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4 News

The latest news from the global industry: UK report warns of risks in switching from plastics in packaging; China places ban on SUPs; Nestlé pledges to pay premium for recycle; US bag makers set targets



PAGE 4

11 Partnerships make progress in film recycling

Industry-wide collaborative projects, new developments in simplifying the structure of films and packaging, and advances in equipment technology, are all helping push film recycling towards circular economy goals. By Mark Holmes



PAGE 11

23 Chemical recycling: A wave of projects

A flurry of companies have launched chemical projects to tackle large mixed waste streams containing polyolefins and other plastics. Peter Mapleston investigates the many technologies being developed



PAGE 23

31 Riding to the rescue of polystyrene

An urgent need to improve the recycling of polystyrene has led styrenics producers, packaging converters and brand owners to collaborate in some promising projects with developers of innovative depolymerisation technology. By Peter Mapleston

37 Keep in touch with regulation

AMI's Plastics Regulations conference takes place in Cologne in March, covering everything from food contact and chemical regulation through to the single-use plastics directive. We preview the event



PAGE 31

42 Diary

COMING NEXT ISSUE

› Melt Filtration › Colours › PET Recycling

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Report raises questions on switch from plastics packaging

The UK food and supermarket industry is concerned the public backlash against plastics packaging risks a switch to alternatives that have worse sustainability credentials, according to a new report. Green Alliance, a policy research group, conducted anonymised interviews with 12 senior representatives from major UK supermarkets and food, beverage and consumer goods companies for the report published in January, called *Plastic promises - What the grocery sector is really doing about packaging*.

"Many of those we spoke to were wary of simply rushing away from plastic towards other single use materials, only to have caused different environmental impacts," the report's conclusion said. "Despite this, some shifts are already taking place that may not prove to be sustainable, and the approaches from different companies are sometimes incompatible."

The sector is coming under pressure to use other materials, even though

these alternatives may perform worse than plastics in environmental and climate change terms.

In response to public pressure, supermarkets have made some quick changes, such as moving from single-use plastic to single-use paper bags for fruit. The implementation of packaging changes can take years and one interviewee said that new product development is focusing on aluminium and glass rather than plastic.

Green Alliance said: "Our interviewees indicated that, already, some decisions are being made without proper assessment of environmental

impact. Worse, some have been taken knowing they could actually increase environmental harm. One supermarket representative was frank: 'We are aware that [by switching from plastic to other materials] we may, in some cases, be increasing our carbon footprint.'"

An area of particular concern for the interviewees is the lack of consumer understanding regarding biodegradable and compostable plastics. Green Alliance said: "Contamination of both compostable and conventional plastic recycling streams could become a problem if mistakes are made in dealing with it.

Some also suggested that material did not necessarily degrade as expected."

Many company representatives said they wanted the UK government to set standards so companies avoid developing separate solutions from each other. One interviewee said: "If I could have a magic wand, I'd like to see more joined up, top-down government intervention... We would like to see government be braver."

Green Alliance expressed its agreement: "This is clearly what's needed to tackle the urgent problem of plastic pollution without making other environmental problems worse. The last thing we want, years down the line, is a new documentary series highlighting the avoidable and shocking problems caused by waging a war on plastic. The fight should be against throwaway society more generally."

The report forms part of the work of the Circular Economy Task Force, a business group convened by Green Alliance.

➤ www.green-alliance.org.uk



The Green Alliance report focuses on major UK supermarkets and food and drinks groups

China places ban on single-use plastics

China is set to ban certain items considered as "single-use plastics", including bags, straws, restaurant utensils and courier packages.

The state planner, reported by Reuters, said that by the end of 2020, the restaurant industry will be banned

from using single-use straws. In towns and cities across China, a target has been set to reduce the consumption of single-use plastic items in the restaurant industry by 30% by 2025.

The production and sale of plastic bags less than 0.025mm thick will be

banned, as will plastic film less than 0.01mm thick for agricultural use, according to the report.

These bags will be banned in all of China's major cities by the end of 2020 and banned in all cities and towns across China in 2022.

Growing plastics shows return to Cleveland in US in 2020

Three free-to-attend exhibitions focused on plastics recycling, extrusion and compounding will return to the Huntington Convention Center in Cleveland, Ohio, USA on 4-5 November 2020. They will also be joined by a new expo focused on polymer testing and analysis.

The Plastics Recycling World Expo, Compounding World Expo and Plastics Extrusion World Expo made their highly successful USA debuts in Cleveland in May 2019, attracting a total of 261 exhibitors and 4,375 visitors.

This year they will be expanded and joined by the Polymer Testing World Expo, a new focused exhibition and conference for scientists, laboratory staff and researchers who develop, test and analyse new polymer materials, formulations and products. The new show will benefit from the considerable crossover with the other exhibitions – last year, 1,091 of the visitors to the other three expos said that they were



Some of the 4,375 visitors to the 2019 show in Cleveland

involved in R&D and materials testing.

The exhibitions will see the return of five free conference theatres. These proved highly popular in 2019, attracting large crowds for a series of technical papers, market forecasts, practical training seminars, and lively business debates featuring industry leaders.

"We were absolutely delighted with the response to our first US exhibitions, which were very well supported by the North American plastics extrusion, recycling and compounding

industries," said AMI's head of exhibitions, Rita Andrews. "We've had extremely positive feedback about the Cleveland shows from exhibitors and visitors alike".

More than 200 companies have already booked their booths for the four focused expos in Cleveland in 2020. They include Amut, Atlas, Avian Granulator, BYK, Clariant, Coperion, Cumberland, Davis Standard, Dover Chemical, Entek, Erema,

Farrel Pomini, Fimic, Herbold USA, Gneuss, Heritage Plastics, Konica Minolta, KraussMaffei Extrusion, Leistritz, Maag, Maguire, Matsui, Milliken, Netzsch, NFM, NGR, Nordson, Omya, Piovani, PolyOne, PTi, Q-Lab, Reifenhauer, Struktol, Thermo Fisher, Vecoplan, Wacker, Windmüller & Hölscher, Zerma, Zoltek and many more.

Booths at the exhibitions start at less than \$4,000. For more information, download the brochure [here](#), or contact AMI's exhibition team at exhibition_sales@ami.international

Starbucks to reduce packaging waste

IMAGE: STARBUCKS



Reusable packaging is now being targeted in addition to recycling

Coffee shop brand Starbucks has announced a "multi-decade commitment to be a resource-positive company" which includes a shift from single-use to reusable packaging.

In a public letter, Starbucks CEO Kevin Johnson set out targets for the reduction of carbon, water and waste by 2030. "By embracing a longer-term economic, equitable and planetary value for our company, we will create greater value for all stakeholders," he said.

The group has set a 50% reduction target in waste sent to landfill from its stores and manufacturing supply chain. It is also targeting 50% reductions in the carbon emissions in its own operations and in its supply chain, and in the water withdrawal for direct operations and coffee production.

Starbucks has also signed the Ellen MacArthur Foundation's New Plastics Economy Global Commitment.

➤ www.starbucks.com

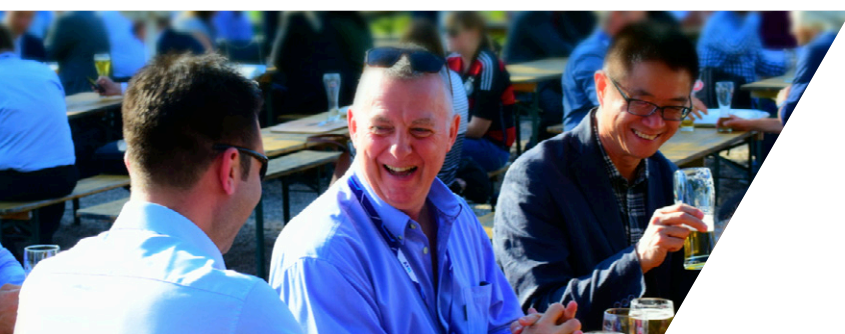


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Nestlé pledges to pay premium to support recyclate market

Swiss food and drinks giant Nestlé has announced it will invest up to CHF 2bn (€1.87bn) "to lead the shift from virgin plastics to food-grade recycled plastics and to accelerate the development of innovative sustainable packaging solutions".

Food-grade recyclate is a prerequisite for the group, so, as part of its plan, it said: "To create a market, Nestlé is therefore committed to sourcing up to 2 million metric tons of food-grade recycled plastics and allocating more than CHF 1.5 billion to pay a premium for these materials between now and 2025."

Nestlé set a target in 2018 to make 100% of its packaging recyclable or reusable by 2025, and reduce its use of



Yes bars have paper wrappers

virgin plastics by one-third, through working with partners to advance the circular economy.

Within the new CHF 2bn investment, the group is setting up the Nestlé Institute of Packaging Sciences and a

CHF 250m sustainable packaging venture fund to invest in start-up companies that focus on packaging innovation, new materials, refill systems and recycling solutions.

"No plastic should end up in landfill or as litter," said Mark Schneider, CEO of Nestlé. "Making recycled plastics safe for food is an enormous challenge for our industry. That is why in addition to minimising plastics use and collecting waste, we want to close the loop and make more plastics infinitely recyclable. We are taking bold steps to create a wider market for food-grade recycled plastics and boost innovation in the packaging industry. We welcome others to join us on this journey."

➤ www.nestle.com

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US bag makers set targets

US plastic film producers and recyclers have set a target for 95% of plastic retail bags to be reused or recycled by 2025.

The American Recyclable Plastic Bag Alliance said its members are already recycling "hundreds of millions of pounds of bags and plastic films each year". The ARPBA members have also committed to targets for recycled content in plastic retail bags: 10% by 2021, 15% by 2023 and 20% by 2025.

➤ <https://bagalliance.org>

Vecoplan invests in German and US plants

Shredder technology group Vecoplan says it is continuing into 2020 with an investment programme worth more than €20m which it started at its facilities last year.

