO of Erema Group, speaking to *Plastics Recycling World* at the K show. The group already has extensive product offerings in areas such as PET, and he indicated the strength of its multiple brand strategy – in which customers work with dedicated teams at the group's companies. This is being extended into chemical recycling with the launch of Chemarema recycling lines for use in pyrolytic recycling plants.

Hackl's vision is that mechanical and chemical recycling will both grow in size. "In my ideal world, there will be huge mechanical recycling plants, and materials that are too difficult to recycle mechanically will go to chemical recycling plants," he said.

However, it could be mechanical recycling capacity that grows faster, said Hackl. Mechanical recycling has advantages such as lower $CO_2$ emissions and lesser energy demand compared with chemical recycling. For mechanical recycling plants, investment decisions can be made relatively quickly, he said, whereas a large chemical recycling facility can take two years to build, and most projects are still at the prototyping stage.

IMAGE: EREMA

**Above: Manfred Hackl, CEO of Erema Group**

Mechanical recycling plants may only have capacities up to 50,000 tonnes/year at present (compared with chemical recycling facilities likely to be a minimum of 200,000 tonnes/year), but Hackl said he thinks typical plant capacity will double to 100,000 tpa in only a few years.

The need for Chemarema systems comes from recognition that waste material needs upfront preparation in order for chemical recycling to deliver high-quality feedstock products. Hackl said Chemarema was developed to cope with the high output required by chemical recyclers, and because of this, issues such as screw wear resistance have been taken into account.

He said Erema's established Intarema system, with its patented counter-current technology, is a good base from which Chemarema has been developed, due to its wide operating window and capability with variation in waste materials. There are eight different extruder sizes for Chemarema systems, allowing customers to choose whatever is suited to their feedstock and output needs.

› **www.erema.com**

# BritAS showcases PET melt filtration system

IMAGE: D ELDRIDGE


**Thomas Lehner, CSO and MD, at the BritAS stand at K2022**

Melt filtration specialist BritAS highlighted its new ABMF-PET-C unit on its stand at K2022. The system, which has been designed for use with PET and other low-viscosity materials, was a winner at the Plastics Recycling Europe Awards.

The ABMF-PET-C was developed by BritAS in close co-operation with a PET recycling customer, said Thomas Lehner, CSO and MD, at the BritAS stand. The customer, which recycles PET bottles, has already bought a second system.

"PET is a material that challenges you," he said. The ABMF-PET-C was developed to deal with filtration challenges and achieve high quality pelletised granules, while enabling customers to run their lines efficiently due to its automatic operation with a continuous melt process. The fineness level of the system is as small as 20µ, he said.

› **www.britas.de**

# Veolia unveils PlastiLoop at K2022

Veolia used K2022 as the platform to launch an integrated customer offer under the name PlastiLoop, which brings together its network of experts and its 37 plastics recycling plants around the world. A large variety of high-performance recycled materials – PET, PP, HDPE, PS, ABS, LDPE, and PC – are available ready for use in multiple industrial sectors, including packaging, textiles, agriculture, home and appliances, automotive, industrial and logistics, building and construction.

Veolia produced about 476,000 tonnes of circular polymers in 2021 and has increased its global recycling capacity fivefold since 2016. It aims to reach 610,000 tonnes of recycled resins delivered by 2023.

Speaking to *Plastics Recycling World*, Benoît Perreau, Markets and Clients Director, said: "One target of

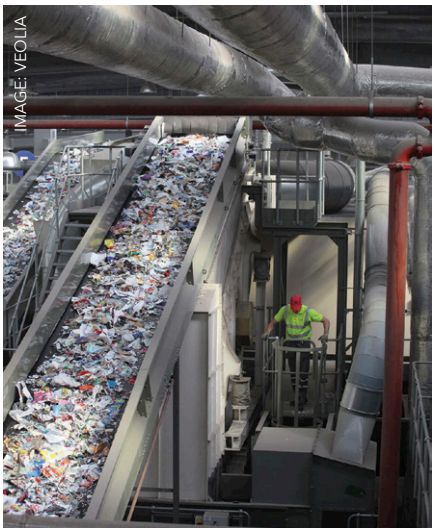
IMAGE: VEOLIA

the PlastiLoop launch is to increase our visibility as a circular polymers partner."

Veolia works closely with customers on their applications, he said, and PlastiLoop's product offering is organised by customer industries. Its work with customers involves an "application mindset", which he said brings them the advantages of reduced time to market, risk mitigation and improved material selection.

"Circular polymers speak to clients' needs," said Perreau. "This is where we want to change the mindset in the market. The approach [with using circular polymers] has to be different."

Each of the PlastiLoop polymers is available with its own product data sheet. A grade specified in, for example, France, can also be produced by Veolia plants elsewhere in the world (although not all facilities produce all the PlastiLoop polymers).

Perreau said Veolia has the ambition to grow PlastiLoop through acquisitions and greenfield projects, and also the development of new grades.

› **www.plastiloop.veolia.com**

# Newcomer Aloxe announces ambitious rPET growth plans

Aloxe made its public debut at K and announced plans to invest €50m in PET recycling plants in France, Poland and Italy, taking its total capacity to 120,000 tonnes/year by 2024. It claims that this will make it Europe's biggest independent rPET producer.

The company was founded by Clément Lefebvre, who was previously with Veolia, and by Arnaud Piroëlle, who joined from BASF. It is funded by US-based Ara Partners.

Executive director Piroëlle explained that recycling capacity will need to increase significantly to meet EU regulatory targets for PET beverage bottles to contain an average of at least 25% rPET by the start of 2025. "Our focus is on delivering high-quality material in high volumes," he added.

Aloxe's first acquisition was Loreco Plast Recyclage in April 2021. Its plant near Nancy in France is being expanded from 12,500 to 50,000 tonnes/year with the installation of equipment from Erema. The new capacity is due on stream in June 2023.

In August 2022, Aloxe acquired Elcen, based in Gdynia in Poland. It has capacities of 5,500 tonnes/year for flakes for bottle applications and 4,800 tonnes/year for fibres and geotextiles. The plan is to open a new plant near Torun in central Poland in the first quarter of 2024. It will also use Erema recycling equipment and will have an extrusion capacity of 40,000 tonnes/year.

The most recent acquisition is the rPET division of mineral water company Ferrarelle, which was purchased in October 2022 and is located north of Naples in Italy. Its current capacity is 15,000 tonnes/year, but the plan is to double this to 30,000 tonnes/year by the first quarter of 2024 using machinery from Starlinger.

Aloxe is primarily targeting packaging applications, offering its Origo rPET pellets in clear, light blue and green grades for food-contact applications, including preforms and thermoforming. These are currently produced at its French plant, while clear and blue rPET flakes are produced in Poland.

Piroëlle said he expects around 60% of Aloxe's rPET to be used in bottles, 30% in thermoforming applications, and 10% in other packaging markets.

› **www.aloxe.one**

# SI Group enters into recycling

SI Group launched a new range of additives for recycling under the brand name EverCycle, which is said to have been created with a view to building industry collaborations with plastics recyclers, machinery companies and polymer producers.

The move underlines a significant transformation in the SI Group business over the past three years, according to Robert Kaiser, VP Polymer Solutions and MD for the EMEA region. This has included investments in expanding antioxidant production at various global sites, in particular production of its Weston 705 phosphite antioxidants, but is also forward-looking.

IMAGE: SI GROUP

"Innovation should not be limited to what we already have but also connected with the future and sustainability," he said at the show.

The first products in the EverCycle family include two additives for PET recycling and converting, which are claimed to enhance process stability and colour control and reduce acetaldehyde levels. The EverCycle PET-102D and PET-103D grades are intended for use with PET bottles, trays, and fibres; PET-102D is available as a pellet and PET-103D as a liquid.

Two additives for polyolefin recycling offer process stabilisation and performance enhancement while enabling increased recycled content. EverCycle PP-101S has been developed for stabilisation in HDPE and PP rigid packaging; LD-101S is intended for stabilisation in LDPE flexible packaging. EverCycle LD-104P targets issues such as gel formation in films that creates weak spots.

› **https://siigroup.com**

## PCF data for BASF additives

BASF announced Product Carbon Footprint (PCF) data for a number of its additives. First PCF data has been made available for several antioxidants and light stabilisers in its Irganox, Tinuvin and Chimassorb additive ranges. BASF Plastic Additives Sustainability Specialist Marina Leed highlighted the company's Valeras platform, which brings together additives and services that have sustainability benefits, and its new IrgaCycle range of additives for mechanically recycled plastics.

› **www.basf.com**

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## Quality is the word for Elix

Elix Polymers is working on application targets for its E-Loop engineering materials containing recycled plastics which were launched in February with the aim of becoming a high-quality drop-in solution in automotive, appliance and medical sectors.

Fabian Herter, Marketing Manager, illustrated this with an example of ABS-PC with 30% post-industrial recycled content sourced from prime automotive material, and used for demanding interior and exterior applications.

He said Elix is working with colour partners to attain the quality needed for E-Loop materials going to the appliances market. It is also partnering Repsol in Spain on securing quality waste streams.

› **www.elix-polymers.com**

# New Clariant products help chemical recycling

Clariant announced a move into the chemical recycling area at K2022 with the launch of a portfolio of new products developed to improve the quality of products from pyrolysis-based chemical recycling ventures.

Projects for chemical recycling of plastics waste are proliferating, with a large proportion based on pyrolysis technology. However, the pyrolysis oil produced in these facilities is likely to require further processing to remove contaminants before it can be used as a feedstock for new polymer production.

Contaminants are highly variable and can include by-products of nitrogen, oxygen, sulphur in differing amounts. Clariant's new HDMax catalysts and Clarit adsorbents are tailored to remove a wide range of contaminants that are continuously changing in the feed, which it says enables the flexibility pyrolysis oil producers need regardless of process configuration.

