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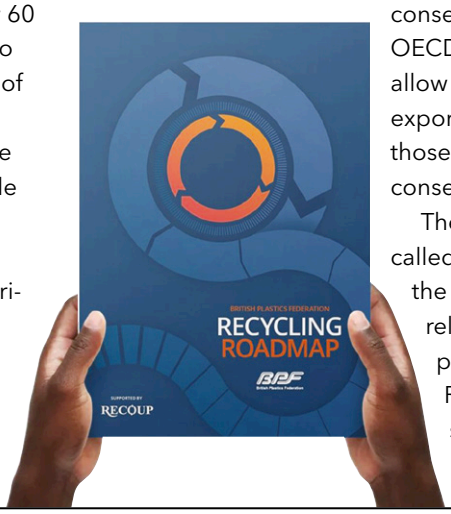
Recycling Roadmap shows UK how to cut waste exports

The British Plastics Federation (BPF) has issued a report highlighting what the UK needs to achieve in order to drastically reduce its reliance on exporting waste plastics for recycling. The report was published amid uncertainty among stakeholders about the ability of the UK and EU member countries to adhere to amendments to the Basel Convention which took effect on 1 January.

The BPF's Recycling Roadmap estimates plastics recycling in UK facilities could increase 3.5 times by 2030 with 16 key actions. It projects that: the UK could recycle up to 65% of all plastic and 75% of plastic packaging by 2030; plastic waste going to landfill could be cut to 1%; the amount of waste reprocessed by chemical recycling could grow 60 times, with capacity to process 300,000 tpa of waste by 2030.

The key actions the report calls for include unified plastic waste collection schemes across all local authorities, the kerbside collection of plastic film, increases in the use of recycled material in new products and better communication to the public about what can be recycled.



Philip Law, Director General of the BPF, said: "Drastically reducing our reliance on exporting plastic waste for recycling and the amount of plastic waste going to landfill is achievable and this roadmap shows how. Most importantly, there needs to be significant investment in increasing UK recycling capacity."

On 1 January, the EU implemented changes to the Basel Convention on global waste shipments and enacted a ban on exports of unsorted and contaminated plastic waste to non-OECD countries. But the UK, no longer part of the EU, has been criticised for instead using an option in the updated Convention to gain "prior informed consent" from non-OECD countries that will allow plastics waste exports to continue to those countries that give consent.

The BPF said it has called for many years for the UK to reduce its reliance on exporting plastic waste and the Recycling Roadmap shows how it is possible to achieve that goal. Nonetheless, Helen Jordan, BPF Senior Recycling Issues Executive, said: "The UK currently does not have enough recycling infrastructure to reprocess all its plastic waste and needs to continue to export some material for recycling. However, it is essential that this material is sent to facilities able to process it in an environmentally sound manner and there are adequate checks in place."

She continued: "If plastic waste is to be exported without prior informed consent, certain criteria must be met, such as being 'almost free from contamination' [as stated in the Basel Convention amendments]. Waste shipment regulations in the UK have been amended to reflect this. Due to the fact these changes prohibit mixed low-quality material from being exported without consent, the BPF is hopeful that these changes will help to drive up the overall quality of recycled material."

In Germany, the BDE waste management association said the EU Commission needs to clarify the obligation for plastic waste shipments to be "almost free from contamination". Clarification is required in order to avoid damage to the European recycling industry, said the association.

› **www.bpf.co.uk**

VinylPlus Med targets PVC recycling

A new project called VinylPlus Med is bringing together hospitals, waste managers and recyclers across Europe to increase recycling of single-use PVC medical devices. The collaborative project is led by VinylPlus, the European PVC industry's voluntary commitment platform.

The project will focus on sorting and recycling of non-infectious PVC waste and builds on the success of the VinylPlus-funded RecoMed recycling scheme for PVC masks and tubing. "Starting with a pilot project in Belgium, we are excited to make medical plastics more circular together with our partners," said Brigitte Dero, Managing Director of VinylPlus.

The Belgian project is a partnership with the Europe Hospitals group in Brussels and will focus on high-quality PVC waste of three dialysis facilities. Partners also include Renewi waste management group and PVC recycler Raff Plastics based in Houthulst.

All Belgian VinylPlus Med partners are located within a radius of 120 km to minimise transport distances and mitigate the project's carbon footprint.

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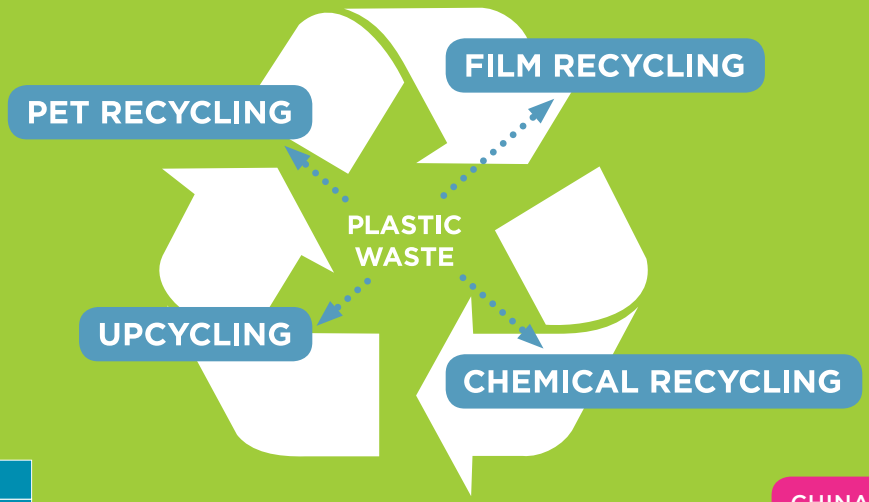

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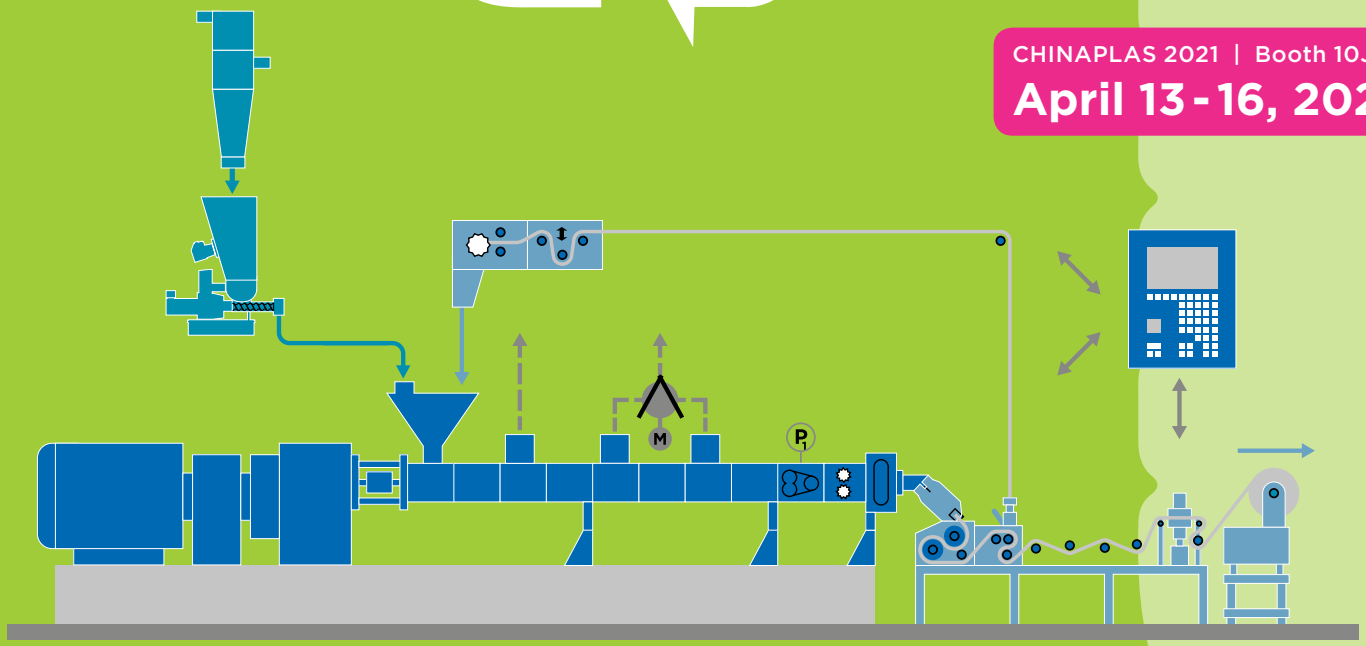

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AMI postpones plastics industry expos in Essen

AMI has announced that its four focused plastics industry exhibitions, which were scheduled to take place at Messe Essen in Germany on 1-2 June 2021, have now been postponed to 29-30 September 2021. On-going uncertainty created by Coronavirus pandemic led to the decision to delay the Compounding World Expo, Plastics Recycling World Expo, Plastics Extrusion World Expo and Polymer Testing World Expo.

Rita Andrews, Head of Exhibitions at AMI, said: "We have been reviewing the on-going situation and consulting with exhibitors and visitors. Our primary concerns are for the health and safety of all attendees at our events, and delivering the very best audience for our exhibitors. With these factors in mind, we have taken the decision to postpone the expos to 29-30 September 2021."

AMI announced the decision to reschedule the event on 1 February. Andy Beevers, Events Director at the company, said: "We felt it was important to make and announce this decision now, in order to end the current uncertainty and to allow exhibitors, speakers and attendees to plan effectively for the new dates. We have had tremendous support and understanding from the industry during this process and are now all looking forward to a successful return to Essen at the end of September."

Rita Andrews added: "Exhibitor numbers are up substantially compared to our launch event in 2018, and we want to ensure visitors can feel confident and comfortable in attending the expanded exhibitions."

Admission to the four expos and their five conference theatres will continue to be free of charge. Registrations that have already been made for the June dates will still be valid. For new registrations for the September dates, click **here**.

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

Fischer needs new investor

In early February, insolvency administration firm Schultze & Braun was appointed at four companies owned by plastics recycler Fischer Group, based in Achern, Germany. The group processes around 65,000 tonnes per year of plastics.

According to Schultze & Braun, Fischer cited a business impact resulting from the economic effects of Covid-19, including a drop in sales to the automotive industry.

The administrator is examining restructuring options and will be looking for an investor to take over the company.

› **www.schultze-braun.de**

Borealis and Tomra open demo plant for advanced mechanical recycling

Borealis and Tomra Sorting Recycling have opened an advanced mechanical recycling demonstration plant in Lahnstein, Germany. The plant sorts post-consumer rigid and flexible plastics and produces pellets for brand owners and packaging companies to qualify, validate and prove in their applications.

The partners said the state-of-the-art plant is unlike many current recycling plants and it will produce pellets at a quality necessary for use in demanding applications in various industries, including automotive and consumer products. "With high purity, low odour, high product consistency and light colour fractions, these Borcycle M grade recycled polymers will meet customer quality requirements across the value chain," they said.

IMAGE: BOREALIS

Left: The plant sorts post-consumer rigid and flexible plastics and produces high-quality material for brands to evaluate

Operation of the plant is a joint enterprise between Borealis, Tomra and waste management company Zimmermann.

"This plant embodies the principles of the Everminds platform founded by Borealis, which seeks to innovate plastics circularity through collaboration," said Lucrèce Foufopoulos, Borealis Executive Vice President Polyolefins, Innovation & Technology and Circular Economy Solutions.

"This plant is just the beginning of what's possible when key players in the value chain come together to make a truly significant impact in the market," said Volker Rehrmann, Executive Vice President and Head of Circular Economy at Tomra.