The company said it expects to achieve "a double-digit percentage increase in sales and a plus of more than 20 million in incoming orders - reason enough to look ahead positively".

At its Westerwald plant in Germany, the group invested in employee expansion, infrastructure

and machinery in 2019.

Vecoplan also expanded the production hall at its US subsidiary's plant in High Point, NC.

Vecoplan said it is "investing several million euros in expanding its vertical manufacturing depth in 2020", which will enable it to build up capacities and optimise processes. Michael Lambert, CFO, said: "In the future, we'll be able to serve our customers faster, more efficiently and with consistently high quality." The group also intends to

significantly increase its workforce in 2020.

Vecoplan celebrated its 50-year anniversary last year. "Our goal is to provide our customers with the best possible support. This was our watchword in 1969, the year the company was founded, and it still applies today," said Werner Berens, CEO.

Last year also provided Vecoplan with a platform to launch new shredders. At K2019, the group launched the new Vecoplan Infinity (VIZ) shredder series.

➤ <https://vecoplan.com>

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Brüggemann aims for polyolefin recycling

German additive producer Brüggemann is developing a new line of performance stabilisers for recycled polyolefins based on technology developed at Fraunhofer LBF.

According to the company, the new stabilisers both protect the polymer from further thermal and photo degradation as well as repairing some of the damage that has already taken place. The technology paves the way for production of recyclate with processing properties and

long-term heat stability that is similar to virgin polyolefin materials, it claims.

Fraunhofer LBF developed the stabiliser technology; Brüggemann's role in the project is to make it market-ready, develop production processes and support market introduction. "We know it works and now we are adapting it to the market," said a spokesperson for the additive maker.

Brüggemann already produces a number of stabilisers and modifiers to support processing of virgin and recycled polyamides.

This development marks a first significant move for the company into the polyolefins market.

"Ultimately, our goal is to significantly improve the quality of recyclates with the help of innovative additives, thereby making an important contribution to the upcycling of plastic waste," said Dr Klaus Bergmann, Head of Polymer Additives at Brüggemann.

Production will take place at Brüggemann's Heilbronn plant in Germany.

➤ www.brueggemann.com
➤ www.lbf.fraunhofer.de

Berry gets into PCR polyolefins

Major plastics processor Berry Group has entered an agreement with Georgia-Pacific Recycling to create a closed-loop system for post-consumer recyclate in the US.

Georgia-Pacific will use its national network of recycled material suppliers to source the PCR waste to be recycled. Berry will reprocess the material to incorporate into its portfolio of polyethylene film and polypropylene products.

➤ www.berryglobal.com
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THE GLOBAL MECHANICAL RECYCLING INDUSTRY

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Partnerships make progress in film recycling

IMAGE: MONDI

Industry-wide collaborative projects, new developments in simplifying the structure of films and packaging, and advances in equipment technology, are all helping push film recycling towards circular economy goals. By Mark Holmes

While film from post-consumer waste and wider industrial applications remains a recycling challenge, there are a number of initiatives and collaborative ventures that are now showing the way forward towards a circular economy vision for plastic film and flexible packaging. Companies in complex supply chains are coming together to ensure that film can be collected, recycled and reused. In addition, manufacturers of films and packaging are designing for improved recycling, making packaging waste materials more suited to recycling processes. In addition, recycling companies are using new systems from recycling machinery manufacturers to process greater quantities of plastic films.

Flexible packaging consortium **Ceflex** has been collaborating with the entire value chain to make flexible packaging in Europe circular by 2025. To date, over 140 stakeholder companies have joined the initiative's 'Mission Circular'. Ceflex says that designing packaging suitable to be collected, sorted and recycled after use is a fundamental step

on this journey. Many companies, organisations and associations have given their technical resources, time and expertise to develop the Designing for a Circular Economy Guidelines. Open consultation for the entire flexible packaging industry has taken place to enhance and refine phase one of the guidelines before publication in the first quarter of 2020. The guidelines have been developed and refined as a result of assessment, input and feedback from a dedicated Ceflex work stream, involving the participation of 80 stakeholders and over 100 experts providing input. Additional rounds of consultation with all Ceflex stakeholders and input from key industry associations and bodies to obtain high-level feedback from all parts of the value chain, including paper, plastic and aluminium have further strengthened the process.

Ceflex adds that the focus is on the largest proportion of the post-consumer flexible packaging waste stream, polyolefin-based flexible packaging structures, which also have proven sorting and

Main image:
Project Proof
is an Ellen
MacArthur
Foundation
Pioneer Project
led by Mondi
which is testing
films based on
a mono-
material
construction to
enable
recycling in
existing
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mechanical recycling technologies on an industrial scale in Europe. Second and further phases will target more complex packaging structures and specific areas under consideration, including chemical recycling, re-use and reduction. The guidelines have been conceived to build an understanding of end-of-life processes, give practical support and advice on circular economy design principles and make design choices for recyclability clear.

Plastics Recyclers Europe has also published a paper identifying the pre-requisites for increasing recycling of flexible polyethylene into a high-quality raw material while ensuring a sustainable and cost-effective process. With European converters' demand for around 9m tonnes, LLDPE/LDPE is the second biggest resin processed in the EU and consequently demonstrates a high recycling potential. However, today's recycling rate of this resin is around 20%.

"Plastic film waste is still perceived as a demanding and difficult stream to treat, however, we in Europe have proven that even stretch film recycling is possible. Nonetheless, to reach for the additional quantities from post-consumer packaging, we need a strong commitment of the



FLEXIBLE POLYETHYLENE RECYCLING IN EUROPE

ACCELERATING THE TRANSITION TOWARDS CIRCULAR ECONOMY



IMAGE: PRE

value chain to work towards making this material fully sustainable," says Ton Emans, President of Plastics Recyclers Europe.

The main bottlenecks specified in the paper refer to low collection rates and low quality of input materials, lack of design for recycling, as well as the continuous development of recycling technologies. Firstly, harmonised collection and sorting processes at the EU level must be introduced to increase both the quantity and the quality of the collected waste.

Secondly, design of plastic packaging controls, to a large extent, the degree to which packaging can be recycled, as structures and materials which are incompatible with mechanical recycling cause a

Above: Plastics Recyclers Europe has published a paper identifying the pre-requisites for increasing recycling of flexible polyethylene into a high-quality raw material

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Right: Dow has developed new optical finishing for polyethylene-based packaging to support brand owners and converters in addressing recyclability targets

number of disruptions in a recycling line. Therefore, specific design for recycling guidelines must be followed when manufacturing a product and when introducing any kind of innovation to the market. Lastly, although the advancements in recycling and sorting technologies have greatly improved in recent years, more investment – as well as research and development – is needed to enhance the quality of recycled material continuously.

The industry's effort will have to be further strengthened by an adequate legislative framework that will create conditions for further expansion. Member states and regions will equally have to thoroughly implement the EU legislation. The new legislative measures introduced by the reviewed Waste Package, the Plastics Strategy and the Single-Use Plastics Directive oblige the industry to take immediate and decisive steps in production and waste management of plastics packaging.

Brand owners are also adopting a shared approach. Companies that place packaged products into the market have started collaborating to develop more sustainable flexible packaging for the circular economy. The **Netherlands Institute for Sustainable Packaging (KIDV)** initiated a Community of Practice (CoP) with a consortium of companies facing similar challenges related to developing metallised flexible packaging that is suitable for the circular economy. The consortium members are FrieslandCampina, Intersnack, Jacobs Douwe Egberts, Mars Wrigley, Pepsico and Unilever.

The CoP will focus on implementing the Ceflex Design for a Circular Economy Guidelines for this specific type of flexible packaging. The CoP has identified the gap between the vision in the Ceflex guidelines and current practices of collection, sorting and recycling of flexible packaging. KIDV aims to support companies in bridging this gap by identifying the main challenges and finding solutions to these challenges.

"The gap identified by the CoP includes techni-



cal constraints as well as institutional challenges," says KIDV's CoP leader Niels van Marle. "We make a distinction between these: the technical constraints companies must overcome if they want to replace multi-layer PET, PE and PP packaging with flexible mono-materials such as OPP and LDPE, on the one hand; and the institutional challenges that prevent the establishment of the appropriate infrastructure for collecting, sorting and recycling mono-materials, on the other hand. Ensuring the quality of the recycled materials from flexible packaging is key. In addition we will explore how to manage the potential impact of substances such as inks, barriers and metallisation when designing flexible packaging."