Speaking to *Plastics Recycling World* at the show, Clariant's Global Business Development Manager Séval Schictel said that in small volume pilot plants contaminants are diluted to low levels, but the need for pyrolysis oil purification is becoming important as chemical recyclers aim to start up production scale facilities from 2025 onwards.

Schictel said the Clarit adsorbents are designed for use in the first step, where they target a range of different contaminants to adjust for the variability of the input materials. The second step involves catalytic hydrogenation using the new HDMax catalysts.

Clariant also introduced Licowax AS 100 TP, which is an anti-scratch additive based on renewable materials for PP and TPO formulations which enables injection moulded products – such as car dashboards and door panels, household appliance casings, light-weight luggage –to maintain their original look and feel for longer. "Expanding the lifespan of products is a key element in the move from a linear to a circular economy," said Martin John, Head of Advanced Surface Solutions at Clariant.

The company also launched a new product carbon footprint (PCF) tool. It says the CliMate automated carbon footprint calculator allows it to offer consistent cradle-to-gate greenhouse gas (GHG) emission data for all of its products.

› **www.clariant.com**

# Lindner goes larger to follow market trend

Lindner executives presented the group's technology in action to journalists in the company's outdoor pavilion during K2022. In daily demonstrations, different post-consumer rigid plastics were shredded live using Lindner's Micromat HP shredder.

Harald Hoffmann (pictured), MD of Lindner Washtech, said there is a trend towards higher throughput in plastics recycling plants, often 2-3 t/h. The new HP version of the Micromat shredder has an increased capacity, raised from 3 t/h to 5 t/h. Likewise, the new Rafter-type pre-washing system has 2-3 t/h throughput, up from 1-1.5 t/h in the previous system.


IMAGE: D ELDRIDGE

"The market has changed. Quality is now a big issue," said Hoffmann.

The new EcoDry thermal dryer achieves energy savings of up to 30% thanks to heat exchangers and insulated material handling components. Having a residual moisture of less than 1%, the materials achieve a particularly high degree of drying, which means that the flakes are better prepared for the subsequent process.

Michael Lackner, MD at Lindner-Recyclingtech, spoke about the group's move to a new 14,000 m² HQ and manufacturing facility in Spittal/Drau, Austria, in July. The production area has been doubled at the new location. The larger set-up has enabled the group to reduce assembly times and has halved delivery time to customers to 10 weeks, he said.

› **www.lindner.com**

***Suppliers of PET recycling technologies showcased new systems at the K2022 show in October. Peter Mapleston reports on developments in the competitive sector***


# New rPET machinery developments at K2022

High demand for post-consumer PET recycling lines – waiting times are anywhere from 12 months to almost two years, with one supplier even said to be taking bids on its equipment – is a sure sign of the need in the food and drink sector to put more rPET into packaging. European Union legislation requires that by 2025, all new PET bottles should contain at least 25% recyclate, with the figure rising to 30% by 2030.

Whether or not recycling plant operators will be able to obtain the necessary feedstock, at a price they can afford, is an open question. But at least if they can find it, technologies for turning post-consumer waste into material fit for new food-contact applications are improving all the time. There were several interesting new developments on display at the K2022 exhibition in Düsseldorf in October.

**Starlinger Recycling Technology** is a good example, with its new RecoStar PET Art bottle-to-bottle recycling system. Here, it has combined the usual two drying units with the residence time of around one hour each into one larger unit with the residence time of two hours. The advantage is that the vacuum unit used on the previous version has gone, reducing energy consumption and maintenance requirements. The RecoStar PET Art saves about 21% production costs. Energy consumption is down by 25% compared to the previous model, and it requires 46% less maintenance time. Output capacity is up by 15%, says Paul Niedl, Commercial Head of Starlinger Recycling Technology.

**Viscotec**, a sister company in the Starlinger group, makes solid state polycondensation (SSP) systems for decontamination to a level required for food contact packaging, and its range includes systems designed for lifting intrinsic viscosity (IV) of rPET. Its new ViscoZero melt phase decontamination reactor is designed for the production of food grade recycled polyolefin and polystyrene resins, plus food-grade and IV-increased recycled PET. Viscotec says: "When recycling PET waste, food-grade rPET pellets are produced in just a few minutes. Both the increase of the intrinsic viscosity and the decontamination of the material is done incredibly fast. It is a cost-effective way to produce pellets for end products made of high-viscosity PET, such as strapping tapes or fibres."

New systems from **Erema** can yield important energy savings, according to Managing Director Michael Heitzinger. He says the company's philoso-

**Main image: NGR's stand at the K2022 exhibition in Dusseldorf, Germany in October**

**Right: At K2022 Starlinger unveiled the RecoStar PET Art recycling line for PET bottle-to-bottle applications. Compared to the previous model, it saves around 21% in production costs**

phy is that waste material needs to be purified as much as possible before it is remelted, partly because the surface:volume ratio of flakes is much higher than that of granules.

For the last four years, Erema has been working with **Polymetrix** (previously a Bühler business unit, but now 80% owned by Sanlian Hope), which is expert in SSP technology, complementing Erema's expertise in pre-treatment, says Heitzinger. Together they created the Vacunite system four years ago, which uses a processing environment completely free of oxygen to reduce degradation – and hence yellowing – of the PET.

Erema has more recently developed EcoGentle technology, which involves the use of a new plasticising screw design to provide more gentle shear and extension, massive energy savings (due in part to reduced processing temperatures), and reduced AA levels. "[Production rates] Up to 6 tonnes/hour are possible with the new technology," says Heitzinger. Measurements on a Vacurema Basic 2628 T system resulted in up to 12% saving in specific total energy consumption and between 30 and 47% energy saving for the extruder drive on Vacurema Basic plants from size 2021 upwards.

**Coperion** has been in PET recycling for some 30 years, with systems based on its ZSK twin-screw extruders converting bottle flake to sheet, and bottles to fibres. It introduced systems for bottle-to-bottle around five years ago; these have a maximum capacity of around 7 tonnes/hour. Coperion is now thinking about even bigger lines for bottle-to-bottle recycling.

Like Erema, Coperion cooperates with Polymetrix on SSP equipment, while washing lines come from Herbold Meckesheim, which is now part of Coperion's Recycling BU following parent company Hillenbrand's takeover in July. Focus area is on larger capacities, upwards of around 2.5 tonnes/hour.

Coperion claims to offer a technology that can handle virgin material and various recyclates (regrind, agglomerates or flakes). Everything can be processed together in the ZSK twin-screw extruder. One novel (albeit not new) solution that Coperion offers involves partial glycolysis, in which ethyl alcohol is injected into the ZSK extruder to reduce IV down to around 0.3; this enables particularly fine filtration of the material – which is useful for highly contaminated waste. After leaving the extruder, the melt can be mixed with virgin PET and the IV fully restored using liquid-state polycondensation (LSP). Alternatively, it can be further depolymerised back to BHET monomer and further purified, and then repolymerised.


IMAGE: PETER MAPLESTON

"Glycolysis is becoming of more interest as a way of processing very dirty material, but it does require LSP afterwards," says Jochen Schofer, Head of Sales, Recycling, at Coperion.

**Bandera** has a long history in equipment for PET sheet and film extrusion, but is a relative newcomer in PET recycling. It claims technology superiority with its twin-screw system over more established rivals' single-screw systems. Bandera also cooperates with Polymetrix on systems with high levels of purification. German company MOPET, part of major recycling group Morssinkhof-Rymoplast, uses a Bandera/Polymetrix system rated at 5 tonnes/hour.

**NGR** reported a "complete success" for its presence at K2022. "In addition to numerous completed orders, a great deal of global interest in [our] innovative PET recycling process was generated," it says, noting that an increasing number of brand owners worldwide rely on its LSP technology for the processing of post-consumer PET.

Günther Klammer, CTO of NGR, says: "We are finding that LSP is a real game changer in PET improvement and is rapidly gaining popularity due to its better energy efficiency and outstanding

**Below: Erema introduced the EcoGentle plasticising unit at K2022**

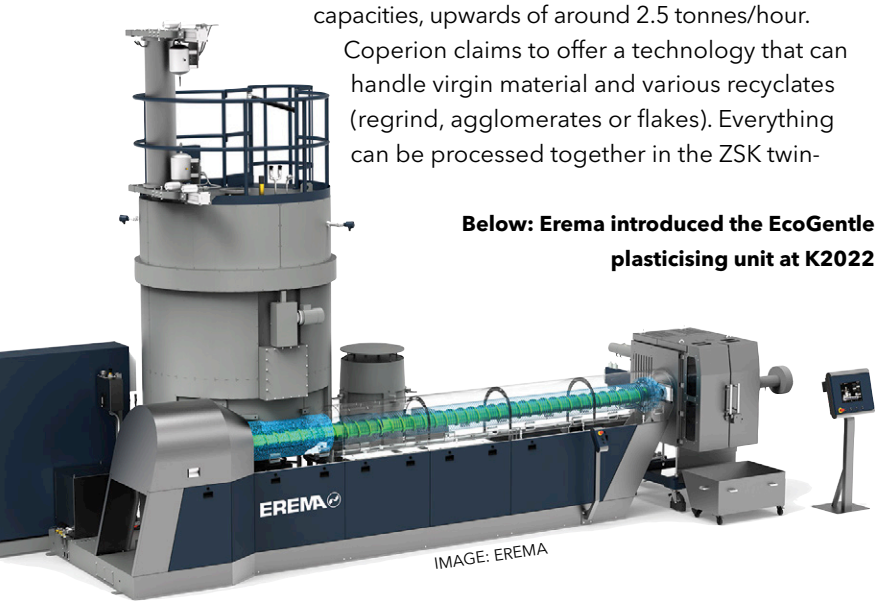
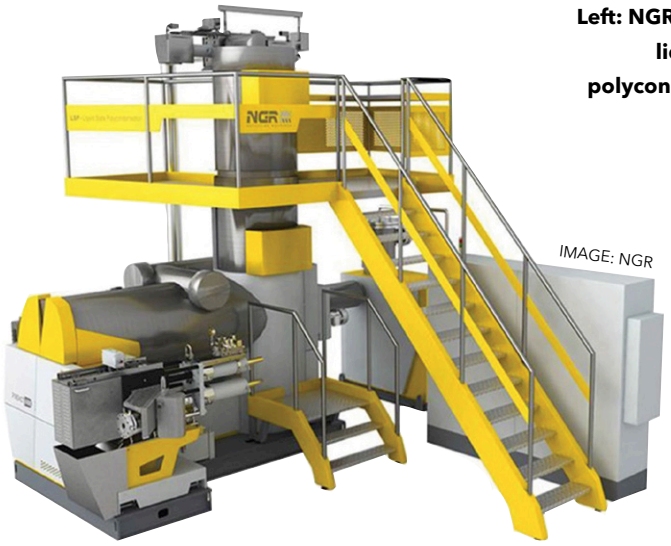



IMAGE: EREMA

cleaning performance. We believe it will soon become the widely accepted standard for bottle-to-bottle PET recycling."