› **www.borealisgroup.com**

› **www.tomra.com**

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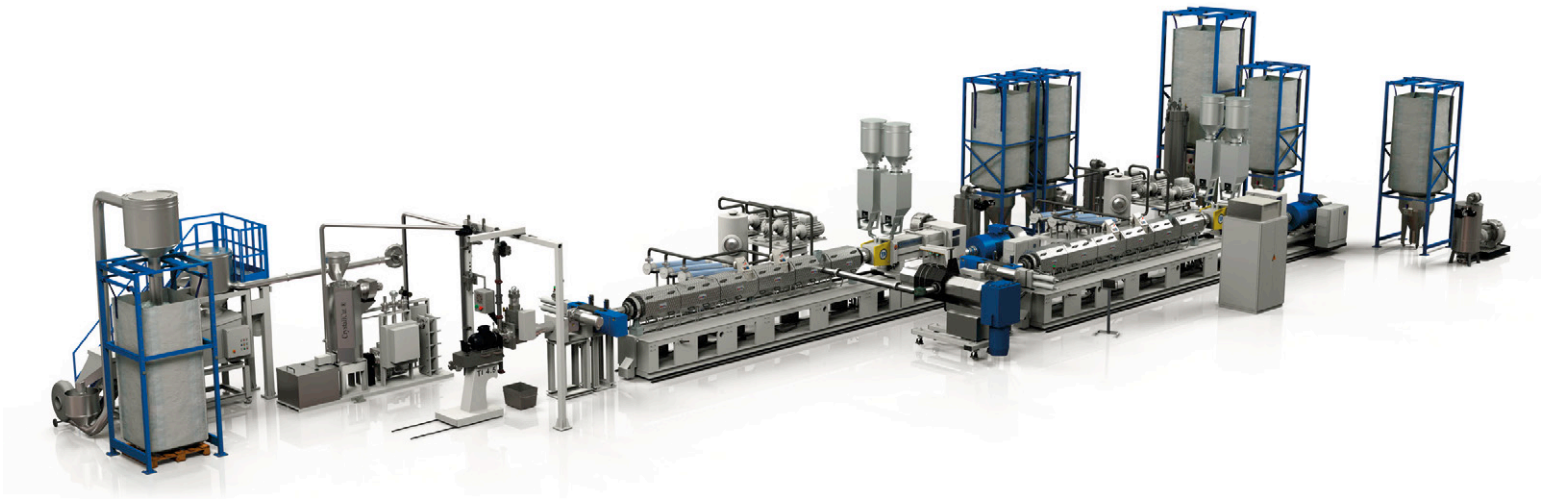

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NGR adds second LSP demo line

Austrian technology group Next Generation Recyclingmaschinen (NGR) is adding a second Liquid State Polycondensation (LSP) demonstration plant to support PET recycling customers.

NGR is a leading technology supplier in the LSP process, in which all impurities are removed from the recycled PET melt during the liquid phase so that the necessary requirements for food packaging, including water bottle grade, are achieved. The process produces EFSA- and FDA-compliant products with excellent results, said NGR.

The LSP plant will be available for demonstration and testing purposes from March.

› **www.ngr-world.com**

Large sorting plant starts up in Germany

Waste management group Nehlsen and PreZero Recycling have started operations at a mixed plastics packaging sorting plant in Bremen, Germany.

The plant has a capacity of 150,000 tpa and is in operation around the clock. The partners made a €40m investment in the plant which is run by their Sortierkontor Nord JV.

The one-year construction process was completed on schedule in December 2020 despite the Covid-19 pandemic. After successfully completing the test phase, the first material acceptance took place on 4 January.

The facility is able to sort yogurt cups, beverage cartons and PET bottles, among other packaging materials. The partners said the system fully meets the stringent demands from Germany's dual systems and the requirements of the country's Packaging Act passed in 2019.

IMAGE: NEHLSEN

Above: Nehlsen and PreZero managers at the opening of the mixed plastics packaging sorting plant in Bremen

Stephan Garvs, spokesman for PreZero Germany, said: "With the commissioning of the new SKN sorting system, PreZero and Nehlsen are jointly taking another big step on the way to a sustainable circular economy."

Christian Kampmann, Head of PreZero Recycling Germany, said: "The high technical level of the SKN system results from the many years of experience that PreZero and Nehlsen have already brought into the planning process."

› **www.nehlsen.com**

› **https://prezero-international.com**

Chemical recycling LCAs called into question by BVSE

A study commissioned by BVSE, Germany's association of mechanical recyclers of plastics, criticises claims that have been made for chemical recycling. The study of life cycle assessments for chemical recycling processes shows these LCAs as "not very credible", BVSE said in an announcement.

The study criticises a number of issues in the LCAs, including creating an impression that chemical processing requires little or no external energy, when it is associated with high energy expenditure.

The output of chemical recycling is not the same quality as new plastic, as claimed in LCAs, and only a small part can be used for end products, according to the study. The material losses in the chemical treatment process are not mentioned in the LCAs and the toxicity values are not examined in detail, it said.

The authors of the study conclude that LCAs can easily be misinterpreted. In particular, they criticise inadequate disclosure of the database for the preparation of the life cycle assessments, as it makes an independent review of the LCAs impossible.

› **www.bvse.de**

Corplex acquires GeboPlast

Extruded rigid packaging group Corplex has acquired French plastics recycler GeboPlast which has two facilities in the Alsace region recycling PE, PP, PS and PC with capacity of 15,000 tpa.

Corplex said the acquired company is ideally located closed to its own Kaysersberg site.

› **www.corplex.com**

Starlinger expands into Germany

Austrian plastics recycling technology group Starlinger has doubled machine production capacity with the start of operations at a facility in Schwerin, Germany. The company is assembling RecoSTAR PET systems – which can reach output rates of up to 3.6 tonnes per hour – at the 11,000 m² facility. The first two systems manufactured at the Schwerin site were delivered at the end of December 2020.

The Starlinger Group generates €130m in its recycling technology division and strong demand led to its decision to expand into unused production halls at UniROTA Maplan Schwerin, a company affiliated with the Starlinger Group, said Angelika Huemer, CEO and Managing Partner. "We had to act quickly to meet the demand. So it stood to reason that we should make use of existing buildings that we could adapt quickly."

IMAGE: STARLINGER

Starlinger RecoSTAR PET recycling line during assembly

Starlinger has experienced "significant growth" in demand for PET recycling systems since 2018, said Paul Niedl, Head of Sales of the Starlinger recycling technology division, which he attributes to stricter plastic packaging regulation and the plastics focus of brands. "These brand owners – in Austria the mineral water bottler Vöslauer, for example – are rigorously implementing their sustainability strategy and thus creating a market for recycled PET," he said. "We already have close to 80 PET bottle-to-bottle recycling plants in operation at customers' sites around the world, 12 of them in Germany, Austria and Switzerland alone."

› **www.starlinger.com**

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› **https://www.ami.international/mags**

Alpla to add new rPET line at preform site

Packaging group Alpla is investing more than €5m in a new extrusion system to recycle PET bottles at its facility in Anagni, Italy. The line will produce 15,000 tpa of food-grade rPET when it goes into operation, which is scheduled for the second half of 2021.

Alpla said the Anagni facility is one of its "most important preform production plants", as it processes 50,000 tpa PET, but only a small only small proportion of that is rPET.

"We will buy in PET flakes made from used household packaging from local recyclers, process them into food-grade rPET and then use this at the site for preforms," said Fabio Mazzarella, Plant Manager in Anagni. According to Mazzarella, production of the recycled material in the processing operations results in attractive synergies in logistics and warehousing and potentially also energy.

› **www.alpla.com**

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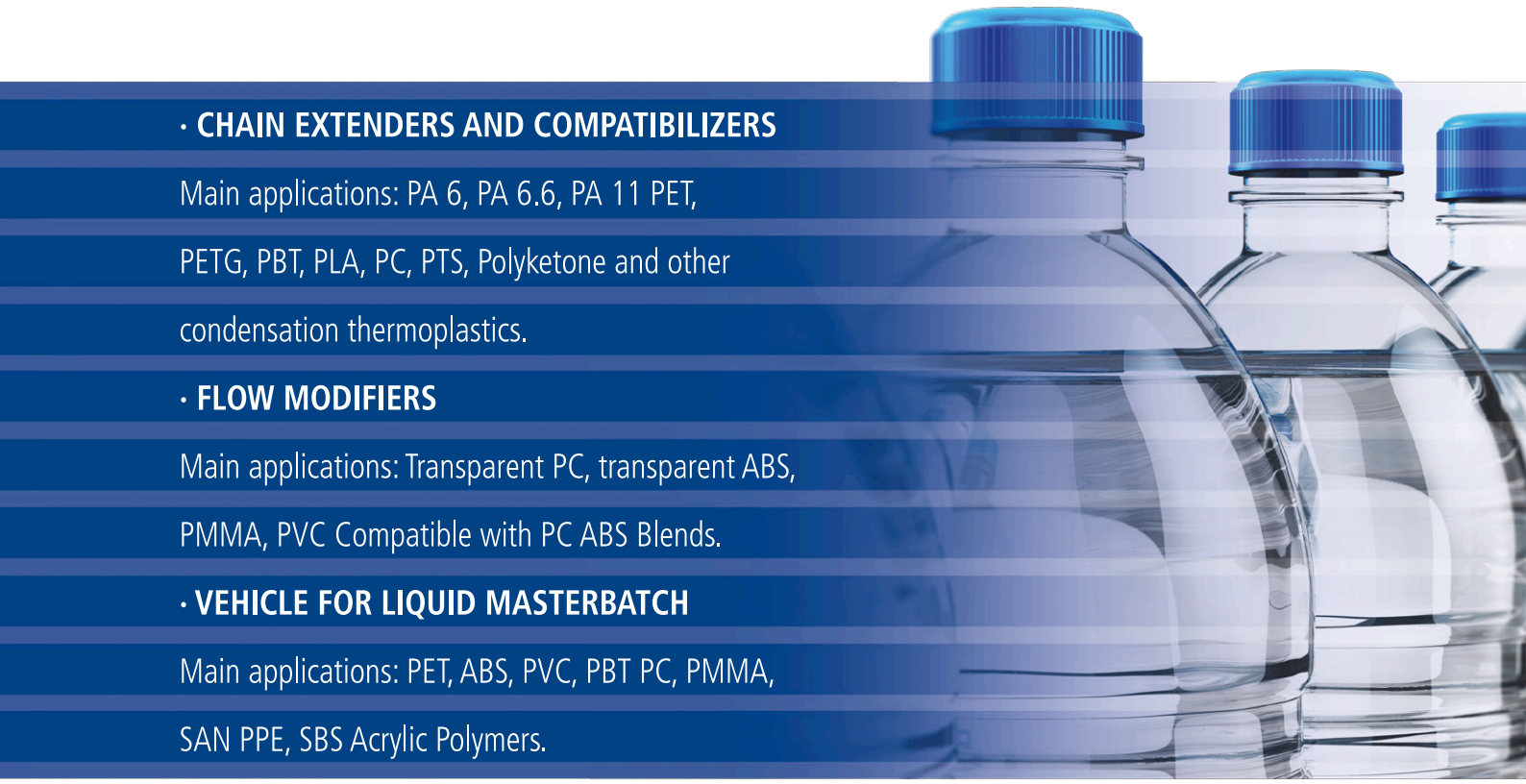

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BASF aims R&D at chemical and mechanical recycling

BASF has significant R&D capabilities in polymer chemistry and processing, giving it one of the most extensive ranges of materials in the plastics industry. The group is now training its R&D firepower on finding solutions for challenges in both chemical recycling and mechanical plastics recycling. At the annual BASF Research Press Conference held online in December, the group's plans were discussed by senior executives led by Martin Brudermüller, Chairman of the Executive Board and Chief Technology Officer.

BASF has set itself some headline goals to be achieved in a Circular Economy Program across the group's products. It has committed to transforming 250,000 tonnes of recycled and waste-based raw materials into new products each year from 2025 and aims to double sales in solutions for the circular economy to €17bn by 2030. Brudermüller said: "This means we will continuously increase our share of recycled and renewable raw materials from sustainable sources. This also means, though, that we will need to consider recycling already at the design stage for materials. And we are working on developing or closing new product-specific material cycles."

BASF has started work to replace fossil primary feedstocks with recycled raw materials for its integrated Production Verbund in its ChemCycling project. The pyrolysis oil it produces from chemical recycling waste plastics and tyres is already being used as an input in the BASF Production Verbund, he said. In addition to waste raw materials, the group is also set to increase the volume of renewable raw materials for use in its production.

IMAGE: BASF

Daniel Santoro, lab technician at BASF's Application Centre for Plastic Additives in Kaisten, Switzerland, compares optical properties of recycled film with and without a stabiliser package

Additives

BASF is also working to improve mechanical recycling of plastics. Brudermüller pointed out that only 20% of plastic waste is recycled each year. "Why is the percentage so small? For one thing, to make good recyclate, the plastic waste must be sorted into homogeneous streams at the recycling plant. But this is not always successful and that has a negative impact on the quality of the recyclate. Moreover, the quality of the plastic deteriorates with every cycle – meaning with every processing and use phase," he said. "Our researchers are working on developing additives that can specifically stabilise recycled plastics and improve their properties. This enables plastics to be mechanically recycled multiple times and the material loops can be closed more effectively and more often."