The CoP will be organising roundtable meetings with other stakeholders in the packaging chain, including collectors, sorters, recyclers and retailers, in order to hear and discuss their views on these challenges and potential solutions. This process will be supported by knowledge institutes and experts in the field. It will also create, agree and propose a roadmap for how to deal with the challenges regarding resource-efficient metallised laminates used for packaging of crisps, coffee, confectionary and milk powder. ➤

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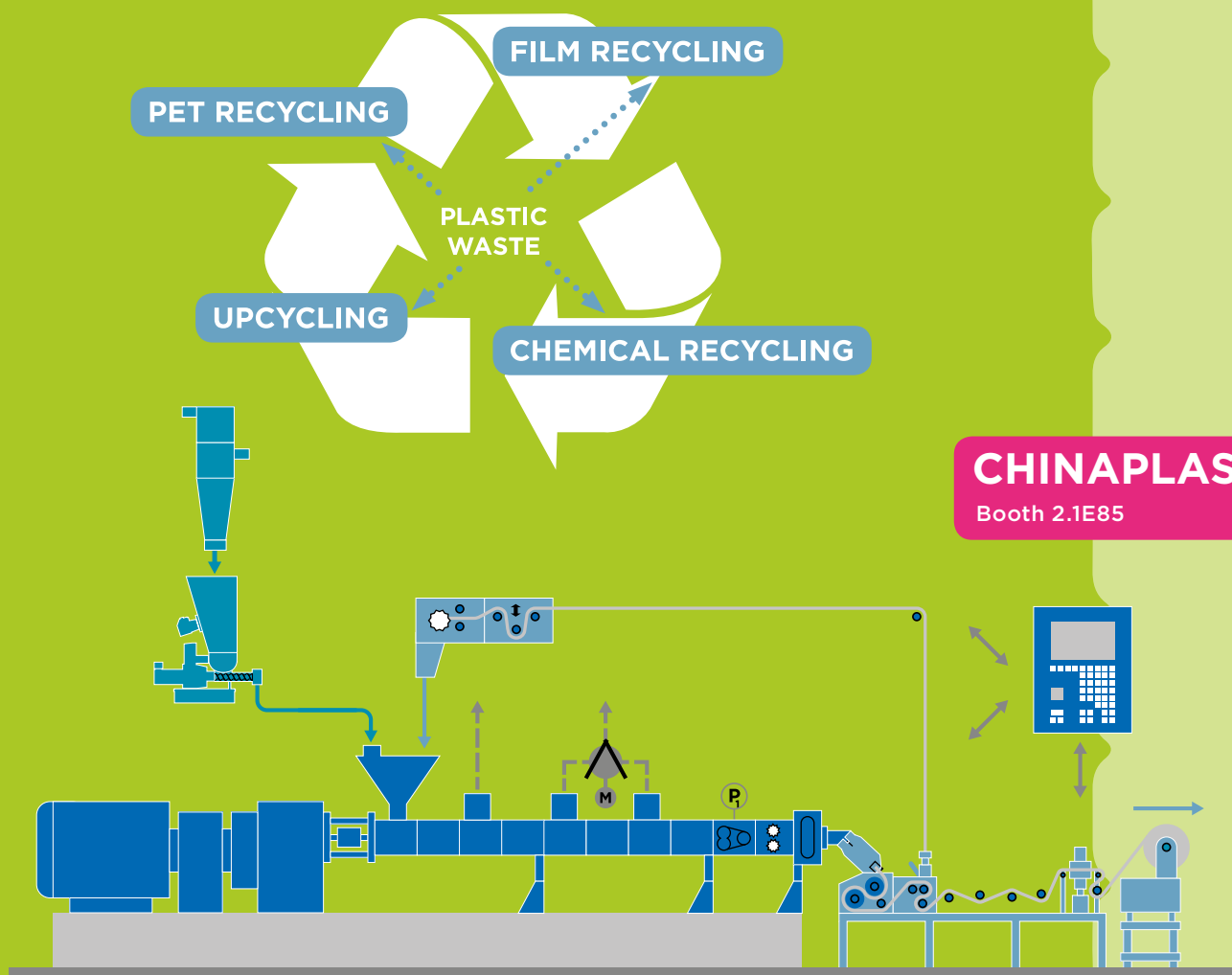
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Right: Mondri Group has collaborated with Unilever to deliver a new polypropylene mono-material solution in Turkey for its Knorr dry soup powder range



IMAGE: MONDI

US pilot

In the USA, a pilot programme was started during 2019 by **MRFF (Materials Recovery for the Future)** for the first curb-side recycling initiative to accept flexible plastic packaging with other recyclables. The scheme looked to identify the best way to collect, sort, and capture value from residential recyclables, using the latest equipment to test positive sorting for a flexible plastic packaging material mix. Montgomery County-based JP Mascaro & Sons was chosen to pilot the two-year programme to recycle at its TotalRecycle materials recovery facility (MRF). Companies and organisations involved in the initiative include: Procter & Gamble, Target, Dow, PepsiCo, Nestlé USA, the American Chemistry Council, the Flexible Packaging Association, the Plastics Industry Association and the Association of Plastic Recyclers.

JP Mascaro was awarded a \$2.6m grant by MRFF to install optical sorting equipment at its TotalRecycle facility, which allow the flexible plastic packaging material to be recycled. The goal of the pilot programme is to demonstrate that the material can be recycled and that the material, called r-Flex, can be marketed to end-users. As the programme progresses, more municipalities are being added.

Dow has developed new optical finishing for PE-based packaging to support brand owners and converters in addressing recyclability targets. The company says that the new Opulux HGT optical finishes can help replace PE/PET or PE/BOPP laminated packaging structures with a PE-based concept that offers high thermal and chemical resistance and delivers excellent optics. Opulux HGT is suitable for many packaging formats and most common coating and packaging equipment.

Materials innovation

Opulux HGT is a high-temperature, high-gloss varnish applied to surface-printed PE films or flexible packaging. It allows for broadening the

processing window of the films and helps expand the PE film performance. While replacing laminated substrates like OPET and BOPP in the outer layers with a monopoly PE-based film, structure simplification and high conversion efficiency are accomplished. Converters can leave out the lamination step and benefit from a wider coating weight range as well as reduced wash downs.

Coveris, a leading European manufacturer of plastic and paper packaging solutions, is among the early adopters of the new technology. "We strive to balance the functional and sustainability performance of our products to deliver cost-effective solutions that can contribute to both our own sustainability goals and those of our customers," says Eric Valette, Director of Innovation at Coveris Flexibles France. "Dow's Opulux HGT optical finishes helped us achieve exactly this balance in our pet dry food packaging, allowing us to create a robust and durable solution, convenient to use, with a great shelf appeal and that is viable for existing recycling infrastructures."

Dow has also introduced a new resin made with 70% recycled plastic. Agility CE is the first post-consumer recycled product offering of Dow's plastics circularity portfolio to incorporate a high percentage of post-consumer plastic waste. This new resin consists of a low-density polyethylene into which recycled plastic shrink film is incorporated without sacrificing material quality and functionality in the final application.

"What is exciting about Agility CE is that, previously, mechanically recycled content has often diminished or degraded in quality," says Carsten Larsen, Commercial Recycling Director for Dow's Packaging and Specialty Plastics business. "Here we have a consistent and high-quality product - taking back used shrink film directly from a retailer and using our material science to recreate a resin which can be used directly back into the same quality shrink film."

This is the first grade of Agility CE and is intended for use in collation shrink films as secondary packaging for transportation of cans or bottles. It enables converters to incorporate more than 50% recycled content in the formulation of the final film, without altering its functionality. The availability of this high quality recycle will help retailers and brand owners meet their sustainability goals while helping reduce the amount of waste going into landfills, says Dow.

DuPont Teijin Films has introduced the Mylar Harvest Fresh rPET range of heat sealable polyester films with up to 50% post-consumer recycled rPET content. As a leading supplier of top seal polyester lidding films, DuPont Teijin Films combines this product with base film made from food contact approved rPET polymer. The Mylar Harvest Fresh range of films delivers the waste and cost reduction benefits of top seal lidding with the additional bonus of a lower carbon-footprint product, giving retailers the ability to promote a clear and consistent sustainability message with post-consumer recycled content in both tray and lid. DuPont Teijin Films adds that it has worked closely with a supplier of rPET polymer, sourcing the raw material solely from one-way bottle deposit return schemes from Germany, Sweden, Norway, Finland and Denmark. The bottles are subjected to several stages of sorting and washing before going through the final patented URRC cleaning process.

French company **BBC Cellpack Packaging** has developed CellPouch, flexible stand-up pouches that are 100% recyclable. The printed laminate film used in the CellPouches, as well as the closure including a cap, can be disposed of via the Dual Systems and be reused as recycled plastic. The films from which CellPouches are made are suitable for filling with hot contents and are noted for their high barrier effects. Due to their barrier properties and a child-resistant closure system, CellPouches are claimed to be the ideal packaging for baby

food and fruit purée.

Mondi Group has collaborated with Unilever to deliver a new polypropylene mono-material solution in Turkey for its Knorr dry soup powder range. Unilever approached Mondi Kalenobel in January 2018 with the challenge of replacing a multi-material laminate, with a recyclable mono-material film alternative. The new packaging preserves the shelf-life of the food product and does not impact the runability on the production machines. Furthermore, the packaging material designed by Jindal is certified as recyclable by the Institut Cyclos HTP. Mondi and Unilever collaborated to investigate the most suitable grade of special raw material and Mondi provided ongoing support and counsel during the design and implementation process. This drive to find new packaging solutions is part of Unilever's commitment that 100% of the plastic packaging used in its products is reusable, recyclable and compostable by 2025.

Project Proof, an **Ellen MacArthur Foundation** Pioneer Project led by Mondi, has developed a usable pouch prototype containing 20% post-consumer waste. The pouch is suitable for packaging household products such as detergent. Project Proof is focused on designing products in line with circular economy principles and has shown that it is possible to use unclean and raw post-consumer recycled content to create new flexible packaging. Mondi will now develop the prototype further to ensure it can be rolled out as a commercially viable product for its multinational FMCG customers. This will support Mondi's work as a signatory of the New Plastics Economy Commitment to ensure a minimum of 25% of post-consumer waste is incorporated across all its flexible plastic packaging, where food contact regulations allow, by 2025.

The second part of Project Proof has focused on long-life food pouches. The standards for food

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Right: Polyplex and TPL have launched biaxially oriented polyester films containing 70% post-consumer recyclate

applications were held to high technical specifications agreed by the participating FMCGs. The aluminium barrier often found in food-standard plastic packaging can extend shelf-life, but creates problems in recycling. Project Proof created an opportunity for FMCGs to re-evaluate and possibly reduce the specifications for certain requirements allowing more sustainable materials to be used. There are already materials being tested based on a mono-material construction without problematic layers such as aluminium, which would make recycling possible in existing waste streams. It was concluded that further development in this area was required as current offerings did not achieve the basic minimum specifications set by the brand owners. Joint Development Agreements are being discussed for future research opportunities in this area.