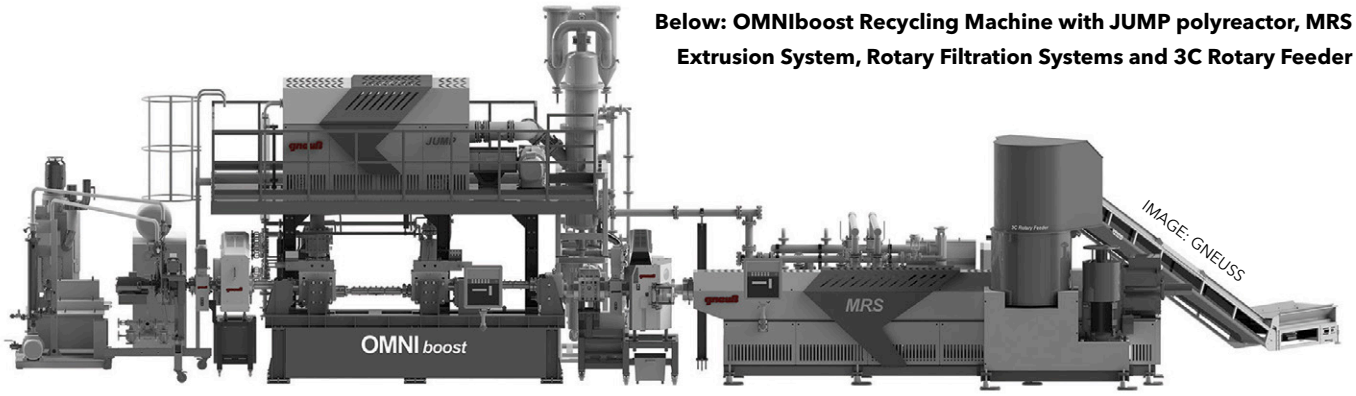
NGR introduced LSP in 2011 under the product name P:React. It says that while decontamination and IV improvement using SSP can require many hours, with the LSP process it takes only minutes. All impurities are removed from the PET melt while still in the liquid phase, "which guarantees simultaneous upgrading of the plastic and recycling to the highest standards of the brand owners". At K2022, NGR promoted an updated version of P:React with some improved modules and which now features inline monitoring and control of the system and process.

Other manufacturers are now also working on LSP solutions for PET processing, NGR notes, but it is well ahead, having already sold more than 50 systems in over 20 different countries. David Hehenberger, Product Manager PET at NGR, says: "The LSP technology is in the market since 2014 for the application of PET fibre recycling and production. In 2016 we had the first machines for PET sheet application, and in 2020 we developed the technology further to produce food grade pellets and also preforms." The company has already installed 10 systems for bottle-to-bottle PET recycling around the world.




**Left: NGR's P:React liquid-state polycondensation system**

LSP works with higher temperature and higher vacuum than SSP, so contaminant molecules are more flexible and easier to remove, he says. "This is also a reason why the IV lift in the LSP-Reactor is done within minutes compared to hours (minimum 6 hours for food grade) in the SSP process. The LSP




**Below: OMNIboost Recycling Machine with JUMP polyreactor, MRS Extrusion System, Rotary Filtration Systems and 3C Rotary Feeder**

method makes use of PET's inherent tendency to condense under vacuum in the melt phase. This condensation results in an extremely quick increase in the IV value."

NGR has four sizes of P:React units, starting with the P:React 600, which has an output ranging from 300 to 700 kg/hour, through to the P:React 3000 (1,500-3,000 kg/hour).

On its stand at K2022, **Gneuss** showed a complete Omni Recycling Machine featuring a new 3C Rotary Feeder developed for low bulk density materials, an MRSjump 70 extruder, a fully automatic RSFgenius 90 melt filtration system and an online viscometer VIS, for the processing of 200 kg/hour of undried and uncrystallised PET reclaim from PET thermoforming.

The core of the MRS extruder, which is based on conventional single screw technology, is a central multiple-screw section for devolatilisation. The new MRSjump has a longer, modified version of this section, which Gneuss says ensures both a longer residence time of the material and more surface area exchange under vacuum.

"The longer Multi Rotation Section, coupled with a powerful vacuum system operating at 1 mbar, can be used to boost the viscosity of rPET and to hold it at a stable level in spite of variations in the input material," says the company. "Therefore, there is no need for any liquid phase or solid state polymerisation." Gneuss says the MRSjump is especially well suited to recycling PET film waste and fibre reclaim, applications for which it says direct recycling with one single extrusion step was previously impossible due to low IV or variable input viscosities. The company says the new system could help processors wanting to use feedstocks other than PET bottle flake, where demand outpaces supply.

An OMNIboost Recycling Machine with a Jump LSP reactor was operating in the Gneuss technical centre during the show. The Jump can lift the IV value of a PET melt up to 0.95 dl/g. In this unit, polymer passes over several slow turning elements which create a polymer film, the surface of which is constantly renewed. The reactor vessel is kept under vacuum. "By regulating the residence time in the reactor, the vacuum, the fill level and the speed of rotation of the agitating devices, the polycondensation reaction can be altered to achieve the required product properties," says Gneuss.

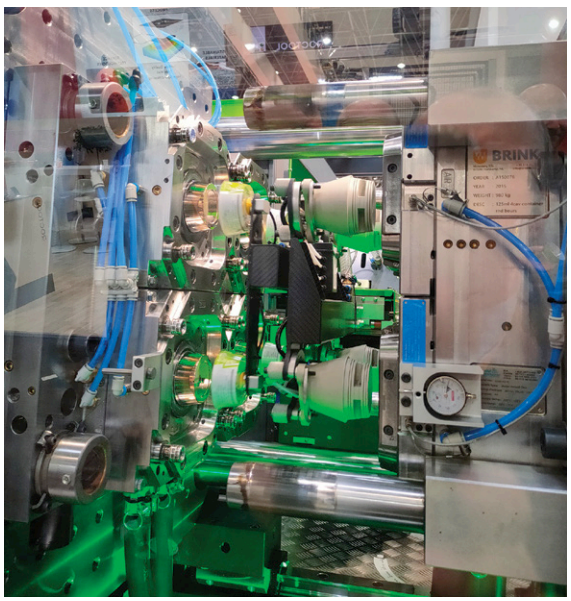


IMAGE: PETER MAPLESTON

**Right: At K2022, Engel made thin-wall cups containing rPET on a new high-speed injection moulding machine**

## Direct to packaging

Injection moulding machinery companies Engel and Husky have independently been working to integrate PET recycling with the production of packaging. At K2022, **Engel** demonstrated an injection moulding system – developed in collaboration with Alpla – producing small cups in rPET, as an alternative to PP. Engel points out that under current European Union legislation, mechanically recycled PP cannot be used in food packaging (apart from very specific cases).

The system was processing a mix of virgin PET and rPET in a 70:30 ratio, but 100% rPET is also possible. It was operating with a four-cavity mould and in-mould labelling (both from Brink), running with two different types of label at the same time. One was in PET and the other was in PP, which can be peeled off the PET cup after use. The cups have

0.32mm walls and are produced in a cycle of around 2.75s. The partners are planning to have a system with an 8+8 stack mould ready around the middle of 2023.

Several PET recycling technology companies have provided equipment to preform production systems leader **Husky Technologies** during development of a technology Husky introduced in May called Recycled Melt to Preform (RMTP); this is offered as a module for use with its HyPET HPP5e system. At the time, Husky said that with one system already running in the field and the second soon to be delivered, this development marks the successful integration of a preform injection moulding system with melt decontamination unit – enabling the direct conversion of washed flake to preforms.

Husky says that by eliminating the drying and melting steps associated with traditional rPET preform manufacturing, its solution facilitates the effective production of packaging made from 100% rPET. It says that bypassing rPET pellet production leads to 30% energy savings.

Pedro Oliveira, Husky's Business Manager for PET Systems says it is possible to connect the HyPET HPP5e RMTP system to any melt decontamination/IV boost solution on the market today. "This could be an Erema Advanced, as seen with our beta system, an Erema Prime that was included on a recently sold system, or a liquid-state polymerisation system from NGR that was used for our initial demo system. We are also exploring other in-line technologies enabling the direct link from washed flake to preform in a flexible and energy efficient manner."

David Hehenberger, Product Manager PET at NGR, says: "We are going directly with the melt out of our LSP unit into the shooting pot of the injection moulding machine. Therefore, we can save a lot of energy, space, material logistics, and more."

**CLICK ON THE LINKS FOR MORE INFORMATION:**

- **www.starlinger.com/en/recycling**
- **www.viscotec.at**
- **www.erema.com**
- **www.polymetrix.com**
- **www.coperion.com**
- **www.luigibandera.com**
- **www.ngr.at**
- **www.gneuss.com**
- **www.engelglobal.com**
- **www.husky.co**

# New EU authorisation for food-contact processes

## *A new EU regulation is significant for recycling companies in the food packaging sector, writes* ***Peter Mapleston***

New European Union rules on the safety of recycled plastic materials and articles intended to come into contact with food came into force in October. Commission Regulation (EU) 2022/1616 replaces Regulation (EC) 282/2008.