Alice Glättli, VP Strategy and Innovation for Performance Chemicals at BASF, spoke about how the group is developing its additive products to address issues specific to mechanically recycled plastics. "We have one of the biggest plastics additives production in the industry," she said. It is using its R&D expertise to address two challenges in using recycled plastics: quality and purity.

Stabilisers

The quality challenge concerns the degradation of a polymer that happens in manufacturing (during melt processing and from catalyst residues, for example), in its first use and in the recycling process. BASF has more than 100 thermal stabiliser and antioxidant products which restore or enhance mechanical properties of polymers. Glättli said: "In our portfolio we have all the relevant stabilisers for all the

polymer production steps. Firstly, the radical scavengers: we have the phenolic antioxidants, the phosphites, but also the hindered amides."

One example she discussed was recycling of HDPE bottles, which often contain traces of PP. "The problem is the PP is degraded much quicker than the PE. So if during recycling we don't restabilise, we have a drastic loss of stability."

A recycled HDPE 95%/PP 5% material that is not restabilised lasts only 18 days to embrittlement. But BASF tests showed that if it is restabilised, it has 116 days to embrittlement.

It often takes a mixture of additives (such as additive packages or blends) to avoid the decomposition of polymer chains. Preventing yellowing of mechanically recycled PET for drink bottles, for example, can be achieved by combining a primary and secondary antioxidant, she said.


IMAGE: BASF

Alice Glättli at the BASF Research Press Conference

To meet the purity challenge in mechanical recycling, BASF is developing compatibiliser additives that deal with immiscible polymers present in a recycler's input material. She showed microscope images of a material comprising waste PET bottles recycled with PP caps where the addition of a compatibiliser resulted in more homogeneous dispersion and fewer defects.

Glättli said: "Additives for stabilisation and the increase of recycling cycles are already part of our portfolio. Just now, we are working around bringing these to the customer and optimising them. With compatibilisers we are still in the screening phase. We are talking about solutions with external partners and customers in order to identify compatibilisers for the recycling market. Thus, step by step, we will build our existing plastic [additives] portfolio and expand it with solutions specifically made for mechanical recycling."

› **www.basf.com**

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IMAGE: SHUTTERSTOCK

Bringing together knowledge and expertise from across the complete value chain is starting to bring significant results in programs for film and flexible packaging recycling. By Mark Holmes

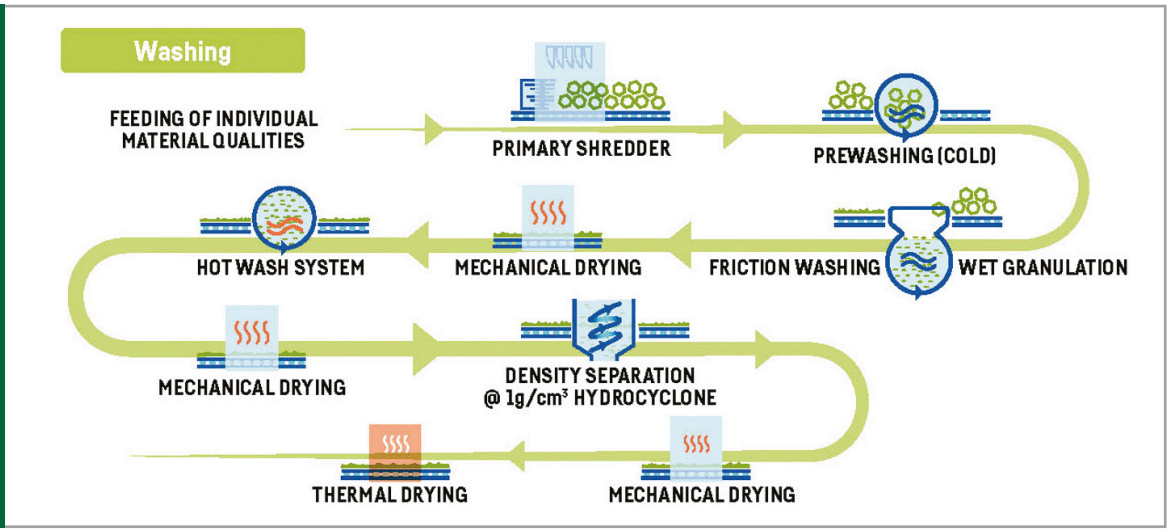
Stepping up innovation in PCR film recycling

Initiatives around the world are bringing widespread expertise across value chains to advance film recycling and bring the circular economy closer. Collaborative ventures bringing together recycling companies, machinery manufacturers, material suppliers and consultants specialising in environmental technologies are finding innovative ways to collect, identify and process plastic films and flexible packaging and then re-use post-consumer recycled resins.

A Quality Recycling Process for flexible packaging developed by **Ceflex** and stakeholders has shown product yield and quality for applications suitable to replace virgin polymer grades using mechanical recycling. Ceflex (Circular Economy for Flexible Packaging) – a partnership of over 160 European companies, associations, and organisations – adds that much can be delivered today with existing sorting and recycling technologies, if only the required infrastructure was in place to unlock its full environmental and economic potential. Collaborating in a sustainable end markets workstream, Ceflex stakeholders aim to bring the Quality Recycling Process to market, delivering recycled polymers for higher-value applications than are currently commercially available. The workstream is moving forward into industrial trials to build the business case for investment in the infrastructure that can leverage this process into a mainstream solution to keep the materials in the economy at the greatest value possible.

Ceflex is demonstrating that recycling for a wider range of non-food flexible packaging is possible, including more demanding applications through mechanical recycling via the Quality Recycling Process. In the process, film grade quality rPE and rPP polymers appropriate for non-food flexible packaging are produced by applying near infrared (NIR) sorting by polymer and colour, followed by hot washing and extrusion with extra filtration and deodorisation. Ceflex says film grade recyclates for natural rPE and all colour rPP can be obtained at good product yields and quality and with mechanical and processing properties that

Main image: Flexible packaging recycling challenges include heavy printing and multi-material lamination



The washing stages in the Ceflex project's Quality Recycling Process for flexible plastics packaging

make these materials capable of matching virgin polymer properties.

Ceflex has also issued new design guidelines to help deliver a circular economy for flexible packaging. The *Designing for a Circular Economy (D4ACE)* guidelines have been developed collaboratively with the entire flexible packaging value chain. The Ceflex project's aim is for the D4ACE guidelines to provide a catalyst for change across Europe: producing higher quality recycled materials is expected to support much needed investment in sorting and recycling infrastructure to make all flexible packaging circular. Focused on polyolefin-based structures, as these represent more than 80% of consumer flexible packaging in the European market, the guidelines provide advice on the key elements of flexible packaging including materials used, barrier layers and coatings, size, shape, inks and adhesives.

The Materials Recovery for the Future (MRFF) consortium has released a new pilot research report demonstrating the successful collection, separation and preparation for recycling of flexible packaging. The pilot, the first of its kind in the USA, was performed in partnership with JP Mascaro & Sons at the TotalRecycle Material Recovery Facility (MRF) located in Pennsylvania and underwritten by the MRFF.

The report, prepared by Resource Recycling Systems, demonstrates that with adequate optical sorting capacity and peripherals, flexible packaging can be efficiently captured in a large single-stream MRF and processed into a commodity bale, known as rFlex, for reuse in a variety of markets while diverting plastic from landfills. The report also identifies more than a dozen end market opportunities for the recycled material. Building products like roofing materials represent the highest volume and most immediate end market opportunities. Other high-volume opportunities for using rFlex are pallets and railroad ties, where recycled plastic can serve as a more durable alternative to traditional wood.

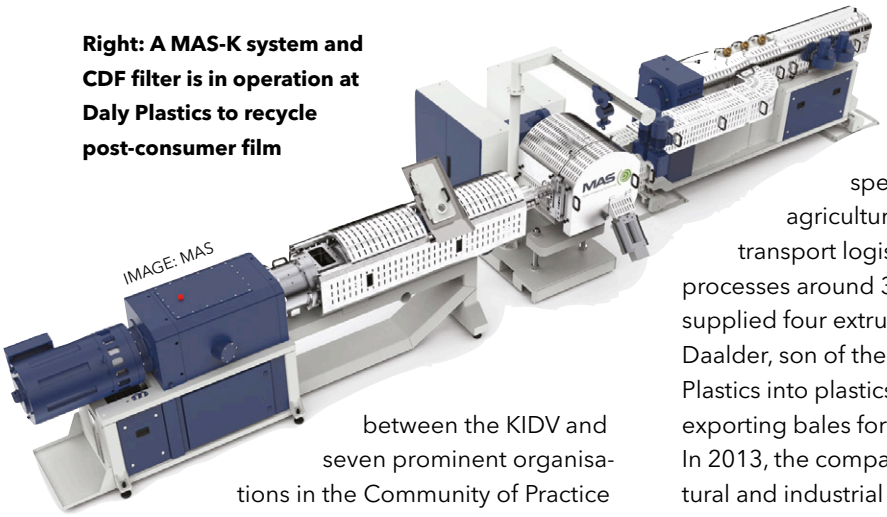
Within a year of installing sortation equipment at the TotalRecycle MRF, four of the five sortation performance goals established for the pilot demonstration were achieved, and the program continues to progress towards achieving the fifth goal. The five pilot performance goals include a reduction of the amount of recyclate going into fibre products, even with increased flexible packaging in feedstocks, as well as minimising paper in the new rFlex product bale.

The Netherlands Institute for Sustainable Packaging (KIDV) has published *Multilayer flexible packaging in a circular economy*, a roadmap document that contains a technical examination of current and future developments pertaining to the design and recycling of multilayer flexible plastic packaging materials. The KIDV illustrates the technical dilemmas and presents eight possible solutions for making laminate packaging materials more circular, along with their respective pros and cons. The roadmap will be used in discussions with the value chain.

The roadmap is the result of collaboration

Below: JP Mascaro & Sons' TotalRecycle Material Recovery Facility in Berks County, Pennsylvania, US

IMAGE: JP MASCARO



Right: A MAS-K system and CDF filter is in operation at Daly Plastics to recycle post-consumer film

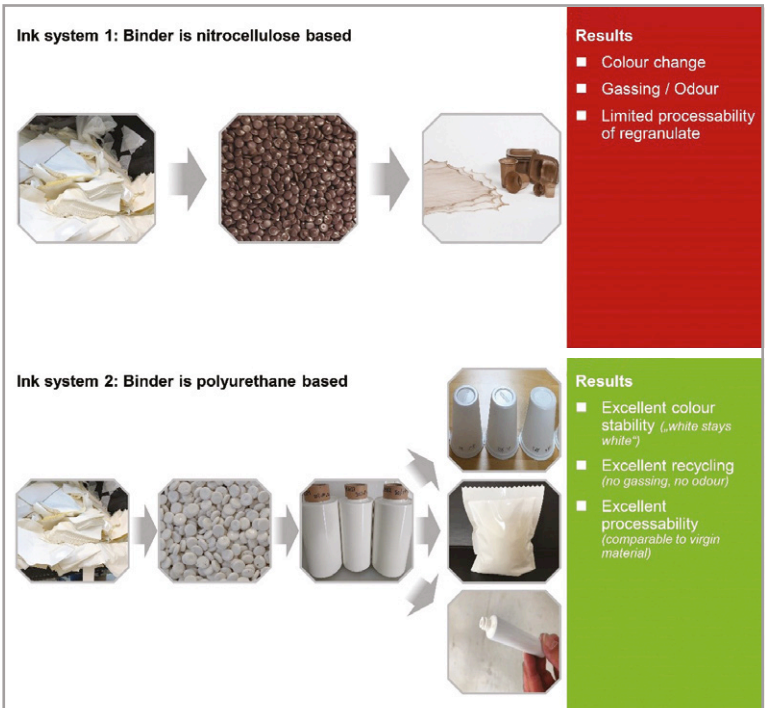
between the KIDV and seven prominent organisations in the Community of Practice Laminate Packaging Materials, which was launched in 2019. The participants are Friesland-Campina, Intersnack, Jacobs Douwe Egberts, Mars Wrigley, Nestlé, PepsiCo and Unilever. These companies all face similar challenges when it comes to the recycling of laminates.