Polyplex and its European distribution partner TPL have launched biaxially oriented polyester films containing 70% post-consumer recyclate, made possible due to investment in chemical recycling by Polyplex. This technology uses post-consumer PET bottles. The bottle flakes are depolymerised to monomers and in a further polymerisation transformed to PET resins suitable for extrusion into BOPET films. This operation can be repeated indefinitely and the BOPET materials produced with this technology are suitable for direct food contact in accordance to US FDA and European legislation. The companies say that a common misconception is that the incorporation of recycled content creates a lower grade product, which does not have to be the case. Unlike other plastics, production of BOPET through chemical recycling does not have any significant performance challenges due to high-quality rPET being virtually indistinguishable from its virgin counterpart. Various standard types of 70% PCR PET films are available, with 90% PCR PET films available on request.

Below: Calex is using Starlinger RecoStar Dynamic 105 C-Vac lines to recycle post-consumer film waste



IMAGE: POLYPLEX

Sumilon Polyester has also introduced a new polyester film containing 85% PCR. Sumilon EcoPet in Morocco has developed a special PCR resin suitable for making these films. In its process, PCR bottles are washed seven times, crushed, shredded, hot washed again, depolymerised to monomers and then further polymerised to make a PCR PET resin. The resins are EFSA- and FDA-approved, making them suitable for direct food contact.

Shrink hood

Total and several partners along the construction value chain have decided to collaborate and form the Clean Site Circular Project, which aims at recycling shrink hood waste from the construction sector in a closed system without degradation of the film's performance. Shrink hoods are films used for protection and stabilisation of goods during storage and transport on pallets. The company says that it has already been demonstrated that a closed loop 'shrink hood to shrink hood' process is industrially feasible and technically equivalent to virgin solutions. The film recipe has been developed by Total, which requires the use of Total Lumicene Supertough 22ST05 as a booster for the recyclates in order to match demanding market requirements.

Suez is constructing a plastics recycling plant in the Bang Phli district, near Bangkok, Thailand. This plant will contribute to Thailand's 2030 target to achieve 100% plastic recycling. The plant will convert 30,000 tonnes per year of locally collected PE film waste into high quality post-consumer recycled plastic for use as quality secondary materials. The plant will be equipped with an advanced water treatment system that minimises water usage and will meet high environmental



IMAGE: STARLINGER

standards. Part of the energy used by the plant is powered by roof top solar panels further improving the site's environmental footprint. Construction work is expected to be completed by mid-2020.

New technology

Recycling company **Calex SRL** has installed a **Starlinger** recycling line for post-consumer film in Satu Nou de Jos in the Romanian municipality of Groși. Calex recycles around 600-700 tonnes of plastic waste each month. In July 2019, the company installed a second plastics recycling line, Starlinger's RecoStar Dynamic 105 C-Vac. One line processes big bags, the other line recycles coloured, transparent and highly printed LDPE packaging films. During extrusion, the high ink content and the residual moisture after the washing process on the upstream washing lines can lead to the increased formation of gases. With a setup consisting of Smart feeder, continuous melt filter and C-Vac degassing module, both lines can meet these challenges, says Starlinger. Through densification and homogenisation of the material and the resulting friction, the Smart feeder has a drying effect. After removal of the residual contamination by the melt filter, the melt surface is increased by 300% in the C-Vac module, allowing efficient extraction of gases. The recycled material is used by plastics converters, such as injection and blow moulders.

Erema has developed Intarema ZeroWastePro, an in-house recycling system for PE and PP film production waste processed inline or offline. Up to 100% of the recycled material can be fed back into the main production process. The company adds that the stability of the process, the consistently high quality of the recycled pellets produced, and a high degree of automation are of key importance to the processing of production waste. The new ZeroWastePro has been designed precisely to meet these requirements.

Intarema machines are all equipped with Counter Current technology and the Smart Start operating concept. In addition, components specifically designed for film applications – featuring optimised screw geometry and quality-optimising in-house controls – are included in the ZeroWastePro as standard, ensuring a significant increase in quality. For example, the newly developed automatic adjustment of the pelletising speed using appropriate parameter combinations enables the production of granulate in an even more consistent bulk density and shape.

The system also includes a hot die face pelletiser with air cooling and an improved pellet transport



IMAGE: EREMA

system. In addition to an optimised design to simplify maintenance and operation, the entire system has been flow-optimised using computer analysis. This has improved the efficiency of pellet cooling and transport. Erema adds that the new pelletiser system is particularly suitable for recycling machines such as the Intarema K series that are operated in combination with blown film lines. Depending on the composition of the films, higher throughputs can be achieved when processing PE films without additional air exchange. In addition, multi-polymer films with a PP content of up to 10% can be processed using this configuration.

"The infrastructure needed for using water as a cooling medium is no longer required. In addition, hot die face pelletising requires less energy and space," said Andreas Dirnberger, Business Development Manager Inhouse and Industrial.

Above:
Intarema
ZeroWastePro
is a new
in-house
recycling
machine from
Erema for PE
and PP film
production
waste

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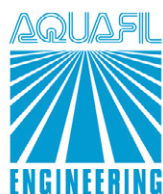
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A flurry of companies have launched chemical projects to tackle large mixed waste streams containing polyolefins and other plastics. Peter Mapleston investigates the many technologies being developed



Chemical recycling projects target tricky plastic waste

"Chemical recycling is a game changer for plastic recycling. Complementing mechanical with chemical recycling will be essential to solve the EU plastic waste problem and achieve the Circular Plastics Alliance's target of having 10 million tonnes of recycled plastic back into products by 2025." That's Daniele Ferrari talking, president of the European Chemical Industry Council, Cefic, and CEO of Italian polymer and chemicals producer Versalis.

Cefic signed the Declaration of the Circular Plastics Alliance last September. The Alliance, supported by the European Commission in the context of the European Plastics Strategy, promotes the use of more recycled plastics in Europe through voluntary action. As of mid-January, the Declaration had been signed by over 180 companies, business organisations, public authorities, standardisation bodies and research and technology organisations.

The chemical industry can play a leading role in

increasing the amount of recycled plastic by scaling up the chemical recycling technology, says Cefic. "Not all types of plastic waste can be efficiently tackled by mechanical recycling. Other technologies, including chemical recycling, are needed to increase the amount of recycled plastic."

Depending on the technology, chemical recycling can process waste containing different polymers, including multi-layered plastic products, such as food packaging, and products that contain legacy chemicals that cannot be used in new products.

Chemical recycling breaks down polymers into monomers and - again depending on the process - other low molecular weight chemicals, which can be used again as a new raw material to make plastics with the same properties as virgin plastics - and which can be used in the same applications, including food-contact applications.

In recent months, numerous companies have embarked on ambitious chemical recycling

Main image:
Attempting to reach recycling goals for polyolefins is a large-scale undertaking



Above: Andreas Kicherer, Senior Expert, BASF Sustainability Strategy, with a sample of pyrolysis oil from plastic waste in front of a steam cracker

projects for plastics. Take **BASF** for example: ChemCycling is the name of a project based on pyrolysis the company announced in 2018. "In the ChemCycling project, we are focusing on plastic waste for which no high value recycling processes are established yet," says Christian Lach, Head of the ChemCycling project at BASF. He cites materials that are difficult to recycle mechanically such as plastics with adhering food residues, plastics degraded after previous mechanical recycling, and multi-layer food packaging, as well as composites used in the automotive and construction industries. "Our aim is to increase recycled content in efficient materials for demanding applications," he says.

"ChemCycling should not be seen as competition but as complementation for mechanical recycling," he says. "In a thermochemical recycling process such as pyrolysis, the polymer chains of plastics and organic residues are chemically broken down into molecules that can be used as raw materials by the chemical industry to manufacture new products. Inorganic residues (e.g. metals or glass fibres) would have to be removed, as would halogens, and, in many cases, PET. The removal could happen either before the pyrolysis step or by purification of the raw pyrolysis oil." Purified pyrolysis oil can be used as feedstock in BASF's production operations (its integrated Verbund), partially replacing fossil feedstocks.

Depolymerisation is in principle more eco-efficient than pyrolysis, says Andreas Kicherer, Senior Expert BASF Sustainability Strategy, as it yields monomers that can be reused more or less directly for polymerisation. "However, it is limited by the need for pure waste material streams. Our ChemCycling project pursues a more general approach with significant flexibility with regard to waste feedstock and reuse of the pyrolysis products."

BASF is clearly aiming for material recovery and not for energetic use of the pyrolysis oil, says Kicherer. "Waste-to-fuel may have a value to reduce greenhouse gas emissions in transport or to improve plastics waste management in countries with little infrastructure. However, it diverts materials from the materials loop, and it therefore has a one-time effect. It is important to develop chemical recycling as a long-term solution and to ensure that potential regulatory incentives aim to balance the streams."

The company is currently working on a critically reviewed life cycle analysis (LCA) for chemically recycled plastics. "The first results give us confidence that considerable CO₂ savings can be achieved, for example compared to conventional plastics made from crude oil, if the incineration of plastic waste can be avoided," says Kicherer.

BASF has been working with partners from various industries to manufacture prototype products using chemically recycled plastics. These include Henkel (for packaging), Jaguar Land Rover, Storopack, Südpack, and Schneider Electric. Henkel has produced Perwoll detergent bottles using chemically recycled plastic in collaboration with packaging manufacturer Alpla. First pilot applications are expected in the course of this year.

BASF aims to develop chemical recycling as a business, says Lach. "However, the commercial scale-up of ChemCycling depends on several aspects. One important aspect is that the technology needs to be developed further for use on industrial scale and to supply our production Verbund with great volumes of pyrolysis oil."

Last October, BASF invested in Quantafuel, a



Henkel produced Perwoll bottles using chemically recycled plastic in collaboration with packaging manufacturer Alpla. The pilot project with bottles of Perwoll is part of the ChemCycling project led by BASF

AMI shares chemical recycling knowledge

Experts at AMI Consulting have compiled a white paper as an introduction to chemical recycling for plastics waste. The white paper, *Chemical Recycling and the Plastics Industry*, provides: an explanation of mechanical recycling and its limitations; an overview of the main technologies being developed and their suitability for recycling certain types of plastics; and the chemical recycling system. Download the white paper for free at <https://go.ami.international/chemical-recycling-whitepaper>.