According to the Directorate General for Health and Food Safety, the regulation "makes it possible to authorise recycling processes for manufacturing safe recycled plastic materials for use in food packaging. It will also help the recycling industry establish suitable ways for recycling plastics that presently cannot be recycled into food packaging."

"In addition, the European Food Safety Authority (EFSA) will have a clearer basis to evaluate the suitability of recycling technologies and the safety of the recycled plastic in food packaging manufactured with processes using these technologies."

The Regulation will allow granting individual authorisations for more than 200 mechanical PET recycling processes, says the DG.

The Regulation has various provisions relating especially to PET recycling processes:

Processes subject to an application received by EFSA before 10 July 2023 may continue after that date to be used by recyclers without authorisation, until they are notified of a decision on their authorisation;

The first of those authorisation decisions,

concerning applications received before entry into force of the Regulation (ie on the basis of Regulation (EC) No 282/2008), are expected within three months from entry into force;

Authorisation decisions place restrictions on recycling processes; these are based on the EFSA opinion applicable to the process;

For recyclate manufactured with a novel recycling technology, it must be in accordance with Chapter IV of the Regulation, which lays down two suitable technologies:

Post-consumer mechanical PET recycling, which requires authorisation of individual processes;

Recycling from product loops which are in a closed and controlled chain; this requires the use of a recycling scheme.

Paul Niedl, Commercial Head of Starlinger Recycling Technology, says: "Existing PET recycling technologies have to register by January 2023 latest. This does not mean that they have to undergo a new food safety evaluation, but they must register their existing process with an existing EFSA positive opinion by that date."

Niedl says a discussion is ongoing that could lead to equipment suppliers such as Starlinger receiving a technology approval, with their customers able to work with that approval under a licence (an approach similar to the one used by the FDA in the USA). "But there is no clear statement when and how this is going to happen," he says.

Brussels-based trade association Plastics Recyclers Europe (PRE) says the change in regulations "provides a system to approve novel technologies, including the recycling of HDPE, LDPE, PP or PS for example. This process requires additional data to determine whether the decontamination technology can produce a recycled plastic in compliance with Regulation 10/2011 and 1935/2004."

PRE says: "A multitude of data points with regard to the monitoring of the contaminants and the ability of the process to decontaminate the material will be generated, allowing a representative assessment of the process to ensure the safe use of recyclates in specific food contact applications. We expect much more processes to be approved in the future."

**CLICK ON THE LINKS FOR MORE INFORMATION:**

- **https://european-union.europa.eu**
- **www.starlinger.com/en/recycling**
- **www.plasticsrecyclers.eu**

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***Mechanical recycling accounts for the major part of PET recycling, but other approaches that are based on depolymerisation and other processes are also being developed around the world. By* Peter Mapleston**

IMAGE: CARBIOS

# Alternative PET recycling projects move forward

Several projects are underway around the world on different ways to treat PET packaging and fibre waste that is unfit for mechanical recycling.

French company **Carbios** is developing a recycling process that uses an enzyme capable of specifically depolymerising PET in moulded plastics and in textiles (see *Plastics Recycling World* Nov/Dec 2021). The Carbios demonstration plant, which started up last September in central France, is now fully operational, and company CEO Emmanuel Ladent says results are "extremely good." The process book should be ready around the end of the year, enabling the company to move ahead on licensing the technology. Carbios is talking with several major potential customers, including not only PET producers, but also waste management companies and possibly even brand owners.

The plant, which operates on a batch basis, can process up to 2,000 kg of waste at a time, with each run taking between 10 and 20 hours. It has already achieved a yield of 97% when running for close to 20 hours. "We are very confident about the technology, but we continue to optimise the process and the enzymes. Our goal is almost 100% yield," says Ladent.

This February, the company announced that it would build its first reference unit, with an input capacity of 50,000 tonnes in Longlaville, France, close to the borders with Belgium and Luxembourg, in partnership with Indorama Ventures. Indorama already has a polymer production unit on an adjacent site. Ladent also says that large amounts of waste are managed in the area, so supply logistics should be advantageous. Negotiations are currently ongoing with potential feedstock suppliers.

Several months ago, Carbios formed a consortium with various brands in the packaging chain, including L'Oréal, Nestlé, PepsiCo, on plastics. In early July, the company announced a similar consortium for the textiles chain, involving Patagonia, On, Puma, and Salomon, to develop solutions that will enhance the recyclability and circularity of their products.

An important element of the two-year deal will be to speed up the introduction of Carbios' bio-recycling technology for application to the textile industry. Carbios and the four companies will also research how products can be recycled, develop solutions to take-back worn polyester items, including sorting and dismantling technolo-

**Main image: Carbios is taking its enzymatic process out of the lab and demonstration plant into a reference plant in France**

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gies, and gather data on fibre-to-fibre recycling as well as circularity models.

"We have already done a lot of tests, although not yet at an industrial level. We are working on steps for waste preparation," says Ladent. "We are extremely confident that polyester textile recycling will be an important milestone for Carbios."

The beauty of the process is that it is tolerant of contamination, says Ladent. "This means that we can process multilayer trays, for example." The plant could work with PET bottle flakes, but given the price that would need to be paid for them, this is an unlikely option. Ladent says around 8-9% of PET post-consumer waste in Europe is in the form of food trays, which are currently either landfilled or incinerated, so prices are much lower.

Carbios has created an LCA that shows its process has associated CO2 emissions that are 46% lower than with virgin PET bottles with a single life. Further work will provide a comparison with other PET depolymerisation processes and mechanical recycling.

In August, Carbios joined the four-year White-Cycle project, launched with the ambition that by 2030 the uptake and deployment of its circular solution will lead to the annual recycling of more than 2m tonnes of PET. The consortium intends to develop various new processes, including: innovative sorting technologies; a pre-treatment for recuperated PET plastic content, followed by the Carbios depolymerisation process; repolymerisation; and fabrication and quality verification of new products made of recycled materials.

## Reaction technology

PET manufacturer **Equipolymers** and technology start-up **Rittec Umwelttechnik** announced a cooperation in Schkopau, Germany, earlier this year. Their intention is to further develop and implement Rittec's RevolPET process into Equipolymers' PET manufacturing plant. The companies plan to use materials unsuitable for mechanical recycling processes, including multilayer packaging and heavily coloured containers.

Lab-scale polymerisation tests have shown promising results. "The replacement of virgin monomers is within feasible reach for us," says development manager Olaf Hempel from Equipolymers. The RevolPET process yields terephthalic acid (TA) and ethylene glycol (MEG).

The technology was developed as part of a research and development project supported by the Federal Ministry of Education and Research (BMBF), in cooperation with the Institute for Chemical and Thermal Process Engineering (ICTV) at Braunschweig Technical University. It is based on a solid-solid reaction in a standard extruder.

"The exceptional aspect is the concept of direct use of the reaction energy released," says Rittec. "In turn, this speeds up the subsequent reactions. The self-supporting system delivers process times of less than one minute. In this time, over 95% of the PET polymers present are broken down." The process is also highly tolerant of contaminants.

## Molecular recycling

In September, **Koch Technology Solutions** (KTS) and **Ioniqa Technologies** announced a partnership to scale up and commercialise Ioniqa's PET recycling technology. As part of this collaboration, KTS has committed to invest up to €30m in Ioniqa, which is a spinoff from the Eindhoven University of Technology in the Netherlands. The Ioniqa depolymerisation process can convert low-grade post-consumer PET using glycolysis into BHT (bis-2 hydroxy-ethyl-terephthalate) monomer. It has already been demonstrated in a 10,000 tonnes/year production facility, which supplies Indorama.

Tonnis Hooghoudt, CEO and founder of Ioniqa, says the partnership with KTS is "a major stepping stone for Ioniqa in commercialising its technology on a global level. Our expertise in [waste depolymerisation] matches seamlessly with KTS' track record in designing and licensing PET production processes worldwide."

Also in September, **Interzero** and **Eastman** announced a long-term supply agreement for Eastman's planned recycling facility in Normandy, France, which will use methanolysis. Interzero will provide up to 20,000 tonnes/year of hard-to-recycle PET household packaging waste that the partners say would otherwise be incinerated. Interzero Plastics Recycling, part of Interzero, has the largest plastics sorting capacity in Europe.

Eastman says its facility "will become the world's largest material-to-material molecular recycling plant". Once complete, the facility will recycle approximately 160,000 tonnes/year of polyester waste. The project is expected to be operational in 2025. It will process coloured and opaque PET waste that cannot be recycled mechanically.

**CLICK ON THE LINKS FOR MORE INFORMATION:**

- **www.carbios.com**
- **www.equipolymers.com**
- **www.rittec.eu**
- **www.kochtechsolutions.com**
- **https://ioniqa.com**
- **www.interzero.de**
- **www.eastman.com**

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# Helping to improve the appearance of recyclates

## *Matching the aesthetics of recycled plastic materials to those achieved with virgin polymers is a challenge, but one that producers of colour pigments and masterbatches are gearing up to meet. By* ***Mark Holmes***

The increased use of recyclates presents recyclers and converters with a number of problems regarding the appearance of their materials. To improve the appearance of recyclates, issues such as preventing thermal degradation, processing, controlling the rheology, reduced yellowing, odour, gels and agglomerate formation all need to be considered. The wide variation in colour and quality of plastic recyclates also poses a problem for achieving consistent colours when using a high post-consumer-recycled (PCR) content. However, manufacturers of pigments and colour masterbatches are developing new products and technologies that can help meet this challenge.