Austrian extruder manufacturer **MAS Maschinen und Anlagenbau Schulz** and **Caroda Polymer Recovery** of The Netherlands – part of Daly Plastics – have collaborated in a project to improve the quality of LDPE film from recycled materials. The companies won the Recycling Machinery Innovation Award at the Plastics Recycling Awards Europe 2020. Daly Plastics specialises in the recycling of agricultural and packaging films from transport logistic sources. The company processes around 35,000 tonnes per year. MAS has supplied four extrusion lines for Daly Plastics. Peter Daalder, son of the company's founder, moved Daly Plastics into plastics collection in 1985 and began exporting bales for recycling to China in particular. In 2013, the company decided to recycle agricultural and industrial film materials itself and purchased the first MAS machine, and Caroda Polymer Recovery was formed. The film recycling project brings together specialist extruder technology from MAS with film recycling expertise from Caroda Polymer Recovery.

"The technology is designed to minimise gels that appear when blowing thin LDPE film from recycled material," says Stefan Lehner, General Sales Manager at MAS. "Gels in foils arise either from contamination that is not sufficiently removed or from crosslinking of molecules. Crosslinking effects are created by a

non-homogenous feedstock and additives used in products that must be homogenised in the recycling process. In a normal extruder, material is heated thermally and by mechanical friction. When the melt is at the correct temperature, it is homogenised. However, at that point temperature-sensitive polymers crosslink and unmelted lumps are formed in the melt. Our extruder is short, conical and co-rotating, meaning that the screw geometry can be optimised. By working with Caroda, we have found a solution to minimise the size of the gels. Normally, gels appear as crystal-like granules on the film surface. We have been able to optimise the process so that there are a minimum number of visible micro gels that feel like powder in the film. This provides much better printing possibilities and improved sustainability in the circular economy."

The special design of the conical, co-rotating MAS extruder permits a twin-screw extruder to be used for economical film recycling without pre-densification or agglomeration prior to the extrusion process. "The conical design provides a big feed opening and a large intake volume as a result," says Lehner. "For example, with the MAS 93-K unit, the feed opening has a size of 200 × 313 mm, with screw diameters of 2 × 93 mm at the melt outlet and 2 × 186 mm at the material intake. As a result of the large intake volume, it is also possible to feed film fluff without pre-densification or agglomeration prior to the extrusion process. Therefore, it is now possible to have the benefits of a co-rotating twin-screw to produce pellets of the maximum possible quality. Flexible, exchangeable kneading elements ensure the right amount of shear, needed to get the best possible homogenisation. In comparison to conventional single-screw extruders used in film recycling, a co-rotating twin-screw provides significantly better homogenisation, which is essential in cases where different polymers are combined to achieve a high-quality pellet."



PrintCYC members have tested alternative ink formulations for printing on BOPP and LDPE films
Images: PrintCYC

He says: "There are also challenges involved in the recycling and extrusion of LLDPE film flakes. After the melt has passed through the CDF melt filter it is well prepared for final venting because it is well homogenised and free of contaminates. A short single-screw extruder, with a standard L/D of around 13.5, is installed downstream of the CDF filter and is equipped with a highly efficient degassing zone, ensuring the highest venting quality. Three large venting ports with relevant vacuum pump performance, provide high venting efficiency making it suitable for the most difficult degassing applications."

According to MAS, the key for this new film recycling technology is the conical co-rotating twin-screw extruder. The screws are segmented and adjusted with exchangeable mixing and kneading elements. The tailored screw geometry, in combination with a suitable screw speed, allows the shear rate to be adjusted to the exact level required to prevent gels and crosslinking occurring. The short processing unit of the MAS extruder means that power and general production costs related to output quality are low. Based on data from existing customers, MAS says that the energy consumption with PE is approximately 0.3-0.35 kw/kg for the extrusion process and melt filtration.

The company adds that disassembling the screws is straightforward and achieved at the rear of the extruder, meaning that it is only necessary to remove the adapter between MAS and the melt filter or melt pump. It is easy to move the cylinder forward and to swivel it to the side. The screws can then be removed from the cylinder at the rear. Time consuming removal of the downstream equipment is not necessary. Disassembling the screws takes between 30 minutes and around two hours depending on the extruder size, says MAS.

PrintCYC is an initiative focussed on recycling printed plastic films and processing of recyclate. Its current members are the machine suppliers Brückner Maschinenbau, Kiefel and PackSys Global, CPP film specialist Profol, ink manufacturer Huber-group, converter Constantia Flexibles and the recycling technology group **Erema**. The initiative is coordinated by Annett Kaeding-Koppers as inde-

pendent packaging and sustainability consultant.

In phase one of the project, PP film and packaging samples containing more than 50% of PP recyclate were successfully produced. The base material was printed biaxially oriented PP (BOPP) film with nitrocellulose-based ink formulations. However, the recyclate quality was not completely satisfying in regard to material properties such as colour, smell and processability.

Based on the initial results, PrintCYC members strived for further improvement by testing alternative ink formulations for printing on BOPP and LDPE films. Switching to a polyurethane-based ink system in flexo printing in phase two resulted in significant improvements in the mechanical recycling process on a production line typically used for reprocessing printed film waste. Due to the high temperature resistance of the inks – greater than 240°C – no volatile by-products, odours or gels were observed, leading to a new class of premium quality recyclates showing colour-stable properties. A first environmental impact assessment showed decreased greenhouse gas emissions due to lower energy consumption of mechanical recycling of LDPE films compared to virgin material production. The recyclates showed excellent processability for the production of blown, cast and biaxially-oriented films which were 100% comparable to virgin material, say the project partners. Up to 100% recyclate in the inner layer of a three-layered ABA film structure could be implemented successfully.

Two interdisciplinary five-year research projects have been completed in Austria by printing company **Renner**, recycling firm Walter Kunststoffe and consulting company M2 Consulting. The companies say that the resulting Circular-Print process makes it possible to reuse heavily printed PP sheet waste to create pellets in an upcycling process for the production of new, printable sheet. The project uses Corema technology from Erema in the upcycling process that enables recycling and compounding in a single step. The project focussed on PP labels used in horticulture but the process has since been extended to applications throughout the large-format printing sector.

A new certification label has been created with the help of the Johannes Kepler University Linz, Austria, in order to distinguish printable plastic sheet products with post-industrial recycling qualities or

Right: R-Cycle is aiming to map the entire value chain of plastic packaging

post-consumer recycling qualities. A digitisation project took place in parallel to set up an online system that records all the stages and processing steps – from the printed plastic sheet to the recycled pellets and the new products – using data input by all the partners involved. This makes uniform certification much easier and saves time and costs.

Film extrusion technology group **Reifenhäuser** has started a collaborative project, **R-Cycle**. The aim is to ensure the recyclability of plastic packaging through the complete documentation of all recycling-relevant packaging properties. The company says that this is the only way to identify valuable materials in the recycling process precisely and use them for reprocessing in diverse and high-quality plastic products. Other partners in R-Cycle include Arburg, Brückner Maschinenbau and Kautex Maschinenbau, representing other process technologies, as well as the Institute for Plastics Processing (IKV) at RWTH Aachen. They are supported by GS1 Germany, a neutral competence and service centre for the optimisation of cross-company business processes along the value chain. A cross-sector and globally applicable standard emerging from R-Cycle will be available to all companies and industries along the life cycle of plastic packaging.

R-Cycle uses tried-and-tested marking and tracing technologies, such as those already used for fresh products in the food industry, to provide the supply chain with digital information. Numerous pilot projects are underway with partner companies, including global raw material suppliers, trading companies, global brands and independent institutions.

An international academic and industry research consortium has secured €12m across two EU- and China-funded projects – BioICEP and Terminus – targeting problematic multi-layered plastics. Researchers at **Athlone Institute of Technology** in Ireland and Sigma Clermont in France have begun joint work on two projects to develop novel

IMAGE: R-CYCLE

technologies that will separate, treat and repurpose multi-layered plastics.

Multi-layered packaging, for example crisp bags and other ready-to-eat snacks within shiny packets, account for up to 56% of plastic packaging in developed countries. The plastics are difficult to separate into discrete layers that can be effectively recycled. By the end of the four-year projects, researchers hope that the combined outputs from both projects will provide a new generation of green technologies.

The Terminus project aims to develop new biotechnology specifically designed to separate out the layers from multi-layered film and packaging using enzymes to degrade the layers of adhesive holding the plastics together. Technology developed through BioICEP will take the individual layers of plastic generated through Terminus and break these down further into their chemical constituents through depolymerisation using combined green mechano-chemical and enzymatic technology. In combination, the two projects will convert multilayer plastic waste into individual building blocks for new plastics.

DuPont Teijin Films is collaborating with Poseidon Plastics, Alpek Polyester UK, Biffa Waste Services, GRN Sportswear, O'Neills Irish International Sports Company and the University of York to develop Poseidon's enhanced PET recycling technology. The collaborative project, partially funded by UK Research and Innovation as part of its Smart Sustainable Plastic Packaging challenge, strives to bring together input from across the PET value chain to demonstrate the potential of the technology to enable a circular economy for some of the more challenging fractions of PET waste.

DuPont Teijin Films will be working closely with Poseidon to facilitate application of its technology to flexible PET films. This will use pilot and production scale polymerisation facilities to develop a PET

Below: Seven different cheeses are now being stocked in Tesco's stores made from the first recycled flexible packaging from materials returned by customers

IMAGE: TESCO

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polymerisation process based on BHET monomer feedstock. The company says that it believes that collaborating with the wider PET value chain on this technology has the potential to enable film-to-film recycling in the future.

Polymer suppliers in the packaging sector have been stepping up their work in circular flexible packaging. **Dow** has introduced its first recycled PE for shrink film applications in North America, which includes up to 40% recycled content in shrink film. It has also developed XUS60030.01 Experimental Low Density Polyethylene Resin which includes 70% certified PCR film. Key advantages of the PCR-rich resin include a final package performance comparable to that of packages made with 100% virgin resins. It maintains recyclability as an all-PE film and offers flexibility to customise PCR content for shrink applications.

SABIC has embarked on a pilot project with Schwarz Group, Europe's largest retail store operator, for the use of transparent film bags made from circular PE. The project includes various PE technologies from SABIC's Trucircle portfolio based on materials produced via feedstock recycling of mixed and used plastics. Through this project 1 kg bags for organic carrots made of SABIC's circular PE (LDPE/LLDPE, HDPE and SUPEER metallocene PE) were introduced between October and December 2020 by the retail group into selected Lidl and Kaufland stores in Germany.

"Our comprehensive strategy is to make all Lidl and Kaufland brand plastic packaging as recyclable as possible by 2025, thereby reducing overall plastic consumption by 20%," says Dietmar Böhm, Managing Director of GreenCycle, which serves as a waste management and recycling service provider for Schwarz Group and other companies.

SABIC is also supplying UK supermarket group Tesco with Trucircle materials to introduce the first recycled flexible packaging based on materials returned by customers. In a trial for cheese packaging, an entire supply chain worked together to collect and recycle waste into new food-grade packaging a minimum of 30% recycled material. Chemical recycling company Plastic Energy, SABIC, Sealed Air and Bradburys Cheese worked with Tesco to conduct the trial to demonstrate that flexible plastic can be recycled multiple times into new plastic as a part of a closed loop recycling system.

In another initiative, **DSM** has collaborated with SABIC, Cepsa, Fibrant and Viscofan to create a multi-barrier casing for meat products made via chemical recycling of post-consumer plastics. DSM Engineering Materials supplies the certified circular polyamide (PA) Akulon CRC-MB. This PA material is produced through a strong value chain collaboration involving a range of partners applying a mass balance approach. Firstly, SABIC produces certified circular benzene, based on materials produced via feedstock recycling of mixed-used plastics, which is used by Cepsa to make certified circular phenol. Fibrant then uses the phenol to produce certified circular caprolactam EcoLactam, which is provided to DSM to produce its circular PA. Finally, Viscofan combines the DSM circular PA with SABIC's circular PE to produce the barrier film for meat casings.

IMAGE: SCHUR

Left: Recyclable and sustainable flow-wrap film from Schur Flexibles is being used for self-service minced meat products

Meat packaging has been a focus for other collaborations. Packaging group **Mondi** has developed a fully recyclable, mono-material, barrier thermoforming film for meat products in partnership with Austrian meat producer Hütthaler.

German retailer Feneberg Lebensmittel has used a new packaging solution – recyclable and sustainable flow-wrap film MonoFlowre – by **Schur Flexibles** for its self-service minced meat products for in-house butchers. By switching from tray to flow wrap, the two companies have managed to save 70% of the plastic used.