AMI is also launching the first edition of its Chemical Recycling



conference on 30 June - 1 July 2020, taking place in Hamburg, Germany.

The event will bring together independent experts and representatives of companies leading the plastics industry's move into

chemical recycling.

This new development holds great potential for the industry to meet plastics recycling and sustainability goals, but more work on technologies, value chains and supporting legislation is still required for chemical recycling to become a reality on an industrial scale.

To understand the challenges and opportunities in this growth market, book your place at the must-attend Chemical Recycling conference at the event website: <https://www.ami.international/events/event?Code=C1075>

Norwegian start-up company and a specialist for pyrolysis of mixed plastic waste and purification of pyrolysis oil. "Together, we aim to further develop Quantafuel's technology for chemical recycling, consisting of an integrated process of pyrolysis and purification, towards optimising the output for the use as feedstock in chemical production," says Lach. "BASF is further investigating various options for supplying the company's production Verbund with greater volumes of pyrolysis oil in the short, mid, and long term.

"An ideal size for a pyrolysis plant is determined by the available waste streams in order to avoid inefficient transport of plastic waste which has a lower density than the resulting pyrolysis products. We estimate that in most cases, capacities significantly below 100,000 tonnes/yr will prove fit-for-purpose."

The largest fraction of plastics packaging waste is made up of polyolefins, so it is not surprising that numerous polyolefin producers are committing to chemical recycling. **LyondellBasell**, for example, says it is exploring partnerships in chemical recycling of plastics, along with developing its own technologies.

In July 2018, the company announced a cooperation agreement with the **Karlsruhe Institute of Technology (KIT)** to advance chemical recycling of plastic materials. LyondellBasell and KIT aim to develop a new catalyst and process technology to decompose plastic waste into monomers. Then last October, it said it was building a new small-scale pilot facility at its

Ferrara, Italy site. The company says that, through its collaboration with KIT, its proprietary molecular recycling technology, known as MoReTec, has shown that use of a catalyst in the pyrolysis process is faster and more energy efficient than traditional chemical recycling.

"We have advanced our chemical recycling capabilities over the last 15 months, and through research and testing we are studying a number of LyondellBasell proprietary catalyst options," says Jim Seward, LyondellBasell Senior Vice President of Research & Development, Technology and Sustainability. "In addition to continuing the development of our catalyst options, our investment in a small-scale pilot facility will help us to advance MoReTec technology towards commercial scale in our quest to achieving a true circular economy."

In common with other technology developers, LyondellBasell's goal with MoReTec technology is to convert typically difficult-to-recycle plastic waste products such as multi-layer films for reuse in new plastics for all applications, including food contact and healthcare items.

At **SABIC**, Bob Maughon, Executive Vice President, Technology & Innovation, says the company is "proud to say that we are first in the industry to scale-up this innovative chemical recycling process." Early in 2019, it announced the production of its first certified circular polymers – polyethylene and polypropylene – partially made using pyrolysis oil from plastic waste, introduced as feedstock at its Geleen production site in The

Right: A different form of liquid gold? An operative holds a sample of output from Plastic Energy's chemical recycling plant in Seville, Spain

Netherlands. The pyrolysis oil was produced by UK company **Plastic Energy**. The companies are planning start-up in 2021 of commercial plants to manufacture and process the waste feedstock.

Plastic Energy, which has its technology headquarters in London, makes the claim of being the world's leading chemical recycling company. It already has industrial plants in Almeria (since 2015) and Seville (2017), Spain, which can produce up to 850 litres of hydrocarbon products, which it brands Tacoil, from 1 tonne of plastic feedstock. Current output is around 5,000 tonnes/yr. "Plastic Energy's UK-based team of technology specialists have more than 10 years' experience developing the unique, patented thermal anaerobic technology (TAC) chemical recycling process," the company says. Next generation plants will be able to process between 20,000-30,000 tonnes/yr (including the one with SABIC).

It says: "TAC does not use catalysts which are often expensive, easily poisoned and hazardous to dispose. Instead, Plastic Energy's TAC plants are uniquely controlled using non-contaminated thermal degradation, agitation and carbon chain length selectivity to produce a variety of outputs."

Plastic Energy says it treats end-of-life plastics that are contaminated, mixed, and multi-layered. It does not treat plastics that it says can be easily mechanically recycled, such as PET. "The plastics we use are comingled with minimum 50% of low-density polythene (plastic bags, films) and the rest a mix of polypropylene, HDPE, and polystyrene. It is unusual to see PVC in the post domestic waste," says a company representative. "PET and PVC are plastics not desirable for our process and are therefore removed."

The company has plans to expand further in



IMAGE: PLASTIC ENERGY

Europe, the US, Asia, as well as South America. "We took the decision in 2018 to roll out assets and plants that we are going to develop, own, and operate," says the representative. "The plan is to build 10 plants in Asia and 10 plants in Europe by 2023."

Last April the company said it had reached an agreement with the province of West Java (in Indonesia) to build five chemical recycling plants "to reduce plastic pollution and, in particular, plastics reaching the ocean around Indonesia, a country which is second only to China for leaking plastic into the sea."

Two months later, Plastic Energy signed an MoU with Petronas Chemicals Group (PCG) in Kuala Lumpur to collaborate in addressing plastic waste that cannot be recycled by conventional means in Malaysia. They agreed to jointly perform a feasibility study to establish a facility to convert plastic waste into Tacoil. "Depending on the outcome of the study, PCG and Plastic Energy may consider building a commercial plant in Malaysia," the companies said.

Plastic Energy is headed by Carlos Monreal, who is also president of **Chemical Recycling Europe** (ChemRecEurope), a trade association affiliated with European Plastics Converters (EuPC) in Brussels which was founded last year. Members other than Plastic Energy include: Gren (styled as "gr3n"), which has developed DEMETO (Depolymerisation by MicrowaVE TechnolOgy) for PET; ReNew ELP, with its Cat-HTR technology that can handle multi-layer film; Ioniqa, a clean-tech spinoff from the Eindhoven University of Technology, specialised in creating value out of PET waste; Arcus Greencycling Technologies (mixed waste to refinery feedstocks and energy); and Clariter (thermal cracking into hydrocarbons). (Plastics Recycling World plans to include chemical recycling of PET in next issue's PET feature.)

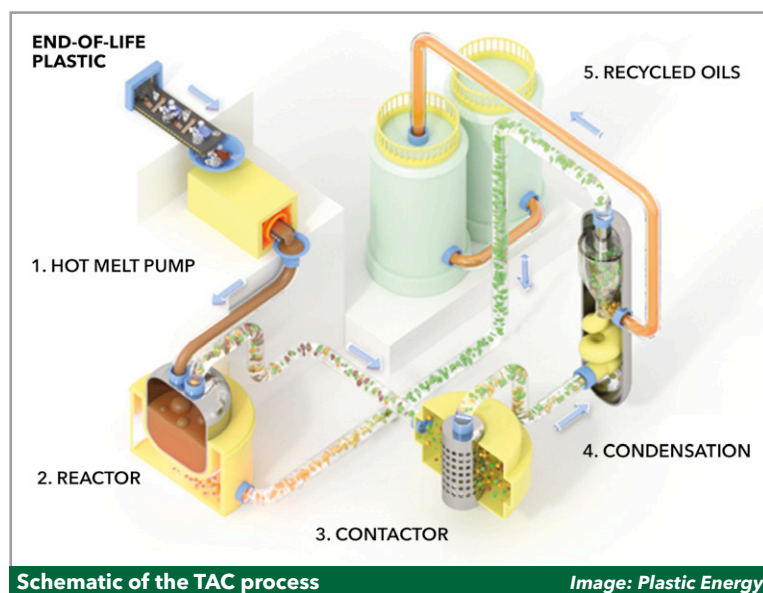


IMAGE: NESTE



Braskem, the polyolefins producer, recently announced partnerships for conducting more in-depth studies of technologies with the potential to transform post-consumer plastics, such as supermarket bags and packaging films for snacks and cookies, into new products with applications in various value chains. The studies are being conducted in partnership with various industrial and academic partners.

"We also have a plan to test a raw material from chemical recycling next year in one of our industrial units in Triunfo (RS), Brazil," says Marco Jansen, Circular Economy & Sustainability Leader at Braskem in Europe & Asia. The partners are working on improving pyrolysis technology and identifying emerging technologies.

Eastman began commercial operation of its own chemical recycling technology at its world headquarters in Kingsport, TN, US, in October. Its "carbon renewal" technology breaks down waste plastics right back to carbon, oxygen, hydrogen, and other elements. This company, too, calls the development a "game-changer". "It provides an end-of-life solution for many plastics from a variety of sources, such as single-use plastics, textiles, and carpet, that traditional mechanical recycling methods cannot process," the company says. Eastman expects to use up to 25,000 tonnes of waste plastics in 2020, and projects are currently underway to significantly expand that amount.

In August, **Dow** announced an agreement with the **Fuenix Ecogy Group**, based in Weert, The Netherlands, for the supply of pyrolysis oil feedstock coming from plastics waste. The feedstock will be used to produce new polymers at Dow's production facilities at Terneuzen, The Netherlands. Sirt Mellema, CEO of Fuenix, says the partnership offers the company the opportunity to scale up its technology.

Neste, which is already a world leader in renewable polymers, chemicals and fuels, is developing chemical recycling capacity together with partners. It has set a target to process over 1m tonnes of plastic waste annually from 2030. Neste and Ravago, the major distributor and recycler of polymers, recently said they were joining forces to develop chemical recycling of plastic waste with the aim to reach significant industrial scale. The two companies have set a joint target to reach an annual capacity to process over 200,000 tonnes of waste plastic.