With growing demand for mechanically recycled polyolefins and the requirement for higher recycled material content in packaging applications, recyclers face several challenges to provide higher quality and easier processability of recycled material to plastics converters, according to **LyondellBasell**. "One of the main challenges faced by recyclers and converters is thermal degradation of the polymer from the multiple extrusion and compounding processes, which can lead to loss of mechanical performance and rheological issues," says Núria Vallespí Salvadó, Marketing Manager, Colour Concentrates, LyondellBasell. "Thermal degradation can also reduce the aesthetic quality of the recycled polymer due to gel formation, yellow discolouration and increased odour. Other challenges may include high moisture and volatiles content coming from the sorted plastics washing process and contamination from mixed polymer recycle, which can also lead to processing problems for the converter and a reduction in mechanical performance."

She says LyondellBasell offers a complete product range of masterbatch additives, which help recyclers and converters to address some of these challenges. It also offers CirculenRecover colour masterbatches using recyclate carrier resins to enable customers to maximise the recyclate content in their products. The company has a range of near-infrared (NIR) detectable colours, including black, to support effective sorting of plastics by polymer type in sorting centres.


**Masterbatch producer Broadway says consistency of the colour within PCR materials is continually being addressed at the company**

Vallespí Salvadó also highlights influences driving new developments in colours and pigments for plastics recyclates, which include regulations, the sustainability goals of brand owners and growing consumer awareness demanding the use of plastics recyclates. In addition, new colour developments still need to provide the brand identity of the end product but also need to consider sustainability attributes and future recyclability. The development of colour enhancers to improve the colour of transparent recyclate, such as PET, is also increasing; recyclate often has a yellow colour due to thermal degradation or


IMAGE: LYONDELLBASELL

**Above: Colour samples of QCP recycled materials from LyondellBasell**

contamination, meaning that colour tints are required to improve the visual appearance.

The requirement to achieve consistent and vibrant colours using a range of recyclate quality needs an understanding of colour travel as the quality and quantity of recyclate changes, Vallespí Salvadó adds. Developing colours with greater tolerance or less colour travel when used with recyclate is required, as well as utilising multi-layer technology to develop colours for enhancement and effects.

The company says that it is also combining colour with additive and polymer technology to address processing challenges with recycled polymer. This will improve thermal stability to reduce yellowing, gel formation and maintaining melt flow index. Combining colour with additive and polymer technology in a single masterbatch can also provide easily dosed solutions to improve processing and mechanical performance when using recyclate with high moisture or volatiles content and contamination from mixed polymer recyclate.

IMAGE: AVIENT

**Above: Sandrine Reboux, Senior Marketing Manager, Personal Care & Home Care Products at Avient**

Sandrine Reboux, Senior Marketing Manager, Personal Care & Home Care Products at **Avient,** says market needs for colour in plastics recycling are focused on the desire from brand owners to develop beautiful and differentiated products that consumers want to buy while remaining circular. "This includes products that are detectable at a sorting facility and contain a high level of PCR resin," she says. "Brand owners want to have the ability to anticipate the impact colour will have on a final product when using a high level of recycled content while also maintaining the integrity of the product, as recycling multiple times can increase the risk of polymer degradation."

Reboux says: "We are also seeing two main trends driving new developments in colours and pigments for plastics recycling: digitalisation and a focus on health. Digitalisation is not a new trend but has been accelerated by the pandemic in that brands are changing how they attract consumer interest during online shopping through colours. Opaques are moving to transparent, bright, and crispy colours in recycled PET resin to increase premiumisation on the digital screen. We are also seeing more consumers asking if a product is healthy and good for them or not. Colour trends are inspired by spa and wellness centres with popular tones such as frost, pastels and natural shades. Plus, packaging may be smaller to facilitate convenience and an 'on-the-go' lifestyle."

Reboux adds that there are also specific problems requiring new solutions in colouring technology for plastics recycling. For example, in packaging applications, PCR resin undertone and opacity restrict colour options in rPET, rPE and rPP, compromising the final rendering. This problem creates a high demand for the lightest colour of recycled materials for all applications, limiting market availability. Also, colouring darker PCR grades can increase complexity and possibly impact brand equity.

Speeding up time to market and global colour consistency are the main technical areas of interest being addressed at Avient currently when working with PCR. Avient's PCR Color Prediction service can help, says Reboux. The company is now promoting the service on a broader scale to support premium customers in packaging applications and the consumer market.

PCR Color Prediction Service is a premium service created to help frame the available colour space based on the PCR characteristics, including opacity and undertone. "With this service, we can digitally illustrate if a new colour will be achievable in a given PCR resin before laboratory trials," says Reboux. "Overall, this helps speed up the time to market by reducing the number of colour trials needed when formulating a colour. The service helps to anticipate the colour impact on backup resin options limiting trials at moulders and increasing flexibility in case of sourcing disruptions or shortages. Applications for the service include monolayer bottles, injection stretch blow moulding (ISBM) or extrusion blow moulding (EBM), and injection moulding. The focus resin is rPET, rPE or rPP."

In addition, Avient has developed Cesa Nox A4R for recycling, which is a specialised antioxidant additive that stabilises polyolefins during processing, preventing typical defects like discolouration, gels and black spots during initial and future conversion steps and recycling loops.

IMAGE: GETTY IMAGES

**Left: Avient is developing products containing a high level of post-consumer recycled resin**

Mirco Groeseling, Market Development Manager, Packaging and Sustainability EMEA at Avient, says: "Cesa Nox A4R is formulated to help brand owners who need to maximise their PCR usage up to 100% to achieve sustainability and recyclability targets, as well as recyclers involved with flake or pellets dealing with multiple processing defects. It can also assist converters of bottles, film, and sheets who need to maintain high-quality levels of PCR performance enhancement."

He says that in its Recycling lab CycleWorks in Pogliano, Italy, Avient is reproducing degradation effects during the multi-pass extrusion process to demonstrate the influence of temperature, shear rate and oxidation on polymers in a controlled environment.

"Protection of polymers against degradation is one part, and it is necessary to make the PCR fit for purpose in terms of circularity," says Groeseling. "But there are many more challenges when it comes to recycled material, for example, rheology behaviour, odour or improvement of mechanical properties are often needed. We are concentrating on these areas by following our scientific approach across Avient's business units and cooperating with partners along the value chain."

According to **Holland Colours**, a major market need for colouring in plastics recycling involves applications that require colour for decorative and brand recognition purposes. "Examples include home appliances and power tools," says Mark Kalisvaart, Global Product Market Manager Additives. "In some applications colour is essential, either for signal purposes or with a function as light barrier. For example, water and gas pipes require signal colours, while beer and pharma PET bottles need amber and green


**Right: Holland Colours' Tintmask addresses discolouration in rPET**

functional barrier colourants."

He says another important aspect is the increased emphasis on food contact safety in food packaging applications over multiple recycling process cycles. "Colourants and additives suitable for food contact applications have to meet demanding requirements in terms of migration limits. The presence of non-intentionally added substances (NIAS) over multiple melt processing cycles also poses a challenge. NIAS may be formed due to interactions between polymers, additives, colourants, contaminants already present in the recyclate, and oxidative and thermal degradation."

He continues: "There is a need to minimise NIAS in recycled plastics to a level that meets the stringent regulatory requirements. Fields of research focus on two approaches: prevention of the formation of these substances, or decontamination of post-consumer material. Prevention can be accomplished amongst others through better and more predictable stabilisation and improved sorting, while decontamination is achieved through advanced washing technologies and in-process purification steps, for example."

Holland Colours also highlights a number of trends driving new developments in colours and pigments for plastics recyclates. Kalisvaart says that colourants in food packaging are under scrutiny because they are perceived to affect the value of mechanically recycled plastics negatively. Fully transparent and colourless plastics can be easily mechanically recycled and retain a higher value because of the fact that they are re-useable in many applications.

When recycling coloured plastics, batch-to-batch colour consistency of recycled material will vary. However, brand owners expect their products to meet tight colour standards. If there can be a wider acceptance of recyclate colour variations, this perceived less valuable material stream will be suitable for a wider range of applications and potentially resolve part of the material availability concern.

In addition to the NIR detection challenge in sorting coloured plastics, mechanical recycling has additional challenges. For recycling streams for which there is low demand because of undesired colour or a too high level of contamination, chemical or advanced recycling is regarded as a solution.

When it comes to the visual quality of un-coloured and transparent recycled plastics, yellowing and other slight discolourations need to be dealt with. "This is predominantly caused by thermal re-processing in combination with remaining trace amounts of components like functional additives, colourants, adhesives, inks and other types of

## Automated PCR colour control project

Difficulties with sorting materials by colour can have an impact when re-colouring the recyclate. Due to colour variations of the input material, the colour pigment for the target colour is usually used in a high concentration during the colouring process in order to achieve a homogeneous, consistent colour.

In a joint research project between **ColVisTec** and the **SKZ Plastics Center**, an automated solution for a colour metering control loop has been developed to save colour pigments during the plastics recycling process.. This reacts to fluctuations in the input material, as well as to colour drifts and controls the dosing of the colourant accordingly. For this purpose, the colour values are recorded spectrally at two measuring points of a recycling plant.

At the first measuring point, the fluctuations of the input material are detected and forwarded to the closed loop system in order to adjust the quantity of colour pigments accordingly at the subsequent colour dosing point. The second measuring point is located at the end of the extruder. Here, the input fluctuations are already largely compensated for, and only a feedback signal about continuous drifts is sent to the colour metering system, which then automatically adjusts the metering output.

By using this measuring system, PCR plastics can be reliably coloured and colourants can be saved, say the research partners. This offers the possibility to produce high quality re-granulate at an optimised price. In addition, the colour range can be expanded without additional colour pre-sorting.

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plastics," says Kalisvaart. "This yellowish off-colour is not widely accepted by the average consumer because it is associated with spoiled or bad product. A technical solution to the undesirable yellowish discolouration is colour neutralisation. Using opposite colourants turns the off-colour into a neutral greyish tint and allows for a wider availability of perceived higher quality material. Depending on the source and seasonable variables, batch-to-batch colour consistency of recycled material can also vary. A colouring adjustment system can be set up to control colour variations within a specified range."