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IMAGE: SHUTTERSTOCK

Polyurethane recycling looks for chemical boost

*Could chemical recycling help polyurethane materials become circular? **Peter Mapleston** explores the multiple projects trying to find technical answers to unlock the recycling potential of PU*

Recycling of polyurethane foams is moving up a gear. Or to extend the motoring metaphor a little further, a new powertrain is being added – chemical recycling.

Mechanical recycling within production operations is often a necessity, especially when working with flexible foam blocks, given how much edge trim can be created. That foam is most usually broken up into small pieces, rebonded, and reused in products such as carpet underlay, gym mats, and acoustic insulation.

As long ago as 2005, ISOPA, the European Diisocyanate and Polyol Producers Association, published what it said was a non-comprehensive list of companies involved in polyurethane recycling; there were 50 companies on the list, the large majority working with industrial scrap, although even then, eight were connected with some form of post-consumer recycling. One company, Agglorex in Belgium, this year celebrates 50 years of recycling flexible foams.

Post-consumer waste recycling, mostly of mattresses, has been going on for well over a decade at a certain modest level, but now it looks like chemical recycling could provide an alternative solution to the problem of where to put all that voluminous material.

Polyurethane, mostly in the form of a foam, rigid or flexible, is used in diverse products that include shoe soles, furniture cushioning, all sorts of thermal and acoustic insulation, and giant wind turbine blades. Annual consumption is around 18m tonnes. At the end of its first useful life, most of it is landfilled, presenting even more problems than solid plastics because of its volume (even if it can be compressed). One major polyurethanes

Main image: Annual global consumption of polyurethane is around 18m tonnes, mainly in foam form

A mountain of mattresses to climb

The word Everest crops up quite a lot when discussing mattresses. Not only because it is a famous brand name, but also because it is used to give an idea of just how huge the problem of mattress waste disposal is.

If mattresspodcost.com is to be believed, stacked up, the number of mattresses discarded each day in the USA would surpass Mount Everest by an additional four miles (6.5km) into the sky. In Europe, according to Dow Polyurethanes, if all the mattresses thrown away in a year were stacked up, the pile would be 678 times the height of the mountain, assuming they were all 20 cm thick. Mount Everest is 8,849 m high.

company estimates that close to half of end-of-life (EOL) polyurethane (PUR) is landfilled, while 33% is incinerated. These solid waste streams end up in the municipal waste stream representing on average 2.75% in weight of the total municipal waste fraction, but 25% in volume.

Mechanical recycling of mattresses goes on around the world, but its spread is quite patchy. It is quite well established in parts of mainland Europe. For example, **Recyc-Matelas** Europe has several facilities in France and Belgium that recycle and recover up to 90% of mattress components. All the sorted materials (wool, cotton, felt, PU foam, latex and mixed textiles) are pressed into bales by specific equipment and are then sent for recycling, reaching an average recovery rate of 90%. Springs are reprocessed too. Recyc-Matelas Europe says its objective is to recycle 2.4m mattresses a year across numerous plants, amounting to over 55,000 tonnes of material. It is a joint venture with Recyc-Matelas (Recyc-Mattress) in Pont-Claire, Québec, which began recycling mattresses in Canada in 2007, recycling around 400,000 mattresses a year.

In Belgium, Valumat, a management body for Extended Producers Responsibility (EPR), established and financed by the sector, has the mission of collecting and reprocessing all discarded mattresses. It cooperates with all stakeholders (manufacturers and importers, collectors, processors, governments, local authorities, etc). MattCanada in Montreal opened its first recycling plant in 2004. It has so far recycled something like 650,000 mattresses.

Below: Used mattresses: a plentiful source for PU recycling

IMAGE: PFA

In the USA, the **Mattress Recycling Council** (MRC) is a non-profit organisation, headquartered in Alexandria, Virginia, formed by the mattress industry to operate recycling programs in those states that have enacted mattress recycling laws. The program is currently running in California, Connecticut, and Rhode Island. MRC Managing Director Mike O'Donnell says last year it recycled over 1.6m mattresses. Pointing to the success of its programs, O'Donnell notes that in California, more than 83% of mattresses discarded in 2019 were diverted from landfills, up three percentage points from the previous year.

"Demand for post-consumer scrap foam is strong in the US and it is currently all mechanically recycled into carpet underlay," he says. "Having said that, we are closely following the polyurethane foam chemical recycling activities by Dow and other companies in the EU."

According to a report issued by the PFA, the **Polyurethane Foam Association** in Loudon, Tennessee, USA, in March 2020, "the flexible polyurethane foam industry has one of the most successful recycling records in the world. In the US, virtually all manufacturing scrap is collected and recycled. And according to the Carpet Cushion Council, approximately 600 to 700m pounds [272,000-317,000 tonnes] of scrap foam are recycled each year from post-industrial sources."

The PFA does point out that flame retardants in foams historically used in furniture complicate the mechanical recycling picture; some of these FRs have since been banned in many countries. "By blending recycled foam containing FRs with other foam scrap, concentrations of FRs are significantly diminished, and the recycled form can be used productively, rather than being discarded," it says.

PFA Executive Director Russ Batson says chemical recycling and also energy recovery technologies have been discussed in several papers presented at recent PFA Technical Sessions, "most recently an update from CHZ Technologies

on their syngas recovery. Our members are actively exploring these technologies as they are refined and scaled up."

One problem with mechanical recycling of post-consumer PUR foam is that second-life applications are generally low-value. Hence the rise of chemical recycling, which offers the possibility of creating new raw materials – polyols – that have just about the same properties as polyols used to make the first-life polyurethanes.

EuroPUR is the association of European flexible polyurethane foam block manufacturers. It says that in Europe, most discarded mattresses are sent to energy recovery plants – but the situation is changing. In a recent statement on the situation in the Netherlands, it said that around three-quarters of mattresses are now collected and recycled. One company alone, RetourMatras, has handled 1m mattresses in recent years across three locations.

Michel Baumgartner, Secretary General at EuroPUR, says: "The reality is however that if all countries were to start to recycle post-consumer foams, market outlets for the recyclates would not be able to absorb all the available volumes. That is why other technologies need to be developed." It says chemical recycling using glycolysis has been in use at an industrial scale in Europe since 2013 for post-industrial waste and has now evolved to also be able to recycle post-consumer foams. "The latter is more difficult to achieve because of the great variation in age and composition of materials coming from discarded mattresses. But we are now getting there."

Many other projects on chemical recycling of polyurethane foam are currently making rapid progress, says EuroPUR. It notes that RetourMatras and its shareholders INGKA Investments (part of the Ikea group) and Renewi Nederland have announced plans to begin chemical recycling, using glycolysis technology developed by Ikano Industry in Poland (also see box on page 39). Ikano

IMAGE: PFA

Left: Production trim scrap. Most gets reused via rebonding

began life as a part of Ikea, but is now an independent producer of mattresses.

A number of publicly funded projects are also looking at chemical recycling across Europe, notably the PureSmart project headed by Recticel, the Polynspire project, and the Danish RePURpose project based around mattress manufacturer Tempur.

"Chemical recycling will play an especially crucial role for polyurethanes," says Jörg Palmersheim, Secretary General of **ISOPA**. The organisation is a member of the European Coalition for Chemical Recycling, set up in March 2019 by CEFIC and Plastics Europe to collectively address key and common issues concerning chemical recycling. PU Europe, which represents the European polyurethane insulation industry, joined in January.

"Our current management of end-of-life polyurethane products is not sustainable and future-proof," say the people at the **RePURpose** project, which focuses on innovative technologies for recycling of PUR. These technologies cover mechanical and chemical means. RePURpose is a collaborative research project involving various local manufactur-

IMAGE: RETOURMATRAS

Above: Mattress recycling lines at RetourMatras in Zeeland, Netherlands

IMAGE: RETOURMATRAS

Above: Recycling and bonded foam production at RetourMatras in Alphen aan den Rijn, the Netherlands

ers from along the supply chain, as well as two academic organisations. Its aim is to develop new approaches for recycling PUR materials.

One is ReUSE, a new form of granulation aimed at in-house recycling of waste occurring at the manufacturer of PUR products. ReCYCLE is chemical recycling of post-consumer material. "End-of-life products consist of many different PUR types and ReCYCLE must be a platform which can handle as many of these types as possible," says project leader Anders Lindhardt at the Danish Technological Institute. "ReCYCLE is focused on developing innovative and mild chemical reaction conditions that can degrade polyurethane."

Polynspire is a four-year EU-sponsored project that began in late 2018. Its title is "Demonstration of Innovative Technologies towards a more Efficient and Sustainable Plastic Recycling." It is not devoted solely to polyurethanes. However, one of three technologies it is looking at is "chemical recycling assisted by microwaves and smart magnetic catalysts as a path to recover plastic monomers and valuable fillers (carbon or glass fibres)."

Transforming thermosets

At the beginning of 2019, Belgian polyurethanes specialist **Recticel** announced the four-year **PUReSmart** project, supported by €6m in funding from the European Union Horizon 2020 Research and Innovation Programme.

Recticel says the PUReSmart collaborative consortium gathers nine partners from six different countries and seeks ways of transitioning from the current linear lifecycle of polyurethane products to a circular economy model. The PUReSmart project will explore new methods, technologies and approaches in order to overcome challenges to recycling this thermosetting material and transform PUR into a true circular material.

PUReSmart targets the recovery of over 90% of end-of-life PU with the goal of converting it into valuable inputs for new and known products. The project consortium plans to develop "smart" sorting technologies to separate a diverse range of PU materials into dedicated feedstocks. These feedstocks will be broken down into their basic components as inputs for existing PU products, and as raw materials for a newly designed polymer that merges the durability of thermosets with the circularity of thermoplastics.

The PUReSmart consortium comprises industrial players and dedicated research partners. Members are Germany-headquartered Covestro, a world leader in production of polyols and isocyanates;

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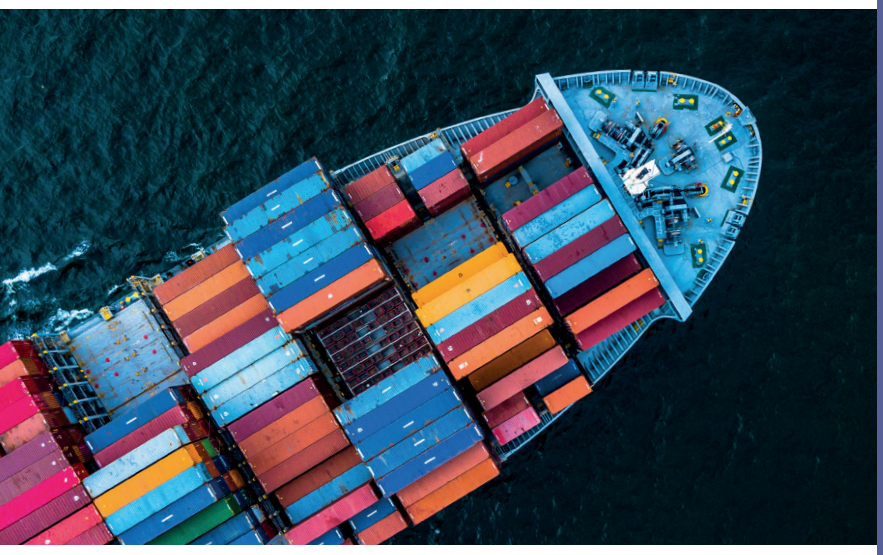

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BT-Wolfgang Binder (Austria), with its Redwave trademark, offering expertise in the sensor-based smart sorting of end-of-life materials; WeylChem InnoTec (Germany), a contract development and custom synthesis company that will develop new building blocks for PUR; Ecoinnovazione (Italy), a research and consultancy firm in the field of lifecycle sustainability assessment; Ghent University (Belgium), which is described as being "at the heart of the breakthrough in the development of new molecules for recyclable materials that must be adapted to polyurethane chemistries"; KU Leuven (Belgium), which has a long history in catalysis expertise; Universidad De Castilla – La Mancha (Spain), which already has experience in recycling thermoset PU and has capabilities in scaling up chemical processes; and Ayming (France) which will provide project management support.

The partners say PUReSmart will "develop Covalently Adaptable Polyurethanes (CAPUs) based on fast reversible chemical bonds that enable the creation of cross-linked polymer networks reversible under certain conditions. Three different routes are under exploration. The choice of best candidates will be determined by their technical and economic feasibility. It will take time before these new PURs are industrially exploited and it will still need a full lifetime of these new products before full recycling takes place. Therefore, PUReSmart also aims at treating current PU materials. As a first step, the partners work on the sorting of EOL PUR-based materials in order to recover the raw materials (or their precursors) that have been used to produce these products. Detection methods will be developed in order to characterise and distinguish different PU foams. Once this is possible, sorting methodologies will be put in place in order to collect the different families in the purest form possible."