"Our aim is to process annually more than 1m tonnes of plastic waste from 2030 onwards. With this, we could contribute to increasing the annual recycling rate of post-consumer plastic waste by 25-30% from the current level in Europe," says Mercedes Alonso, Executive Vice President, Renewable Polymers and Chemicals at Neste.

Last October, Neste signed a deal with **Remondis**, one of the world's largest privately owned recycling, service and water companies, operating across four continents, to collaborate in the development of chemical recycling of plastic waste. The companies are targeting an annual processing capacity of over 200,000 tonnes/yr.

"In order to establish chemical recycling of plastics at an industrial scale, it is necessary that the recycling industry and the chemical industry work closely together," says Jürgen Ephan, Managing Director of Remondis Recycling.

Recycling Technologies has developed a machine, the RT7000, that uses pyrolysis to transform residual plastic waste into an oil which it calls Plaxx. "Our approach is to centrally build RT7000s for distribution and installation at existing waste sites," says Elena Parisi, Recycling Technologies' Sales & Marketing Director. "By taking the solution to the problem, some of the commercial challenges that affect larger-scale central operations, such as transportation costs, high investment and emissions related to high transport movements, can be mitigated."

The company operates a pre-production "beta" plant in Swindon, UK, and is on track to install its first commercial full-scale RT7000 at the end of 2020 in Perthshire, Scotland. The beta plant is being used for R&D and for conducting demonstration trials with companies that include retailer Tesco.

Recycling Technologies has also entered into a trial with CITEO, the French resource efficiency body, which has provided a grant for the company to collaborate with Total, Mars, and Nestlé to demonstrate that waste plastic in France can be

Left:
Developers say chemical recycling is suited to treating difficult waste streams, including post-consumer mixed plastics packaging film

IMAGE: PYROWAVE



Above: Pyrowave has received Canadian government funding to expand its chemical recycling technology to work with mixed plastics waste

turned into Plaxx and then new plastics.

Says Parisi: "We foresee a continuing powerful push from consumers demanding a more sustainable solution for plastic as highlighted by our trial with Tesco. Shoppers have engaged with the trial in a remarkable way demonstrating just how much people care and want to recycle more.

Canadian company **Pyrowave**, which is

currently mostly involved in chemical recycling of polystyrene, is also developing technology for handling polyolefin fractions, which yields waxes and naphtha. The wax can be used in applications like coatings. In mid-January, the company said it has obtained a \$3.2m grant from Sustainable Development Technology Canada (SDTC) to extend its technology platform of chemical plastic-to-plastic recycling to mixed plastics. Company CEO Jocelyn Doucet says this will help Pyrowave to "provide a one-stop shop for PP, PE and PS recycling." The grant will be used to create a dedicated R&D unit of three PhD engineers. Doucet says Pyrowave has already partnered with Nova Chemical, which would use recycled naphtha in one of its crackers.

Last December, **Agilyx** in Tigard, OR, US, (also heavily involved in polystyrene chemical recycling) announced a collaboration in artificial intelligence (AI) technology with GE. "Combining Agilyx's deep domain experience in chemical recycling with GE's vast experience in the application of Industrial AI, the two companies are aiming to increase the chemical recyclability of all post-use plastics from the current 10% to over 95%," the

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company said in a statement.

CEO Joseph Vaillancourt says the announcement comes at the end of a year-long effort to assess GE's advanced modelling technology and its applicability to the database of chemical conversions of post-use plastics that Agilyx has amassed over the last 15 years.

"Thanks to our database, we have been able to develop predictive models, so that if somebody gave us their plastics waste, we could tell them what it would be appropriate for, if they were using chemical recycling. Equally, if a petrochemical company came to us and said, can you make this specific fuel or naphtha, we could tell them the plastics recipe they would need to make it."

Today waste recycling companies have no idea about the chemical profiles in the materials that they recover, Vaillancourt says. That's one reason why the current worldwide rate of recycling plastics is only around 11%. "We've gone to primary and secondary recycling facilities and, in all cases, we have found chemical recycling alternatives for over 95% of their plastics, even plastics destined for landfill because nobody could figure out what to do with them.

"Our system does not need waste material to be sorted, washed, pre-processed, pelletised, in order for it to go into our machines. Nor do we try to control the variability of the material at each source. If you went to 100 municipal MRFs, 80% of the plastics coming out would be different enough that it would not be interchangeable."

So Agilyx now chemically profiles the feedstock at source, says Vaillancourt. "Using the GE AI, if we have 1,000 bags in our inventory, and today we want to mix 50, we know which 50 to mix to make sure the naphtha comes out OK. Then tomorrow we're going to mix a different 50. It's a completely different way to think about recycling."

The system is designed to have low sensitivity to contamination. Vaillancourt says: "We can also change operating conditions in our system so that we can produce products in all three states - we started with polymer-to-fuel, we now have over 25 projects in various stages of development in polymer-to-polymer; and we have qualified our polymer-to-naphtha process with several major petrochemical companies."

Vaillancourt says AI applied to plastics waste makes it possible to source material years in advance of plants opening. "This is important because nobody wants to aggregate material because they don't know if it can be used later, and at the same time it can be hard to finance facilities if you don't have a long-term feedstock agreement.



IMAGE: AGILYX

Left: Keeping chemical recycling under control

We are proving that we can chemically prepare feedstock for our partners."

The company now has a single polymer-to-polymer plant in Tigard. But Vaillancourt says that within its R&D program, it has qualified products in all three categories (polymer-to-polymer, naphtha, and fuel) with some of the world's largest companies. "Agilyx is negotiating with potential customers in around 12 countries. Our model is to licence to our large industrial partners."

In January, Agilyx said it has agreed new financing from European investors led by Carnegie Investment Bank. It has selected Oslo, Norway as the location for an office to support European market opportunities in addition to a new office in Boston, US.

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Riding to the rescue of polystyrene packaging

An urgent need to improve the recycling of polystyrene has led styrenics producers, packaging converters and brand owners to collaborate in some promising projects with developers of innovative depolymerisation technology. By Peter Mapleston



Polystyrene has come in for some harsh criticism as a packaging material in recent years. Back in 2016, for example, Ikea phased out expanded PS from its flat packs to be replaced by fibre-based packaging. McDonald's eliminated PS foam packaging from its global system in 2018. The Ellen MacArthur Foundation has given it the thumbs down too. There is a feeling in some quarters that polystyrene packaging cannot be recycled – or at least is difficult to recycle.

The numbers don't look good, if you look at current recycling practices around the world. Recycling levels are at best in the low double digits, according to a representative at **Styrenics Circular Solutions** (SCS), a joint industry initiative founded in 2018 and – in its own words – the unified, driving force behind the acceleration of styrenics recycling through innovative technologies and partner-driven solutions. But SCS believes those numbers could look a whole lot better if and when chemical recycling of PS takes off. There appears to be a lot of good reasons to think that it might.

SCS members include several polymer producers investing heavily in chemical recycling. They include Ineos Styrolution, Trinseo, Repsol, Total, Versalis, and Elix Polymers. Last December, these companies were joined by Coexpan, which

specialises in rigid foils and thermoformed packaging. SCS also cooperates with companies along the supply chain, including developers of polystyrene depolymerisation technologies, such as Agilyx and Pyrowave.

"We want to unlock the potential of chemical recycling, but to do that we need the involvement of the full value chain," says Jens Kathmann, Secretary General of SCS. "That means polymer manufacturers, converters, brand owners and recyclers."

"Given the urgency of reducing waste, litter and the environmental impact of plastic, we have set ambitious milestones to meet these goals and propel the circular economy forward," says SCS. "In polystyrene, we have the opportunity to truly close the loop – full recycling back to the monomer and then onto polystyrene with the same properties as virgin material is possible."

SCS says that to jump-start the recycling rates of post-consumer styrenics, it is "determined to develop and scale-up innovative technologies to recycle styrenics back into high-quality applications, even for food contact; create a market pull away from incineration and landfill towards game-changing recycling solutions for styrenics; and unlock the unique potential of styrenics for true circularity by engaging with the whole value chain". ➤

Main image:
This Müller yogurt container is made out of chemically recycled polystyrene

**Right:
Incoming
material at the
Agilyx facility
in Tigard,
Oregon, US**

Kathmann points out that while there are many different technologies and solutions in plastics chemical recycling, depolymerisation of polystyrene is among the most promising, since it takes the polymer back to a single monomer, styrene, and it is possible to produce a pure stream of styrene that is basically the same as virgin. Styrene monomer is a liquid, which makes it easy to purify in a distillation column. All this means that chemically recycled polystyrene can be used in applications requiring the highest quality, including food contact applications, which clearly is critical for the acceptance of the technology.

"Polystyrene and depolymerisation is a perfect marriage. We think converters will be keen to be part of the new game."

At a conference held by SCS at K2019 in October, Kathmann's view was confirmed by Anabela Ferreira, co-owner and Executive Board Member of Portuguese food packaging foils producer, **Intraplás**. "We are completely ready to introduce [chemically recycled polystyrene] and supply it to our clients," she said. "We are willing to put our machines to work using these materials as soon as possible."

"Chemically recycled material is the ideal solution because it goes to the virgin state and we can incorporate it as regular material. We are looking forward to having that solution."

Jocelyn Doucet, CEO of **Pyrowave**, a Montreal, Canada-based company that has developed "catalytic microwave depolymerisation" technology for polystyrene, was also at the conference. He confirms there is no issue with FDA compliance with chemically recycled polystyrene. "You're resetting, literally, the lifetime of this polymer to what it was initially, so that you can reprocess it through the same route and get the same approvals," he said.

IMAGE: AGILYX



"Depolymerisation technology is ready to go. The main problem is finding the feedstock. If there is material out there, there are people who are willing to take it because we can convert it into material we can sell."