Tintmask is Holland Colours' solution to address discolouration as a result of mechanical recycling of uncoloured plastics. It is available in both liquid and solid form and can be optimised to the requirements of the customer. Holland Colours' SORT is another example where it is working together with its customer base to develop NIR detectable colourants that allow for flawless sorting in separation and sorting lines. As well as these two technical solutions, other products are currently being developed to meet the needs of plastics recycling.

Masterbatch manufacturer **Broadway** reports that it has been working on the use of a PCR carrier resin to create PCR-based masterbatches. "This is particularly advantageous for any brand wishing to claim their packaging is made from 100% recycled plastic," says James Rous, Marketing Manager. "Masterbatch typically accounts for between 1-5% of the material in the final moulding, so the carrier resin within the masterbatch needs to be a consideration when claiming '100% recycled plastic'."

Other influences in the development of colours for plastics recyclates include legislation and political influences which will determine thresholds for PCR use – such as the 30% PCR required to avoid the UK Plastic Packaging Tax. Stephen Rayner, R&D Scientist at Broadway, says that this will also affect the level and types of pigments that will be required to cover up any inherent tints of the PCR material. In addition, colour matching using PCR material often takes high levels of pigments to mask underlying colours of the PCR material itself. As such the coverage capacity of pigments needs to be considered as using more pigments counteracts the sustainable ethos associated with using PCR.

He says the consistency of the colour within PCR materials is continually being addressed at Broadway. On-site colour matching can allow a customer to review, and if necessary, request adjustments before approving new colour matches for various batches of recycled material in a single day. Other important influences include developments in spectrometer technology and its software to support the rapid rematching of colours (as required) due to fluctuations of colour of PCR material, as well as legislation relating to the food contact and toy status of PCR grades.



**Above: Production facilities at Broadway in the UK**

**Left: Colour inspection at Broadway**

Colour tolerances permitted by moulders and brand owners when using PCR material will also need to be addressed. "Brands will increasingly need to accept that to be environmentally friendly, they need to use high levels of PCR in their plastic packaging wherever possible," says Rous. "This may result in imperfections or inconsistencies in colour. It would be useful to develop a culture where consumers are accustomed to these and understand the reasons for them – promoting the message that the environmental impact of packaging must come before aesthetics."

Broadway says that it is currently addressing a number of issues through R&D projects and technical collaborations with various organisations. These include the use of lower levels of virgin material through the use of sustainable additives, such as fillers and blowing agents, as well as the use of PCR as a masterbatch carrier.

The company's latest products include PCR-


**Above: Einar colour dispersing aids from Palsgaard**

based masterbatches for various polymers, such as a PP PCR masterbatch with excellent colour consistency that can be used in both opaque and translucent applications. Odour neutralisers are currently being trialled with customers as a cost-effective way to trap VOCs in PCR materials. A recycled carbon black masterbatch made from recycled tyres is currently undergoing in-house trials and a major collaboration with an academic partner is currently underway to develop a non-toxic endothermic blowing agent for trial with customers across a range of industry sectors.

An NIR detectable high gloss 'piano' black masterbatch has completed in-house trials at Broadway and is now undergoing extended trials in partnership with waste sorting facilities. The next goal is to achieve recognised certification for this product. The masterbatch meets standard EU food contact regulations and is compatible with both PET and PP. High opacity, high gloss black plastics are a popular packaging choice, commonly used to offer products a premium appearance. Broadway says that the new product range has undergone extensive and successful in-house NIR spectroscopy-based tests, returning a distinct and statistically significant spectroscopic signature.

Rayner adds that future developments at Broadway will include an extension of the PCR-masterbatches to other polymers, such as PE and PET, as well as the development of NIR detectable blacks to other polymers beyond PET and PP.

**Palsgaard** has developed a range of sustainable bio-based polymer additives, including a pigment dispersing aid for PE, PP, PET, PVC and PA colour masterbatches. The company says that the dispersing aid works as well with recycled polymers as with virgin materials and is a good drop-in replacement for fossil-based additives. Einar 101 is a plant-based polyglycerol that is highly efficient as a dispersing aid where it wets, stabilises and disperses the pigments in the polymer mix. It can fully replace current dispersing aids or boost the performance in combination with the chosen dispersing aid when added to existing formulations. Addition to the colour masterbatch is in

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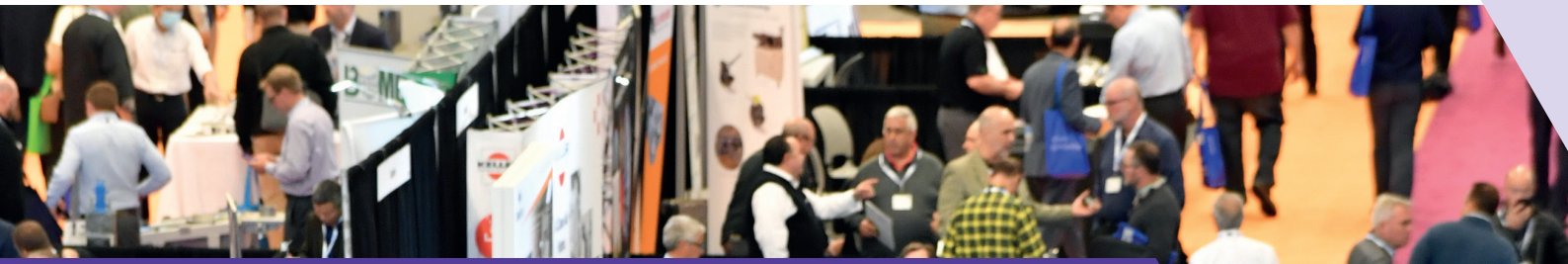

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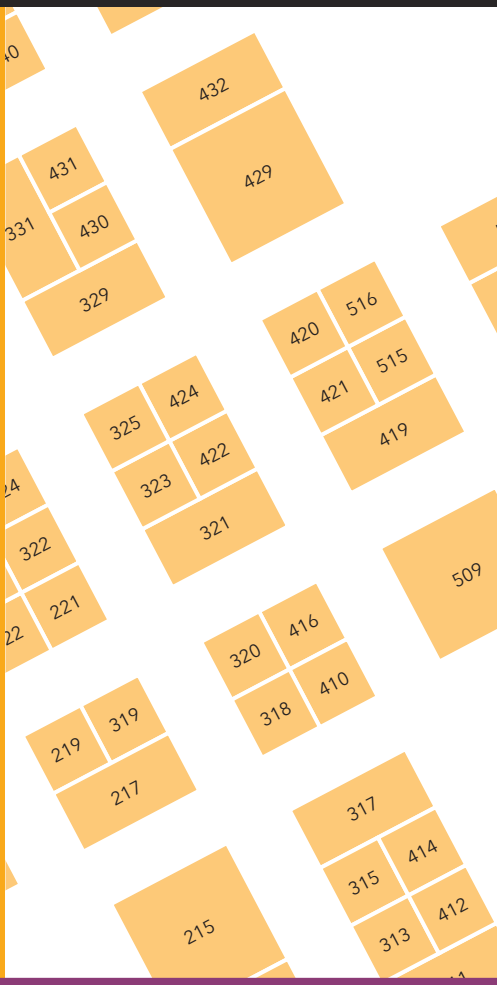


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concentrations of 1-5% of the total formulation.

**Ampacet** has added Rec-NIR-Black PE 512 for black flexible applications to its carbon-free Rec-NIR-Black masterbatch range. Rec-NIR Black PE 512 is NIR-detectable, while providing a high level of opacity for black flexible packaging. Products made with this NIR-transparent masterbatch solution are oriented to the PE flow when using a sorting model suitable for dark plastics. Rec-NIR-Black PE 512 is suitable exclusively for indoor use because, unlike conventional carbon black masterbatches, it does not provide a stabilising effect against UV degradation.

**Chroma Color** has developed a specialised formulation path to solving the need for colourant alternatives to carbon black as a means to address the recycling of black or dark colours in packaging for improved environmental sustainability. The alternative recipes allow MRF sorting operations to identify and successfully sort the plastic articles according to the US *APR NIR Sorting Potential of a Whole Plastic Article*. The leading third-party independent lab PTI of Holland, Ohio, conducted all testing and analysis. The company says that its NIR sortable black technology is based on IR reflecting/transparent components using a combination of speciality dyes and organic pigments.

**Karl Finke** has developed a sustainable new Fibratec masterbatch series for PCR rPET. As carrier polymers for the Fibratec masterbatches, Finke uses both recyclates from household waste and recyclates obtained from production waste in industry. They can be processed in the same way as masterbatches based on virgin material.

The company has also developed Fibraplast NIR detectable black masterbatches to make packaging fit for NIR sorting. They can be used for colouring all common packaging plastics, such as HDPE, PP, PS and PET. The masterbatches do not contain carbon black pigments. This allows dyed black plastics to be easily detected in NIR sorting systems. Black bottles, lids or trays made of HDPE, PP, PS or PET can be easily separated from each other using standard sorting technology, just as with all other colours. This has been proven by tests carried out in cooperation with leading sorting plant manufacturers, says Finke.

**Gabriel-Chemie Group**, in cooperation with GSM Sella and Aurora Kunststoffe, has developed a new masterbatch for post-industrial PA66 to produce stadium seats. The masterbatch added to post-industrial polymer guarantees the manufactured articles' mechanical resistance and flame-retardant properties, as well as a good aesthetic appearance and the necessary resistance to


IMAGE: FINKE

**Above: Karl Finke has developed a sustainable new Fibratec masterbatch series for rPET**

prolonged exposure to UV rays and other aggressive atmospheric agents, in compliance with the strict international safety regulations of the stadiums. The result of this successful cooperation is the production of 30,000 new stadium seats.

Gabriel-Chemie has also invested in an NIR-detectable device and can offer NIR inspection and certification of all masterbatches for customers. Due to the current demand from various markets, this test is increasingly desired for all colours. An existing end product or masterbatch can also be tested. If NIR detection is not possible, Gabriel-Chemie says that it has a sustainable solution available.