These sorted PUR families are then chemically broken down. The final aim of the PUReSmart project is to recover the raw materials from existing PUR products on the market, and to use these raw materials to make a new generation of recyclable thermoset polyurethanes.

An interim report from the project partners late last year said the first CAPU elastomers have been obtained at Gent University and are being further evaluated, while work on the development of innovative sorting methods "moves ahead of schedule. Under the leadership of Redwave supported by Covestro and Recticel, detection methods were found to distinguish different PU foam families [which] were reorganised to enable an economical feasible but high quality chemolysis process."

IMAGE: AIMPLAS

Right: Appliance insulation is another source of PUR foam waste

The chemical breakdown of current polyurethanes is mainly investigated by KU Leuven, Covestro, Recticel and the University of Castilla-La Mancha. Covestro has been investigating the feasibility of a scale-up from laboratory scale to semi-industrial level to enable the handling of larger quantities of foams and to finally generate recycled polyol and recycled amine fractions. This will ultimately enable foaming trials with the recycled products.

The project has already led to two patent applications being submitted, one by Covestro and one by Recticel, related to the smart chemolysis process.

The partners note that the recuperation of polyol fractions "suffers from a non-sustainable use of raw materials (i.e. too much solvent has to be used and the recycled products can only be re-used at low percentages together with the virgin polyol stream in non-flexible foam applications). The PUReSmart project is working on a process with complete recovery of not only the polyol, but also of the isocyanate precursors (amines), which will hopefully lead to the first recycled isocyanate in the world."

Foam-to-foam

Since 2018, independent Spanish plastics research organisation **Aimplas** has been participating in the Foam2Foam project, the objective of which is also to obtain raw materials from polyurethane waste via chemical recycling (catalytic glycolysis in this case). This Spanish government-funded project involves three companies (Titan Recycling, Arcesso Dynamics and AMB Electrónica de Brescia) and two technology centres (Gaiker and Aimplas). It was launched in July 2018 and is due to end in July 2021.

Three waste streams are being looked at: post-consumer PUR insulating foam from refrigerators, flexible foam from old mattresses, and

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Right: Rampf Eco Solutions boasts expertise in the formulation of PUR systems for products such as mattresses based on its own polyols

post-industrial production scrap.

Nora Lardiés-Miazza works in the Chemical Recycling Group of Aimplas. She says: "In the Foam2Foam project, the goal is to examine the viability of glycolysis for pre-consume polyurethane foams, which consists of chemical depolymerization by breaking the polymer chains with chemical agents (including a solvent, generally in the presence of a catalyst) under specific, controlled reaction conditions.

"Since, currently, the chemical recycling of polyurethane is not a widespread practice and is not economically viable, especially in plants with a treatment capacity of more than 8,000 tonnes a year, in the Foam2Foam project modular plants are being built with a capacity of 2,000 tonnes a year and link several modules together. In the case of post-consumer flexible PU foams, the main challenges to make high value products through suitable chemical recycling ways is the unknown and inhomogeneous compositions of foams. The analysis and clear separation before the solvolysis process are imperative and previous treatment of the post-consumer flexible foam material (collection, disassembly, grinding, cleaning, etc.) have a great influence in waste foam processing. Based on this, different large companies, SMEs, local authorities of different regions and research institutes developed a closed loop concept for post-consumer scrap flexible foam polyurethanes within the UrbanRec project framework."

The EU-sponsored **UrbanRec** project, which ended in late 2019, looked at prevention, collection, sorting, separation, crushing of bulky waste,

IMAGE: RAMPF

Above: Chemical recycling plant for polyols developed by Rampf. In two of the largest multi-functional plants in Europe, tailored polyols are manufactured from PU waste materials or PET/PSA using solvolysis (glycolysis, acidolysis, and polyolysis). After being recycled through either Rampf Eco Solutions or another PU systems house, the resulting basic polyols are integrated back into the customer's production process

IMAGE: RAMPF

and special treatments for materials or products flows obtained. Project partners from seven EU countries represented the complete bulky waste value chain.

Aimplas says construction of the solvolysis pilot plant at Gaiker's facilities should be finished before the end of June. "If the results are favourable, they will be put into industrial use as soon as possible," says a representative. The glycolysis technology and equipment were developed by Gaiker itself.

One of the members of the UrbanRec project was **Rampf Eco Solutions** in Permasens, Germany. It has developed chemical processes for obtaining high-value recycled polyols from plastic waste such as mattresses and upholstery.

Frank Dürsen, Head of Future & Sustainability at the Rampf Group, says recycled polyols obtained from bulky waste using glycolysis and acidolysis have already been successfully used for the manufacture of high-quality adhesives, foams, insulation materials, and solvents.

RAMPF Eco Solutions is expert in developing chemical solutions for the manufacture of high-quality alternative polyols. It already has two large facilities where it makes polyols from PUR residues. It says the basic polyols are integrated back into the production process of customers.

The company has also developed a chemical process for making what it calls "alternative polyols" from various polyesters (including PLA and PHB) and various other bio-based raw materials.

Rampf has an installation for the chemical recycling of flexible PUR foam in Pirmasens, which has been in operation since 2012. Further back, in 1998, it built a small plant for a customer in automotive, which recycled PU soft foam. Rampf is now active in selling the technology and the necessary chemical expertise. Together with German plant construction company Keil Anlagenbau, it also designs and builds customised plants for the conversion of nearly every kind of PUR and PET

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Right: PU foam is a focus of Dow's Renuva circular economy program

IMAGE: DOW

waste material into high-quality polyols. "We have already sold three plants for customers throughout the world, who manufacture polyols from production or post-consumer waste," says a representative.

"The market used to be very volatile. In consequence, the use of recycled products was generally dependent largely on factors such as the price of oil. In the meantime, we are seeing a fundamental rethinking here – on the one hand due to regulatory requirements and social developments, on the other because the quality of the products has improved significantly. Thermosetting polyurethanes were once considered unrecyclable. With our technology, this disadvantage is no longer hindering recycling processes."

Recycled polyols

Some projects to establish chemical recycling as a commercially viable proposition are being driven by the polyurethane raw material producers themselves. For example, last year, **Dow Polyurethanes** unveiled its sustainability strategy, which the company says places an important emphasis on its belief that polyurethanes should continue being a material of choice in various applications in the future.

In Europe and countries in the EMEAI region, Dow is advancing the Renuva "circular economy" program, with the aim of chemical recycling end-of-life PU products in collaboration with partners along the value chain. Dow unveiled the Renuva program at the end of May last year. With its flagship mattress recycling program, Dow says it will help create markets for the resulting material and also demonstrate the possibility of closing the use-recycle-reuse loop.

France has been a key area so far for advancing this project. This involves the recovery of PUR from used mattresses, the chemical recycling of the material (using a combination of glycolysis and acidolysis), and supply to an industrial-scale production plant (now in the final stages of construction) for the production of new polyols for use in flexible or rigid foams. Dow expects to enter production of chemically recycled polyols later this year.

Dow's partners in the project are Eco-mobilier, Orrion Chemicals, and Vita Group. Eco-mobilier, a French mattress and furniture EPR organisation, will recover the PUR foam (Eco-mobilier has been collecting used mattresses since 2013 and by 2019, the volumes collected already reached 66,000 tonnes); Orrion Chemicals Orgaform is responsible for installation and operation of the plant to recycle material into new polyols, in Semoy, France. The reactor unit and process know-how come from process and turnkey installations provider H&S Anlagentechnik.

Vita Group, a leading flexible polyurethane foam solutions provider in Europe, will use the polyols from the project in production of new foams at its ICOA site in Crancey, France. New capital equipment is currently being installed and commissioned and it is expected production will start towards the end of the first half of this year.

Vita says it has for several years used an innovative technology that pulverises foam by-products and incorporates this as a raw material for specific PUR foams at sites in Germany and Lithuania. A representative says the group also collects and regenerates all trim across its European footprint to manufacture 100% new products in various forms. The ability to use the Renuva polyol is the next step in this evolution.

"We use a number of different polyols to produce foams with a wide range of properties and comfort characteristics. The chemistry of Renuva differs from existing polyols, therefore Vita is performing precise tests on its formulations and manufacturing process to ensure it can produce foams of high quality, along with the required physical properties of density and hardness. Initial customer interest has been from the bedding market, but due to the potential for our customers to increase their position in the circular economy we are receiving enquiries from several technical and industrial customers," says the Vita representative.

Vita's MD for Comfort, Gilbert Davids, says: "We are already seeing strong interest from customers across Europe for the Renuva technology and in response to this demand we are looking to have this capability expanded across some other selected sites."

Further applications for Renuva polyols will be explored, says Dow. It sees potential applications in products such as building insulation, while polyols in

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Right: H&S has developed its own technology and reactor installations for the chemical conversion of flexible and rigid PU foam residues into new polyols

flexible foams could end up back in new mattresses.

"We are convinced that polyurethanes have an important role to play in a circular economy and reducing our impact on the environment," says Marcel Moeller, Global Marketing & Sustainability Director, Dow Polyurethanes. He says around 30m mattresses are thrown away in Europe every year.

"We are addressing the challenge of discarded mattresses head on," says Neil Carr, president of Dow Europe, Middle East, Africa, and India. "We have been actively reviewing centrally organised waste collection, dismantling, and recycling systems for end-of-life material for years. France has set an example by creating the EPR scheme and Eco-mobilier is leading the way in mattress and furniture waste collection."

Mechanical limitations

The new development builds on Dow's existing collaboration with **H&S Anlagentechnik**, announced in 2017. H&S has developed its own technology and reactor installations for the chemical conversion of flexible and rigid PU foam residues (from production and also post-consumer) into new polyols. "In comparison to previous recycling methods, polyols generated by H&S technology have good reactivity and do not contain primary aromatic amines (methylene and toluene diamine), which are hazardous and not acceptable especially in bedding and upholstery foams," H&S says.

"Polyurethane foam manufacturers of both rigid and flexible types are showing a lot of interest in [chemical] recycling technology. For flexible foam, this is because the methods previously used, such as rebound foam for carpet underlay and sports mats, are no longer economically attractive. Applications for mechanically recycled rigid foam, as powder, are limited. Also, since an enormous volume of rigid scrap is generated by processors such as big insulating panels manufacturers,

IMAGE: H&S

recycling small amounts ground up as a powder filler cannot use it all. Of course the growing price of polyols also plays a role here."

H&S has already successfully realised several projects in this area, including one of the first industrial reactor systems working with post-production flexible PU foam residues for Ikano in Poland (put into operation in 2013 with a capacity of 2,400 tonnes per year), and a system converting semi-rigid automotive PU foam into polyol in China – this plant, which began production in 2015, was supplied to a large automotive supplier producing headliners, luggage compartment and other components.

The company has also delivered various reactors for aromatic and aliphatic polyester polyols synthesis based on PET and other raw materials around the world. Another "significant" post-consumer PU foam recycling project is in the pipeline, said Mila Skokova, Product & Sales Manager, in late January. More details on this project are set to be announced later this year.

Capacity of H&S reactor systems is individually designed depending on the customer's needs. Capacity of recycling systems is up to 3,000 tonnes per year. For polyester polyol systems it is up to 15,000 tonnes per year.

Skokova says: "The process is distinguished by a high yield up to 96%. From one tonne of PUR foam, approximately 2.2 tonnes of recovered polyol can be generated. We are using basic polyol or glycol (depending on the technology) to dissolve the PUR. In general, recovered polyols produced by H&S technology can substitute up to 30-40% of original polyols without compromising the quality of the final product, depending on the application. Manufacturing cost of recovered polyols is significantly lower than the market price of the original polyols and makes realisation of such projects very attractive commercial-wise."

Below: BASF has conducted pilot tests for a chemical recycling process for used mattresses

IMAGE: BASF

IKEA searches for PU foam solutions

Furniture giant IKEA, a major user of PU foam in mattresses and other products, is on the path to switching to renewable and recycled materials. By 2030, the global group wants to be "climate positive" and to "regenerate resources", said Caroline McGarvey, Sustainability Manager at Ikea, Range and Supply, at AMI's Polymer Foam virtual summit in January.