According to Doucet, Pyrowave technology can yield up to 95% in styrene monomer. "We have 50% more yield than competing technologies," he claims. Greenhouse gas emissions to produce polystyrene from recycled material are three times less than from virgin fossil material. Production of styrene through the Pyrowave technology uses 15 times less energy, he says - roughly 1 to 1.5 kWh/kg of processed materials.

Pyrowave's 600 Series CMD reactor is specifically designed for polystyrene raw materials and can process the full range of expanded polystyrene (EPS) and high impact polystyrene (HIPS). The continuous process first prepares waste plastics into a mixture that removes contaminants such as labels and films as well as other impurities. (Pyrowave uses an extrusion system from Erema, which is capable of handling high levels of contamination.) The conditioned polystyrene is introduced into the reactor where it is mixed with silicon carbide particles to interact with a high energy microwave field. Microwaves heat up these particles very quickly, at very high temperatures, causing depolymerisation.

Doucet says a single depolymerisation module facilitates local recycling, since it can easily be incorporated into already existing equipment. Each module has a processing capacity ranging from 100 to 200 kg/h. "We sell skids that hold six reactors, which means that the assembly can process between one and 1.5 tonnes of polystyrene per hour which means 20 tonnes per day." 2020 should be a big year for announcing commercial

IMAGE: PYROWAVE



Above: Pyrowave has developed "catalytic microwave depolymerisation" technology for polystyrene

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IMAGE: PYROWAVE

Left: a polystyrene sample from Pyrowave

developments in Asia and in Europe, he says.

The main challenge now is price. For a typical petrochemical company, says Doucet, if it is to change from using crude oil raw materials to raw materials derived from plastics waste, it needs to be able to source the new materials at the same price or possibly less than the price of crude oil-based materials. There is no way you can handle waste as cheaply as crude, he says, "so no matter what you do it will always be more expensive." However, where it exists, Extended Producer Responsibility (EPR) - the policy approach under which producers are given a significant responsibility (financial and/or physical) for the treatment or disposal of post-consumer products - should help ameliorate the situation.

All EU countries have pledged to increase EPR fees charged to consumer packaging companies for plastic waste. These fees are used to build recycling infrastructure. Also under consideration is the idea of imposing a steep tax of €800 per tonne of unrecycled plastic on producers under the EU's Multiannual Financial Framework.

At present, Doucet points out, EPR is not as widespread across the US as it is in Europe and some parts of Asia. "In the US, the concept of plastic-to-plastic chemical recycling is not as attractive as plastic-to-fuel. There's increasing pressure coming from consumers though, so the situation may change over time."

The Pyrowave technology is to be evaluated by SCS member companies, it was announced in January. Ineos Styrolution, Total, Trinseo and Versalis will carry out the evaluation under a non-disclosure agreement. Jens Kathmann, Secretary General, SCS said: "We see the decentralised approach of Pyrowave's proprietary depolymerisation technology as highly complementary to the other recycling

technologies that we are scaling up in Europe."

Pyrowave has one demonstration plant. Its business model is to license the process and to sell units. "Our primary focus is to identify chemical companies that are using virgin styrene as a raw material, and who are interested in decoupling the price of styrene monomer from the price of crude oil," says Doucet. "Our short to medium term strategy is to target potential users consuming between 10 and 100,000 tonnes/yr of styrene monomer."

Back in September 2018, Pyrowave, polystyrene producer Ineos Styrolution, and Canadian "clean technology" company ReVital Polymers - which has technology that sorts and converts recovered plastics into discrete resin types - announced a strategic partnership to recycle polystyrene packaging collected in consumer curb-side and depot recycling systems as well as other sources such as restaurants, offices, schools and universities. The intention is to recycle single-serve polystyrene packaging into new products. Doucet says the project is making good progress.

Ineos Styrolution is also cooperating with another developer of polystyrene depolymerisation technology, **Agilyx**, based in the US. Bill Cooper, SVP Strategy and Corporate Development at Agilyx, says the company has spent 15 years on looking at how all polymers break down. "Polystyrene has emerged as a great polymer for depolymerisation," he says.

Agilyx has been working for the last four years on a pathway to take polystyrene back to styrene monomer. It is already commercially producing styrene monomer in Tigard, Oregon for use by one of its partners, Americas Styrenics (AmSty), which is co-owned by Dow, Trinseo, and Chevron Phillips. It is also working with Trinseo in Europe, together with Ineos Styrolution.



IMAGE: AGILYX

Above: The Agilyx facility in Tigard, Oregon, US

Last April, AmSty and Agilyx formed a joint venture, **Regenyx**, dedicated to fully recycling post-consumer polystyrene materials back to new polystyrene products. Regenyx is taking over the assets of Agilyx's Tigard facility. In addition, AmSty and Agilyx will work together to develop plans for a larger regional facility scaled to close to 50 tonnes/day, currently envisaged for the West Coast.

Agilyx has two projects running with **Ineos Styrolution**: the first involves a plant processing 100 tonnes/day of polystyrene in Channahon, Illinois. This is currently in the engineering phase. "We have worked out feedstock sourcing," says Agilyx CEO Joseph Vaillancourt. Ricardo Cuetos, VP for Standard Products at Ineos Styrolution Americas, says the plant "will dramatically increase recycling rates in the greater Chicago area, dispelling the myth that polystyrene can't be recycled."

The second project concerns a 50 tonne/day facility in Europe in collaboration with Trinseo. A decision is close on the location of that facility, which is also in the engineering phase. Both facilities should be up and running by around year-end 2021.

Ineos Styrolution's global marketing communications manager Ralf Leinemann says the company has partnerships with numerous leading chemical recycling technology providers: not only Agilyx and Pyrowave, but also GreenMantra, another Canadian clean technology company, based in Brantford, Ontario, which utilises proprietary catalytic depolymerisation technology to produce a primary stream of low molecular weight polystyrene and a secondary stream of styrene monomer; another project involves Belgian waste management company Indaver.

Last October, **Indaver** said it had received the environmental permit to build a new

demonstration plant for chemically recycling 15,000 tonnes of end-of-life plastics each year. Indaver is planning to install the facility on its site in Antwerp and intends to start treating the first waste streams in the summer of 2021.

The "Plastics2chemicals" plant offers a recycling solution for both mixed polyolefins and polystyrene, Indaver says. According to CEO Paul De Bruycker, Indaver has developed an innovative depolymerisation technique that takes polyolefins back to naphtha and wax, while polystyrene will be broken down into monomers.

Indaver has been testing the process since 2017 in a laboratory environment in collaboration with Ghent University and the University of Antwerp. "With the installation of the new demo plant facility in Antwerp the process is being scaled up from 2 kg/hour to 2 tonnes/hour," it says. "If the demo plant confirms our expectations, we plan to install large-scale facilities at strategic locations across Europe, which are dedicated to recycling both polystyrene and polyolefins."

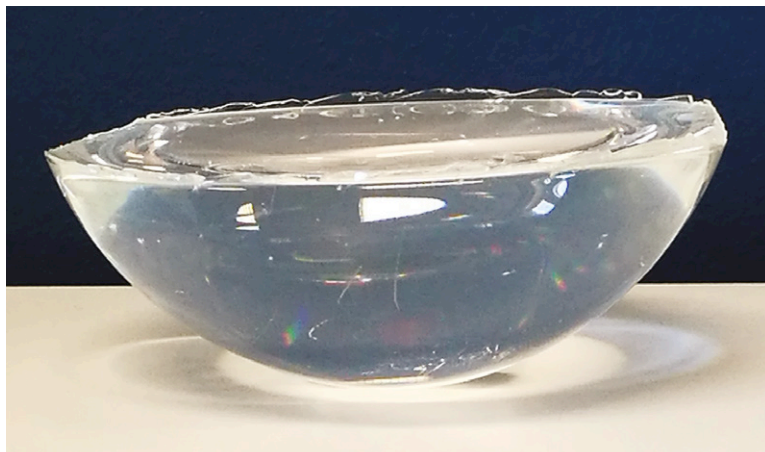
Leinemann at Ineos Styrolution adds: "In addition, we run an R&D project to understand some basic details of chemical recycling. In particular, we run the 'ResolVe' project together with various academic institutions and funded by the German government." First results of that project were announced a few weeks ago. Ineos Styrolution has also completed a "proof of concept" for chemical recycling of polystyrene. "Next step is to bring the technology to a commercial scale," says Leinemann. "First customers have recently joined us on our journey." These include dairy products leader Müller, and packaging company Sirap, which is heavily involved in PS foam products.

During K2019, Ineos Styrolution said it had produced its first small batches of chemically recycled polystyrene at its facility in Antwerp and provided sheets containing 50% of recycled GPPS to Müller, which used it to produce yoghurt cups. Leinemann says the two companies have agreed on a phased approach, with last year's lab-scale phase to be followed by a pilot-scale phase this year and a commercial-scale phase in 2022.

CLICK ON THE LINKS FOR MORE INFORMATION:

- > <http://styrenics-circular-solutions.com>
- > www.intraplas.pt
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IMAGE: INEOS STYROLUTION



Above: Chemically recycled polystyrene taken from the first run at Ineos Styrolution. The material is 20 cm in diameter

AMI's Plastics Regulations conference takes place in Cologne in March, covering everything from food contact and chemical regulation through to the single-use plastics directive. We preview the event



IMAGE: SHUTTERSTOCK

Keep in touch with regulation

AMI's fourth Plastics Regulations EU conference takes place on 11-12 March in Cologne, Germany, providing a valuable opportunity to gain focused advice on a range of legal and compliance issues impacting on polymer producers, compounders, processors and end users. Bringing together a wide variety of leading legal experts, the conference presents a cost and time efficient way to future-proof your business by making sure you are aware of changing and developing regulations.

This year's event will be preceded by a standalone pre-conference Brexit workshop that will explain the potential regulatory and trading implications of the UK's departure for UK, EU and non-EU companies. See the box on the following page for more information on the expert speakers and content or click [here](#).