**Delta Tecnic**, the Spanish-headquartered masterbatch maker focused on PVC and cable applications, has introduced new products aimed at specific markets including PVC recycling. The company is offering new colour masterbatches for recycled PVC in black, white and brown. Eva Gotor, Marketing Manager, says that they all have high concentrations of pigments and are formulated to deliver good dispersion. She added that the white masterbatch has a high titanium dioxide content and includes ingredients to help restore the appearance of recycled white PVC that has yellowed during its lifetime.

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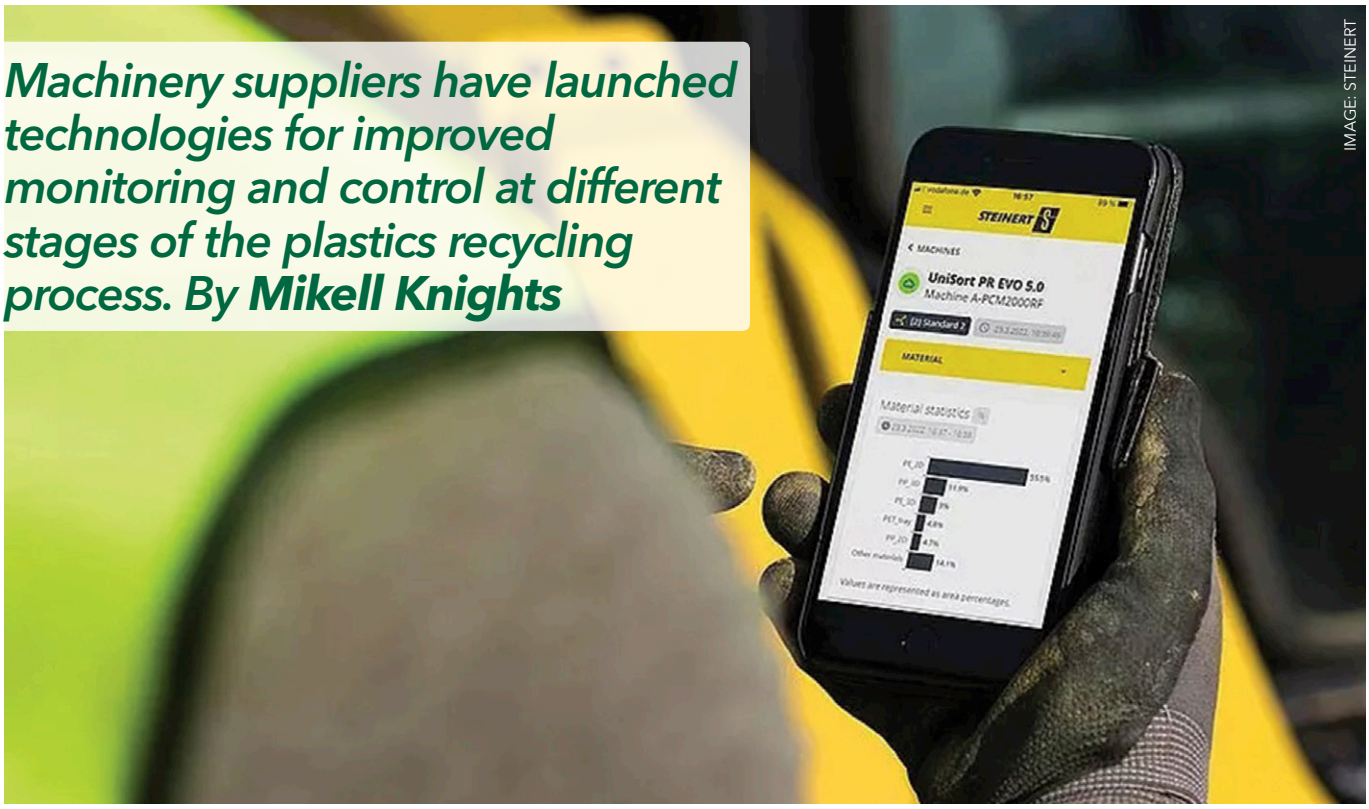



IMAGE: STEINERT

***Machinery suppliers have launched technologies for improved monitoring and control at different stages of the plastics recycling process. By Mikell Knights***

# Visualising solutions

Machinery and equipment producers for various aspects of waste plastics processing have new ways for better monitoring of recycling technology from sorting through to extrusion and after. The data from improved monitoring can then be used for making informed decisions about interventions by line operators.

**Steinert** has developed a new real-time data visualisation and monitoring mobile app for its sensor-based sorting machines that provides users with insight into the availability and output of individual machines, and the condition of their applications or sorting facility. The Steinert.view mobile app gives users an overview of key performance and output data, providing access to detailed machine data at any time and from any location.

Working in close collaboration with customers and with extensive testing, Steinert says the app is designed for a novice machinery operator to understand and use, while for the advanced operator it can visualise complex process technologies and offers filtering functions that can be used to identify areas where problems are arising or where an efficiency may lie untapped.

The app offers access to a multitude of metrics for users to structure a large number of processes and can assist with improvements to sorting performance or to work more cost-effectively. Problems can be proactively countered by making changes to a metric. Service staff for example can be alerted as to the work they can expect to be doing before arriving at the machine. The mobile access can get other staff for the project assembled and started without delays, which can reduce downtimes and improve speed.

Users can compare nominal and actual values in graph form to determine where an action in an operation needs to be taken. In this way, the data can be used to visualise the effectiveness of the measures, allowing the user to dial-in the machine's optimum operational point. The Steinert.view app can provide insight into other aspects of the operation that may bring more transparency across the entire system, to improving operating output and optimisation of resources. For example, changing the material composition can allow conclusions to be drawn about the efficiency of an upstream screen or the quality of a batch of material. Steinert.view is an IoT platform that employs international standards, secured data transmission and encryption.

**Main image: Steinert.view mobile app gives users an overview of key performance and output data from Steinert sorting equipment**

Post-consumer hygroscopic plastics must be dehumidified to produce new products says **Piovan**, however, the process to extract the moisture also extracts substances absorbed by the polymer. The air circulating in the circuits of the dehumidifier can be at risk of becoming saturated with organic compounds, which can lead to Non Intentionally Added Substances (NIAS) from the treated plastic, saturation of molecular sieves with consequent loss of functionality or oil deposition on the internal surfaces of the dehumidifier. Piovan developed Vulkano, a portable Total Organic Carbon (TOC) analyser for detecting and quantifying the presence of organic carbon compounds in the dehumidification process air.

It offers a fast and accurate method for verifying the purity of the process air. It allows monitoring of the saturation of the filters to indicate the relative time for replacement. Users can measure ambient temperature in a range from 5-35C. The unit requires connections to compressed air, and a hydrogen and air oxidation reactor. Vulkano features an intuitive interface and operates on a 10.4-inch TFT colour and touchscreen display.

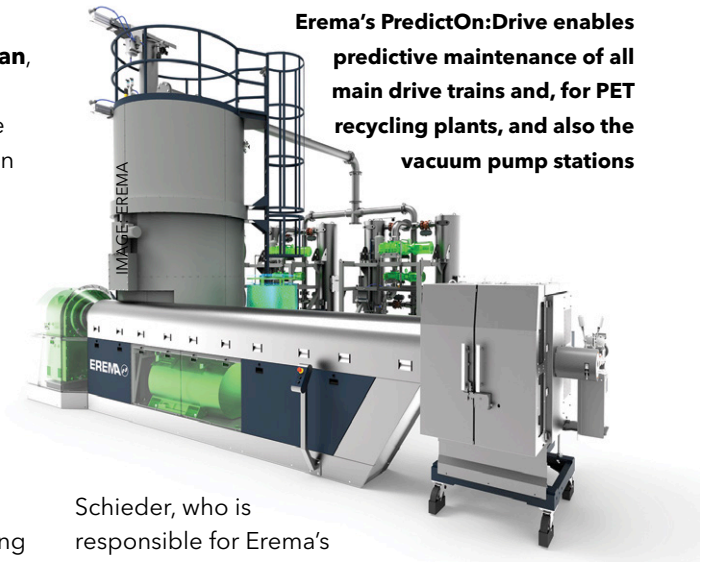
At K2022, Piovan showed other new technology connected with plastics recycling. Visitors were able to to view Odor Minder, which is a compact in-line electronic nose designed to verify the effectiveness of the post-consumer plastic deodorisation process. In addition, Piovan offered to test visitors' finished products (sheets and bottles) or semi-finished products (granules and preforms) in PET and rPET for benzene or acetaldehyde using its Inspecta analyser.

**Erema** has launched a predictive maintenance package called PredictOn for plastics recycling machinery. The first element in the offer, PredictOn:Drive, was highlighted by the company at K2022.

Erema says: "Real-time visualisation of process and machine data holds great potential for the circular economy as a whole and for recycling processes in particular."

PredictOn:Drive has been developed for the company's PET recycling machines and can be used to monitor the condition of the main drive trains and vacuum pumps using sensor-based data during operation to predict when maintenance needs to be performed next. Visualisation is through an app in the BluPort digital customer platform.

"The big benefit of recognising maintenance requirements and anomalies on critical components in good time is that machine operators can respond before a problem occurs," says Florian Schieder, who is responsible for Erema's development and innovation planning. "Deploying service personnel and obtaining spare parts can be better planned using predictive maintenance and leads to higher plant availability and lower costs compared to routine or scheduled preventive maintenance. That is because we only intervene when a problem has been identified."




**Erema's PredictOn:Drive enables predictive maintenance of all main drive trains and, for PET recycling plants, and also the vacuum pump stations**

PredictOn:Drive is supported by a modular measurement and sensor system for real-time data acquisition and storage that is used for machine condition evaluation. The data is also used for advanced analysis of damage location and damage spread and the system then proposes possible countermeasures.

The necessary measuring systems for drive train monitoring are currently fitted on all large-scale Intarema, Vacurema and Vacunite technology featuring extruder diameters larger than 160 mm. The company says existing plants can also be retrofitted with these systems. It is planning to extend the monitoring systems for use in smaller plants and in the machines supplied by sister company Pure Loop.