The group's Sustainability Report for 2020 said it was in the final stages of testing recycled polyols in collaboration with recycling company RetourMatras in Netherlands. This has the potential to remove 3m mattresses per year from incineration or landfill.

IKEA products used 155,000 tonnes of foam in 2019; sales of mattresses were about 15m and sales of sofas more than 17m. Foam makes up 52% of materials used in comfort applications.

IKEA has three main objectives in its foam agenda: to reduce and replace traditional foam; to increase the use of renewable and recycled raw materials; and to improve disassembly after-life for post-consumer recycling.

IMAGE: IKEA

"Is foam really a comfort material for IKEA?" asked McGarvey. Since 2015, the group has been looking at whether it should continue using foam or instead focus work on alternative comfort materials. "We still have this as an open question and here is where we need the industry and our partners to come in and help us in this journey."

Polyols derived from soy have been used by IKEA to partly replace oil-derived polyols for five years. McGarvey said castor is in the early stage of trials as another bio-feedstock. Despite progress, it still faces challenges on the road to meeting its 2030 goals. In foams, she said: "We miss a solution on isocyanates and we miss partnerships that enable us to explore and implement solutions globally."

BASF has also developed a chemical recycling process for used mattresses. Last year, it said it was starting pilot tests at its Schwarzheide site in eastern Germany. Once again, the aim is to create raw materials for use in the production of new mattresses.

"The target is to recover the raw materials with a quality comparable to that of non-recycled/virgin raw materials", says Shankara Keelapandal, Business Management Isocyanates Europe.

Last June, BASF said first volumes of the recycled material would be delivered to project partners later in the year to develop pilot projects together. "The project is technically complex, but the potential to reduce waste volumes and save resources makes it all worth it," said Keelapandal at the time.

"Our target is to recover the raw materials with a quality comparable to that of non-recycled/virgin raw materials and the highest recyclability," says a company representative. "The project is progressing very well including the pilot trials at Schwarzheide." No more details are available at present.

Most mattresses today last no more than 10 years on average, BASF says, "thus squandering resources and creating high quantities of waste. At the same time, valuable raw materials are needed to manufacture new soft foam mattresses – above all crude oil. A circular economy solution for mattresses can therefore both reduce waste and save fossil resources."

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Perfecting your pellets

IMAGE: SHUTTERSTOCK

*Speed, efficiency, and the flexibility to handle a broad range of compound formulations that include high filler loadings and recycled content are prime requirements for a modern pelletiser, writes **Mark Holmes***

The needs of the compounding industry are changing and manufacturers of pelletising systems are responding to that, adapting product offerings to satisfy key user demands such as the need to more effectively handle recycled and difficult-to-pelletise polymers. The latest equipment innovations also target the need for greater flexibility, faster change-overs and higher levels of automation.

Interest in recycled product is identified as a key global trend by **Maag Group**, which brings together the Gala, Reduction Engineering, Sheer and Automatik brands. Society is becoming more environmentally-aware and the company reports that, after a strong three-year period for pelletising systems for virgin polymers, it now sees a growing requirement for recycling equipment. It also identifies an increasing market focus on pelletising solutions for special engineering thermoplastics and high-performance polymers.

Maag says compounders are also looking for increased flexibility and more automation. "Nobody wants to limit their production possibilities tomorrow with the equipment they purchase today, because we do not know what the market will be like in one or two-years' time," says Product Manager Alexander Helm.

"On the other hand, we are also aiming to be more efficient at the same time. This trend highlights the need for fully automated pelletising systems, which are unaffected by upstream process errors, require only a low level of manual maintenance work and therefore reduce downtime to a minimum," he says.

Helm says that the principle of plastics pelletising has not changed greatly over the years and equipment has improved largely through a process of continuous improvement. "Nevertheless, we still need new ideas completely detached from existing principles to solve problem applications, such as pelletising of extremely soft or low viscosity polymers and high temperature polymers without defects," he says. ›

Main image: More challenging formulations and shorter product runs make pelletiser selection an increasingly important consideration

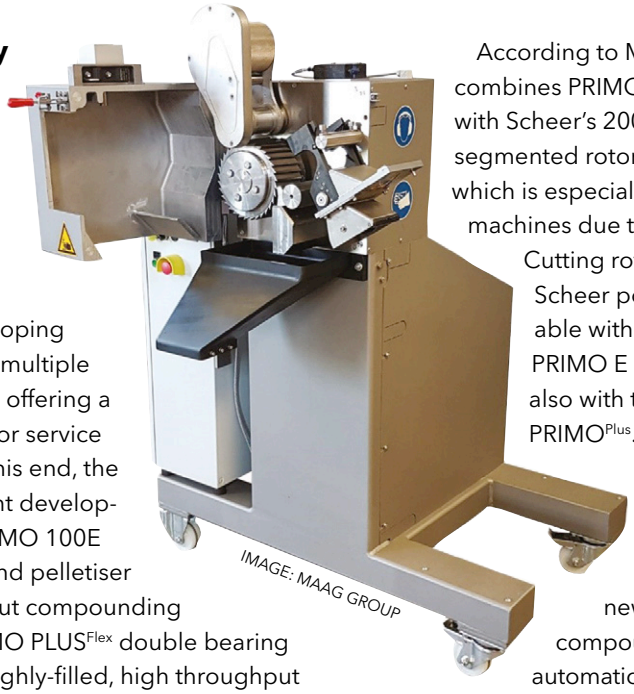

IMAGE: MAAG GROUP

Right: The PRIMO 100E is a single sided dry-cut strand pelletiser for low volume throughputs

Flexible efficiency

Due to rapidly changing market requirements, Helm says that customers need both more flexibility and improved efficiency. He says that means developing machines suitable for multiple applications while still offering a reasonable package for service and lifetime cost. To this end, the company's most recent developments include the PRIMO 100E cantilever-design strand pelletiser for medium throughput compounding applications and PRIMO PLUS^{Flex} double bearing strand pelletiser for highly-filled, high throughput compounding applications.

Maag says the PRIMO 100E completes its single-sided strand pelletiser portfolio and provides the ability to efficiently process even highly-filled products in the lower throughput ranges. The new model is particularly suitable for compounding thermoplastics, for functional or additive masterbatch production, and for production of colour concentrates up to 1,000 kg per hour.

In common with the larger PRIMO 200E, the 100E features a cutting geometry with a flat entry angle and short unguided length between the feed rollers and cutting unit. This allows a straight path to the carbide cutting tools and guarantees high cut quality for hard, brittle and very soft strands. A highly wear-resistant metal feed roller is available on the PRIMO 100E in place of the usual elastomer feed roller, and granule length can be easily changed during operation by means of a second optional dual drive.

According to Maag, the PRIMO PLUS^{Flex} combines PRIMO^{Plus} machine technology with Scheer's 200mm cutting rotors. The segmented rotor geometry is maintained, which is especially beneficial for larger machines due to its modular structure.

Cutting rotor segments from the Scheer portfolio are interchangeable with cutting tools of the PRIMO E series machines and now also with the Flex version of the PRIMO^{Plus}.

Pelletising projects

Maag has recently delivered a number of new pelletising systems to compounding customers. Three automatic JSG (Jet Stream Granulation) systems have been delivered to DSM's high performance materials compounding operation at Evansville, Indiana, in the US. The systems provide an overall throughput of 18 tonnes/hr. Two lines comprising standard water bath and JSG pelletisers have been supplied to Germany's Akro Plastic. The company has also supplied 26 standard pelletising lines and two automatic JSG systems with a combined throughput of 25 tonnes/hr to Poly Plastic Masterbatch, which is based at Suzhou in China.

Helm says future strand pelletising developments at Maag will involve machine condition and wear monitoring depending on vibration, improved connectivity and machine intelligence, as well as alternative pelletising solutions.

Underwater pelletiser developments within the Maag Group are also focused on improved product flexibility, easy changeovers and a higher degree of automation and efficiency. "Good looking product within the customer's specification is an absolute expectation, which is what end-users are looking to get from these machines to differentiate themselves from other suppliers," says Michael Eloo, Managing Director at Maag's Gala Kunststoff- und Kautschukmaschinen division.

"From our point of view, pelletising is the heart of the machine - this is the step where the product finally becomes a visible form of the plastic," he says. "At this point, the pellets need to meet all of the required specifications. Overall, there is a need for a holistic approach to downstream equipment following the extruder, compounder, reactor or mixer. This addresses issues of cleanability, accessibility and the ability to exchange tools in operation. However, such flexibility cannot affect the efficiency of the machine."

IMAGE: MAAG GROUP

Maag's PRIMO PLUS^{FLEX} combines Primo machine technology with Scheer's 200mm rotors

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Maag's PEARLO underwater pelletiser has been specifically designed to process spherical pellets efficiently at high capacities. The machine is suitable for use with virgin materials, compounds, masterbatches, engineering plastics, wood and natural fibre-filled polymer composites, and thermoplastics elastomers, as well as for recycling applications, and can reach production rates of up to 36,000 kg/hr. Since its introduction, more than 150 machines have been supplied to the plastics industry.

According to the company, the integration of moveable and flexible components of the PEARLO on a single frame helps ensure increased uptime, efficiency and low waste generation. Plastic melt is transferred to the die plate via the hydraulic start-up valve and from there extruded through the ring-shaped die into the cutting chamber, which is flooded with process water. Cut pellets are carried to the dryer in the process water, where they are separated. The pellets go onto packaging while the process water is filtered, tempered and returned to the cutting chamber.

IMAGE: COPERION

Above: The latest generation of strand pelletisers from Coperion Pelletizing Technology include no-tool cutting gap adjustment

Maag says the PEARLO's narrow face-width die plate designs and the use of wear resistant surface materials, along with a turbine-style flexible cutter hub and standard single-sided long blade, allows one cutter hub to be used for multiple jobs. This results in a cost advantage of up to a factor of eight. Heat losses have also been reduced by 25%.

The PEARLO is available in top-mounted and rail-type configurations with automated and manual blade-advance capabilities and can be easily upgraded at any time. The fully automated EAC version provides precise blade advance during operation and is suitable for continuous, as well as batch, operation.

Automation demand

Pelletising systems for recycling applications are also identified as an area of increased interest by **Coperion Pelletizing Technology**, which reports growing demand across the entire market for increased automation, improved cleaning and shorter shutdown times. "Pelletisers are also now required to handle a wide range of different recipes, such as hard, soft, abrasive and coloured compounds," says Raphael Strehle, Head of Sales at the company. "Improvements for easier cleaning, for example smooth surfaces, have been necessary, as well as rapid maintenance through quick couplings and centric pins, to minimise downtime that results in higher profitability of the complete production system. Other important issues at present include easy handling, improved cutting performance, high efficiency and noise reduction."

To meet these needs, Coperion has improved its SP series dual bearing strand pelletisers. The SP140, SP240 and SP340 models have been equipped with a variety of enhanced features to provide rapid handling and optimised pellet quality. The company says it has also developed a new cutting gap adjustment technology.

The re-engineered strand pelletisers feature a more compact design with an integrated operation panel and redesigned interior space arrangement. The cutting tools have been installed closer to one another, enabling a shorter unguided strand length that is said to ensure optimal cutting results, particularly with soft materials. This new construction results in reduced dead space in the interior which, together fewer free surfaces, is said to improve cleanability. The new quick-change cutting chamber system is also accessible without tools and the cutting unit can be exchanged quickly and easily to minimise machine servicing times and downtime.

The company has also reworked the intake area. The previous conical construction is now replaced with a straight intake to allow strands to be optimally side-fed into the pelletiser. This eliminates deflection while side panels on the intake roller prevent individual strands from breaking free. The operating width has also been increased by 20 mm to support higher throughputs. Noise levels have been reduced as a result of the more compact interior cutting space and smaller sound chamber and location of the motors under base plate.

Recycling interest

While the Covid-19 pandemic has resulted in projects being postponed or frequently rescheduled, the overall market for pelletising systems is stable, reports **Nordson Corporation**, which like other key suppliers sees strong interest from the recycling sector worldwide. "In particular, there is a boom in PET recycling and huge investments in China for SAN/ABS," says Frank Asmuss, Business Development Manager Pelletising at the company.