Plastics Regulations 2020 will open with a global regulatory update on the plastics economy, which will be presented by **Peter Sellar**, Partner at **FieldFisher** in Belgium. This will be followed by an overview of international economic sanctions presented by **Siegfried Richter**, Policy Officer at the **European Commission**. Then **Bonita Reynolds**, Senior Director Authoring Services at

Verisk 3E in the US, will speak about the US Toxic Substances Control Act (TSCA) and achieving compliance for plastics.

Recycling issues

It would be difficult to underplay the importance of recycling and waste regulations in today's business environment. **Joachim Quoden**, Lawyer at **Law Firm Joachim Quoden** in Germany, will provide a perspective on the impact of the initiatives and tools being used to build the circular economy. Then **Luke Douglas-Home**, Managing Director of **Clear Public Space** in the UK, will share details of a study highlighting differences in plastic packaging regulations across EU member states (and the UK).

The next session will turn to the topic of REACH. **Marcus Navin-Jones**, a Partner at **Keller and Heckman** in Belgium, will ask whether REACH authorisation is becoming a barrier to recycling and re-use of plastics. **Dr Frank Friedel**, Senior Chemicals and REACH Consultant at **TSG Consulting** in the UK, will give an overview of the Single-Use Plastics Directive and the REACH regulation. And **Filippo Mattioli**, an Associate at **Steptoe & Johnson** in Belgium, will cover

Main image:
AMI's fourth European Plastics Regulations conference will update on food contact, packaging and recycling regulations

microplastics and the moves towards REACH restriction.

The final session of the first day looks at sustainability issues. It will be opened by **Dr Gary Ogden**, Technical Manager at **Wells Plastics** in the UK, who will discuss regulations and standards covering oxo-degradable plastics. Regulations applicable to plant-based additives for plastic food contact materials will be explored by **Job Ridderbecks**, Food Contact Technical Specialist at **Intertek** in Germany. Then **Ines Zitterbart**, Senior Regulatory Consultant at **Yordas Group** in Germany will bring the day to a close with an explanation of the challenges and misconceptions relating to biodegradable plastics.

Expert discussions

The second day of Plastics Regulations will open with a panel discussion exploring the outcome of the EU framework review and the implications it holds for the plastics industry. Expert participants will include: **Marcel Bosma**, Regulatory Expert at **SABIC** in the Netherlands; **Dr Peter Oldring**, Manager Regulatory Affairs - Europe at **Sherwin Williams** in the UK; and **Dr Anna Gergely**, Director EHS Regulatory at **Steptoe & Johnson** in Belgium.

The conference then turns to discuss the challenging topic of non-intentionally added substances (NIAS). **Dr Stamatis Stamenitis**, Senior Principal Scientist SRA at **Mars** in Germany, will open the session with an overview of what is happening in Europe in this area. NIAS testing, database implementation and post-run evaluations will be detailed by **Dr Marinella Vitulli**, Technical and General Manager at the **Food Contact Center** in Italy. And **Dr Christian Kirchnawy**, Team Leader at the **OFI Austrian Research Institute** will talk through safety assessment of food contact materials, including the value and limitations of in-vitro bioassays.

Registration of food contact resins and additives in China will be covered by **Ran Liu**, Regulatory Consultant at **CIRS Group** in Ireland. Then **Dr Ralph Derra**, Managing Director of **ISEGA** in Germany, will share some new developments in test methods for plastics in contact with food.

The final session of Plastics Regulations 2020 looks at regulation of specific additives. **Alfred Voskian** and **Jytte Syska**, both Consultants at **Syska Voskian Consulting** and based in the US and Denmark respectively, will outline the current state of play on pigments used in plastics. And **Mark Carpels**, Environment Product safety and CSR at **Campine** in Belgium, will discuss the impact of REACH on antimony and other metals.

Brexit – find out what it will mean for you



The UK's departure from the EU will have far-reaching consequences for many companies. And those consequences are not restricted to EU and UK firms; they will also affect companies from outside the EU that have, until now, used a UK subsidiary or representative to access the European market.

With this in mind, AMI has assembled a special one-day Brexit Workshop that will highlight the legal implications of Brexit and their potential impact on businesses trading from or to the EU, UK and other global locations. Taking place one day before Plastics Regulations 2020 on 10 March 2020, the event will be run by three experts on international trade and regulation: **Paul Ashford**, Managing Director of **Anthesis-Caleb** in the UK; **Simon Tilling**, Partner at **Burges Salmon** in the UK; **Dr Anna Gergely**, Director EHS Regulatory at **Steptoe & Johnson** in Belgium.

Each host will run a session looking at the impact of Brexit from different perspectives, allowing attendees to build a picture of the potential risks it entails and to formulate a readiness strategy. The workshop will be broken up with round table discussion periods moderated by the workshop hosts.

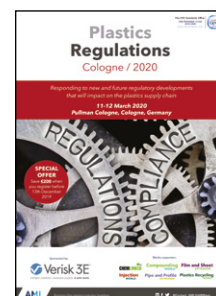
Find out more and book your place [here](#).

Learn about Plastics Regulations 2020

AMI's fourth Plastics Regulations Europe takes place on 11-12 March 2020 at the Pullman Cologne Hotel in Cologne, Germany. It will be preceded by a special one-day Brexit Workshop on 10 March 2020 (see the box above or click [here](#)).

The conference will bring together a selection of expert speakers to detail the latest regulatory developments impacting on the plastics industry, from chemicals and food contact through to recycling and single-use packaging. Aside from the formal presentations, it will provide extensive networking opportunities during the break-out sessions and complimentary cocktail reception.

To find out more, contact the conference organiser, Emily Nicholson. Email: emily.nicholson@ami.international Tel: +44 (0) 117 314 8111. Or visit the [conference website](#)



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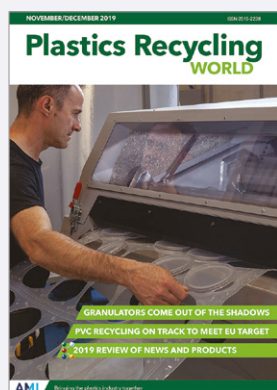


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Plastics Recycling World November/December 2019

The November-December issue of Plastics Recycling World explores the growing importance of granulators, updates on PVC recycling and reviews the recycling highlights of the K2019 show.

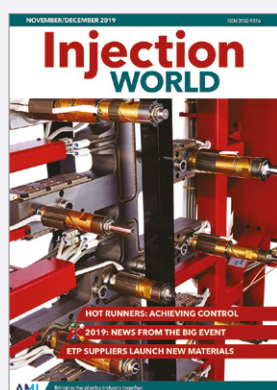
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Plastics Recycling World September/October 2019

The September/October edition of Plastics Recycling World explores a new sorting technology that uses watermarks to identify polymers. Plus, a look at the latest initiatives in rigids recycling and a preview of K's innovations.

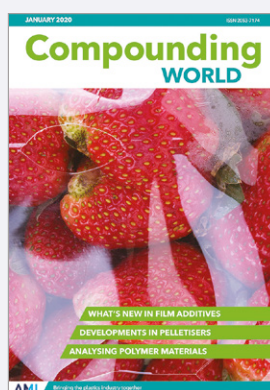
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Injection World November/December 2019

The November/December edition of Injection World takes explores new developments in hot runners and engineering thermoplastics. It also examines some of the latest automotive applications and details innovations on show at K2019.

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Compounding World January 2020

The first edition of Compounding World in 2020 explored the latest developments in additives for film materials. It also looked at some of the most recent innovations in pelletisers and polymer analysis equipment.

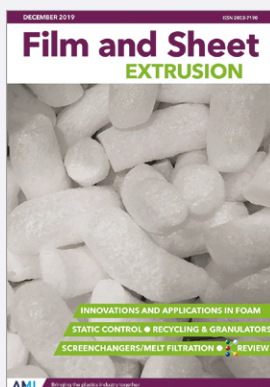
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Pipe and Profile Extrusion January/February 2020

The January-February issue of Pipe and Profile Extrusion looks at applications using engineering plastics and composites, provides updates on mixing technology and melt filtration and delves into the titanium dioxide market.

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Film and Sheet Extrusion December 2019

The December 2019 edition of Film and Sheet Extrusion looks at the latest developments in foamed sheet. It also reviews new introductions in melt filtration, static charge control and granulation equipment, plus some of the best from K2019.

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	11-13 March	Expo Plasticos, Guadalajara, Mexico	www.expoplasticos.com.mx
	25-26 March	Plastics Recycling Show, Amsterdam, Netherlands	www.prseventeuropa.com
	26-28 March	MECCSPE, Parma, Italy	www.mecspe.com
	21-24 April	Chinaplas, Shanghai, China	www.chinaplasonline.com
	7-13 May	Interpack, Dusseldorf, Germany	www.interpack.com
	19-22 May	Plastpol, Kielce, Poland	www.targikielce.pl
	2-6 June	Equiplast, Barcelona, Spain	www.equiplast.com
	8-11 June	Argenplas, Buenos Aires, Argentina	www.argenplas.com.ar
	15-18 June	Plastivision Arabia, Sharjah, UAE	www.plastivision.ae
	16-19 June	FIP, Lyon, France	www.f-i-p.com
	21-25 September	Colombiaplast, Bogota, Colombia	www.colombiaplast.org
	29 September-1 October	Interplas, Birmingham, UK	www.interplasuk.com
	7-8 October	Plastics Recycling World Expo, Essen, Germany	www.plasticsrecyclingworldexpo.com/eu

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11-12 March 2020	Plastic Regulations, Cologne, Germany
17-18 March 2020	Plastic Pouches, Vienna, Austria
7-8 April 2020	Polymers in Footwear, Portland, OR, US
20-22 April 2020	Stretch & Shrink Film, Barcelona, Spain
12-14 May 2020	Polymer Sourcing & Distribution, Hamburg, Germany
30 June-1 July 2020	Chemical Recycling, Hamburg, Germany
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