The BluPort platform can be accessed via PC and mobile devices and offers a suite of service and data visualisation apps that help plant operators control quality and improve machine performance.

The app offering is constantly being expanded, says Erema. The basic package is free of charge. Customers who purchase the Smart Service Package get the full version including extra content.

***Additional reporting by David Eldridge.***

**CLICK ON THE LINKS FOR MORE INFORMATION:**

- **www.piovan.com**
- **www.steinertglobal.com**
- **www.erema.com**

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A comprehensive analysis of the waste plastics value chain from the point of disposal, to the point the plastic exits a material recovery facility destined for a recycler or incineration/landfill. Essential insights are given for on a country by country basis, to help you understand the collection and sorting of plastics waste, understand trends, address industry challenges and assess future availability of feedstock for recycling.

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## **MARKET REPORT:** Chemical Recycling, Global Status 2022

Identify emerging business models, potential future leaders in the industry and growth opportunities.

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- a report providing background to chemical recycling technologies and concepts, plus information on the industry's operating environment and growth drivers.

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## **MARKET REPORT:** Recycling of Flexible Polyolefin Films in Europe 2021

The study aims to quantify the market for flexible polyolefin recycling, analysing the supply and demand balance, along with an evaluation of current capacity in Europe. A detailed review of the end use applications for recyclate is given, with an examination of potential future absorption. It is relevant to all those involved in the plastics industry value chain, from resin producer through to brand owners/end users of plastic products.

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## **MARKET REPORT:** Single use flexible plastic packaging in Europe - Regulatory context and market magnitude in the retail channel

This report navigates through the present European legislation and discusses the impact each will have on the consumption of single-use plastic packaging. With a specific focus on flexible plastic retail packaging, this report highlights the issues being raised by recent and upcoming regulatory instruments, the trends that are driving the market to change and solutions currently being deployed.

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## **MARKET REPORT:** The Global Plastics Recycling Industry 2020 - Capacities, Capabilities and Future Trends

This report details current trends and future recyclate volume forecasts in a rapidly changing environmental sector. This quantification includes the supply and demand balance, with an evaluation of the current plastic recycling capacities by region. This is done in the context of the economic disruption taking place in the first half of 2020 due to the Covid-19 pandemic and its economic consequences across markets.

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## **MARKET REPORT:** Rigid Polyolefin Recycling in Europe - Capacity, technology and recyclate usage

A deep-dive analysis of the European mechanical rigid polyolefin recycling industry (PP and PE). It quantifies recycling capacities, waste streams (municipal and commercial, production scrap, other), and actual recyclate volumes of pellets, compounds, regrind and flakes. It provides context on sustainability drivers and how they shape innovations in the value chain including structural and format changes.

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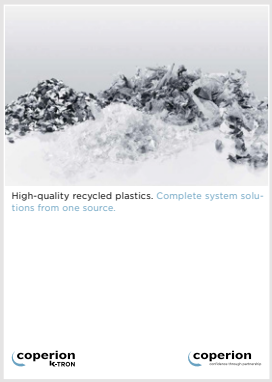


Whatever your recycling need – mechanical, solvent or chemical - Coperion provides a single source solution. Its offer ranges from shredding and agglomeration, through washing and conveying, on to melt processing and degassing, and pelletising.

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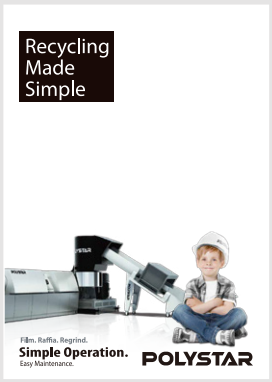
## POLYSTAR: PLASTICS RECYCLING




Recycling Made Simple is the brochure from Polystar where you can find information about all of the company's plastics recycling systems. Its Repro Flex lines can recycle post-industrial and post-consumer PE/PP packaging and PP raffia/ woven materials.

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## GLOBAL COLORS GROUP


Find out about Global Colors Group in this brochure showcasing the group companies, their vision and focus on quality, R&D, technology and sustainability. Its portfolio includes colour, white and black masterbatches.

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## 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.

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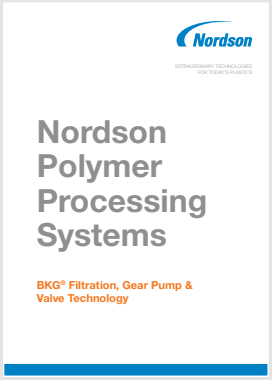
## NORDSON: FILTRATION SYSTEMS




The BKG range of filtration systems and screen changers from Nordson Polymer Processing Systems are detailed in this six-page brochure which also features products from BKG's ranges in gear pump and valve technologies.

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## NOURYON: UPCYCLING PP


In this brochure about upscaling recycled PP, Nouryon presents its portfolio of organic peroxide additives. Its Trigonox products modify PP to increase the MFI, while Perkadox decreases the MFI for higher melt strength.

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

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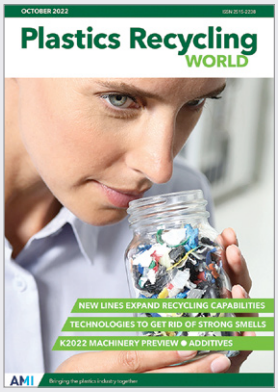


**Plastics Recycling World October 2022**
The October 2022 edition of Plastics Recycling World looks at the latest technologies for removing odours from recycled plastics. This issue also explores the latest developments in recycling extrusion lines and additives. Plus, we preview the US Plastics Recycling World Expo.

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**Plastics Recycling World September 2022**
The September edition of Plastics Recycling World looks at innovations in sorting technology. It also explores developments in granulation and food grade PP recycling. Plus, a preview of planned material introductions at K2022.

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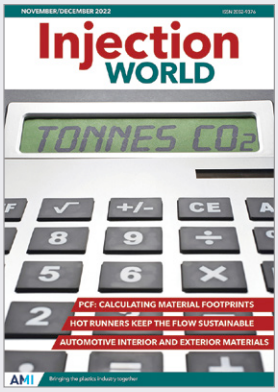


**Injection World November/December 2022**
The November/December edition of Injection World magazine looks at the fast emerging area of Product Carbon Footprints. It also explores developments in hot runners and automotive plastics, plus a review of key news from October's K exhibition.

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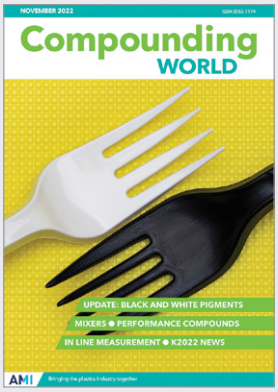


**Compounding World November 2022**
The Compounding World November issue has a cover feature that looks at black and white pigments and how they must meet demanding regulatory, environmental and performance needs. Plus features on high-performance compounds, inline measurement and mixers.

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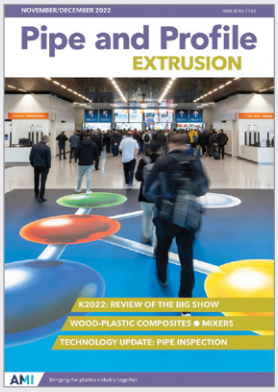


**Pipe and Profile November-December 2022**
The November-December of Pipe and Profile Extrusion investigates how formulations with high recycled content are making wood-plastic composites more sustainable. Other features look at what's new in pipe joining and batch mixing, plus there is a review of K2022.

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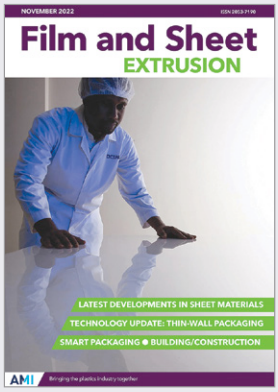


**Film and Sheet November 2022**
The most recent issue of Film and Sheet Extrusion magazine has a cover story that explores recent developments in the sheet sector. The November edition also has features looking at thin-wall packaging, plastics in construction and smart packaging.

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| | | | |
|---|---|---|---|
| 2022 | **1-3 December** | Plast Print Pack West Africa, Accra, Ghana | www.ppp-westafrica.com |
| 2023 | **17-19 January** | Swiss Plastics Expo, Lucerne, Switzerland | https://swissplastics-cluster.ch/ |
| | **1-5 February** | PlastIndia, New Delhi, India | www.plastindia.org |
| | **17-20 April** | Chinaplas 2023, Shenzhen, China | www.chinaplasonline.com |
| | **30 May – 2 June** | Equiplast, Barcelona, Spain | www.equiplast.com |
| | **14-15 June** | Plastics Recycling World Expo, Essen, Germany | www.plasticsrecyclingworldexpo.com/eu |
| | **5-8 September** | Plast 2023, Milan, Italy | www.plastonline.org/en |
| | **26-28 September** | Interplas, Birmingham, UK | www.interplasuk.com |
| | **20-21 September** | Injection Molding & Design Expo, Novi, MI, USA | www.injectionmoldingexpo.com |
| | **17-21 October** | Fakuma, Friedrichshafen, Germany | www.fakuma-messe.de |
| | **8-9 November** | Plastics Recycling World Expo, Cleveland, USA | www.plasticsrecyclingworldexpo.com/na |

## AMI CONFERENCES

| | |
|---|---|
| **29 Nov-1 Dec 2022** | Polymers in Footwear, Virtual Summit |
| **13-14 December 2022** | Recycling Flexible Packaging, Cologne, Germany |
| **30 Nov-1 Dec 2022** | Stretch & Shrink Film, New Orleans, LA, US |
| **31 Jan-2 Feb 2023** | Polyethylene Films, Orlando, FL, USA |
| **22-23 February 2023** | Stretch & Shrink Film, Bangkok, Thailand |
| **6-8 March 2023** | Agricultural Film, Barcelona, Spain |

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