"In general, the trend of moving from strand pelletising to underwater pelletising (UWP) continues steadily," he says. "In addition, water-ring pelletisers are a good, easy-to-handle alternative to strand pelletisers, especially for commodities like polyolefin and styrenic compounds. The market for recycled materials is also continuously growing,

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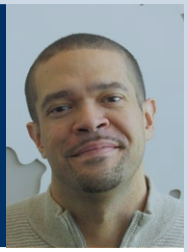

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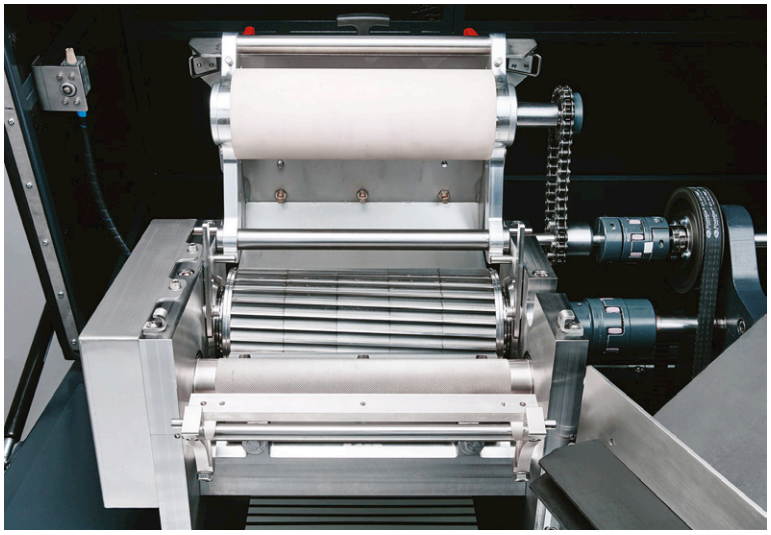


Above: Coperion Pelletizing Technology's SP cutting chamber features an optimised cutting tool arrangement to improve cut quality and cleaning

and there is strong demand for increasing recycling rates. New potential growth areas are the production of micro-pellets for use in 3D printing and a recent increase of biodegradable materials."

Higher levels of contamination in feedstocks from recycled materials brings new challenges in terms of melt filtration. "A fine filtration with minimum material losses is key to meeting these challenges," says Asmuss. "In addition, energy consumption is increasingly being considered by companies investing in pelletising systems. Besides new features for all types of pelletisers which improve process stability, handling, energy efficiency and productivity, the 'core' of each equipment system is still the most important detail to take into consideration; by that I mean the die plate design for pelletisers, and the filter medium for melt filters."

Nordson has developed a range of BKG systems for pelletising, including a complete system for producing virgin-like rPET from PET bottle flake. "Regulatory and market mandates call for a dramatic increase in use of rPET in the major markets - fibres, bottles and films. Our product line for rPET combines the next generation of BlueFlow gear pumps, HiCon V-Type 3G+ screen changers and BKG underwater pelletising systems. Included are the new FlexDisc filters for finer filtration at lower material losses and the CrystallCut system for energy-saving inline crystallisation. Of course, using the latest developments in die plates offers the longest lifetimes for changing raw material qualities," he says.

Strand alternative

Asmuss adds that, while water-ring pelletisers (WRP) are not appropriate for lower-viscosity materials such as PET, they provide advantages over strand pelletisers in processing a wide range of polyolefin and styrenic materials. The company's latest generation WRP – the BKG WRP 1000 –includes a number of improvements adapted from its well established BKG underwater pelletisers.

"The compounding and recycling industries are moving away from strand pelletising because it is labour intensive, has a substantial footprint, generates dust, tends to yield pellet inconsistencies, and provides little scope for automation," says Asmuss. "The BKG WRP 1000 water-ring pelletiser eliminates these problems for a capital investment that is mid-range between that of a strand pelletiser and our more high-performance underwater systems."

Nordson says that, compared to equivalent strand pelletisers, the new WRP design is more compact, generates less dust, is more capable of automation, and yields pellets of more uniform shape and size. Obviously, strand breakage is eliminated.

Key features of the WRP 1000 include a split-design die plate with separate heating flange and easily exchangeable insert, which is said to make for rapid colour changes and easy cleaning. The die plate is heated with electrical heating cartridges and is designed for uniform polymer flow in the die plate holes. The centrifugal drying system is adapted from the established pellet dryer design used for BKG UWPs. The company says it provides low moisture levels in the pellets, noise levels of below 85 dB, and easy maintenance access doors.

The WRP 1000 provides a maximum throughput of 1,000 kg/hr and can operate at pressures up to 210 bar and temperatures of 320°C. It can be used to process a wide range of olefin and styrenic polymers and copolymers with densities up to 1.5 g/cm^3, including moderately filled formulations. Die plates are tailored to the specific material to be processed and the machine is available in a pre-wired version without control for system-integrators, or as a stand-alone PLC-based system for independent operation or upgrading of existing lines.

Right: Nordson says water ring pelletisers such as its BKG WRP 1000 offer advantages over strand alternatives

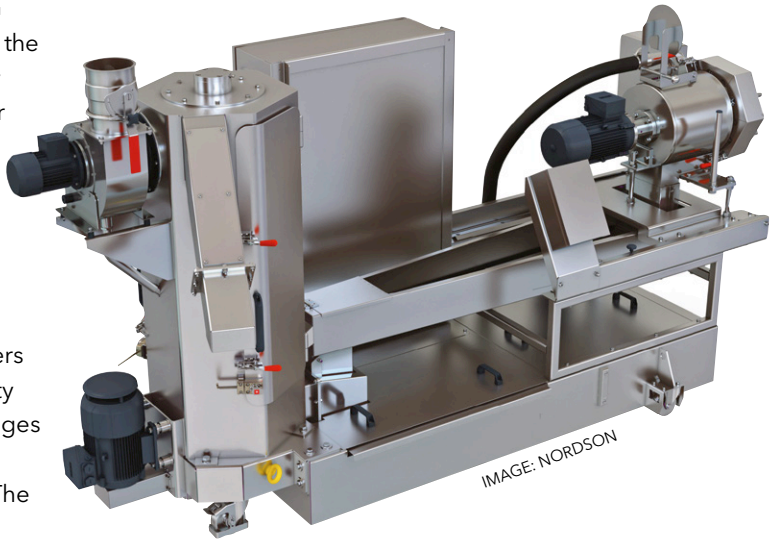
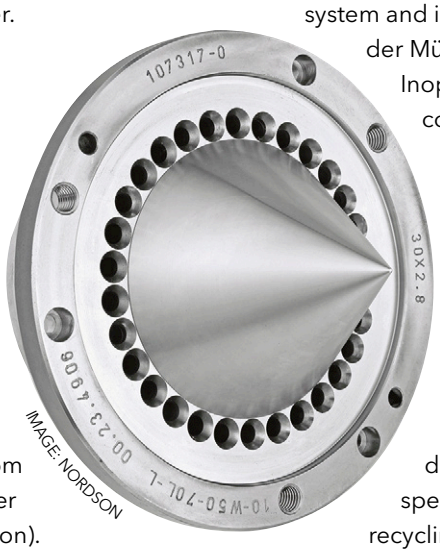


IMAGE: NORDSON

Nordson has recently built a dedicated production line for die plates used in its BKG underwater pelletising equipment at its plant at Münster in Germany. Die plates are wear components which must be periodically refurbished or replaced. While the most common die plates are held in stock and can typically be delivered within a couple of days, delivery times for less common plates can be significantly longer.

Cutting lead times

The combination of the new dedicated production with a database of standard design elements has allowed the company to eliminate certain upstream engineering processes that had contributed to longer lead times. As a result, it can now deliver many of its electrically-heated die plates in just three weeks from order placement (including order entry, engineering and production).



Left: Nordson has invested in a dedicated production capability for electrically heated die plates

"The dedicated production line for die plates enables Nordson to meet the needs of customers much more quickly, helping then to reduce downtime and maintain product quality," says Andreas Trouvain, Sales Director EMEA for Nordson's BKG product line.

At present the capability is limited to two-piece, electrically-heated die plates for BKG A, AH, Compact, and AHD190 families, which it says comprise the largest share of its die plate output. These are available with the most common nozzle bore diameters and with optional features such as different carbide inlays, thermal insulation layers, pressure reduction, nozzle bore configurations, and both standard and short land lengths.

"We continue to expand the range of designs that can be produced in this line, and we are looking for more ways to shorten the processes upstream and downstream of die plate production in order to make lead times even shorter," Trouvain says. Nordson continues to offer fully custom designs where required for specific customer applications.

Success with recycling companies is a highlight for Germany-based **ips Intelligent Pelletizing Solutions**. Recycler Inoplast Kunststoff has put an automated ips-SGU 120/2 underwater strand pelletiser from ips into operation at its Windischeschenbach facility in Germany. It is used to produce high-quality recycled materials from PET and PA waste.

Inoplast's main focus is contract recycling of production waste, returning customers' plastic scrap as high-quality recycled material. It replaced its previous strand pelletiser with the automated underwater strand pelletisng system in order to increase output and reduce waste.

The ips-SGU 120/2 system at Inoplast is integrated with the ips-PWS 200 A process water system and ips-GT 1200 pellet dryer. Alexander Müller, Managing Director at Inoplast, says: "We were more than convinced by the fact that the plant is more in line with our requirements, the outstanding expertise of the ips team in the recycling branch and the 'Made in Germany' quality."

Gerald Weis, owner and Managing Partner of ips, says: "The ips underwater strand pelletising system has been designed particularly for the special requirements of PET and PA recycling." The system features a strand feed with rounded start-up head and flexibly adjustable extrusion heights as well as a hinged spray nozzle unit for simple and fast access to the cutting head.

The cutting gap consistency is achieved through simple adjustment options with the cutting head. All plant parts, such as the process water system with band filter unit and pellet dryer, are mounted on a joint machine frame. Ips says the system achieves a throughput of up to 1,500 kg per hour of granulate.

"Thanks to the modular product system, we can respond to the individual wishes of our customers and tailor the system exactly to their needs," says Weis.

The company is able to offer complete pelletising systems, consisting of a strand feed, the process water distribution system, the actual underwater strand pelletiser, post-cooling section with agglomerate catcher and water jet pump, pellet dryer, process water system and complete control. With the ergonomic ips operating system, the complete plant is controlled by means of a graphic touch screen user interface. Automatic start-up and shutdown can be done at the touch of a button.

Ips has developed a new product, the ips-DR/K option for its underwater pelletising systems for the inline crystallisation of recycled PET material. The ips-DR/K rotary drum, with its compact, horizontal design and dedicated process guid-


IMAGE: IPS

Right: Wolfgang Strigl (left), Plant Manager, and Alexander Müller, Managing Director at Inoplast Kunststoff, standing next to the company's new ips-SGU 120/2 under-water strand pelletiser

ance, is suitable for continual production. Continuous movement of the drum – without an external power supply – prevents the amorphous PET pellets clumping and sticking together during the crystallisation process. Throughputs of up to 2,500 kg/h can be achieved in continuous operation.

In processing, the amorphous PET pellets move from the ips-GT pellet dryer into the rotary drum with the pellet temperature above the necessary crystallisation start temperature. Use of the PET pellets' own thermal energy makes them crystallise, so external energy from infrared heaters, for example, is not necessary.

Thanks to the special layout of the conveyor elements, the PET pellets are transported gently and separated at the same time. The optimum speed range prevents breakage, abrasion and damage to the product.

The company says control of the rotary drum is done via the control panel of the ips-UWG S or a local control panel directly at the rotary drum. The rotary drum is driven by a 3-phase AC motor which has a continuously variable speed. The simple and sturdy structure offers very good access to the conveyor elements on the inside, so that the rotary drum can be cleaned and serviced quickly and easily, says the company.

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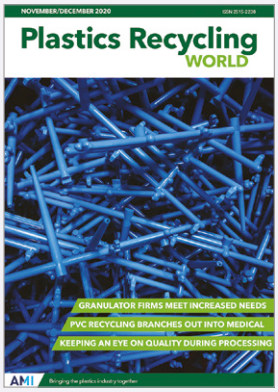

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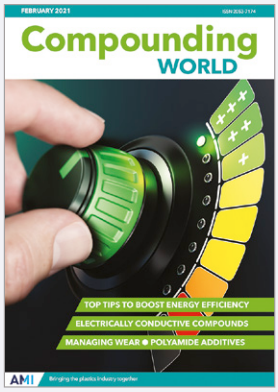

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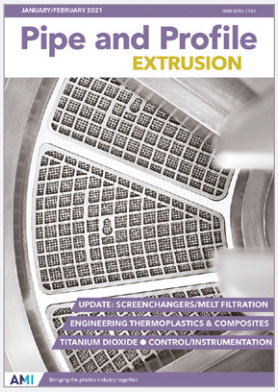

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