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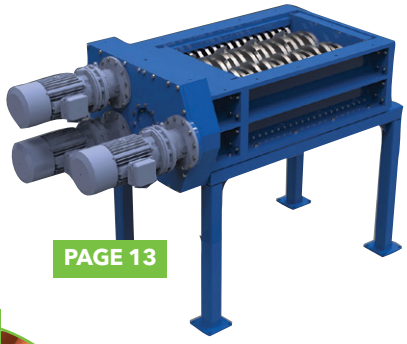

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Borealis and Reclay team up in packaging recycling

Recelerate, a venture focused on sorting and recycling of post-consumer packaging, has been set up by polyolefins producer and recycler Borealis and waste management services provider Reclay Group.

The groups announced: "The new organisation's mission is to redesign the critical steps of the plastics sorting and recycling system for lightweight packaging (LWP) to speed up circularity, born from a need to meet the rising market demand for high-quality recyclates for use in high-end plastic applications."

The new entity will follow "a smart systems-thinking approach", they said, which aims to increase the amount and quality of LWP recycled into high-quality materials. Recelerate will play a critical connector role in the plastics value chain, bringing downstream and upstream expertise to gether to rethink how LWP waste is managed, sorted, processed, and recycled. It combines Reclay's strength in the area of extended producer responsibility schemes (EPR) and Borealis' focus on growth of a more circular plastic model, based in part on its proprietary Borcycle recycling technology.

IMAGE: BOREALIS

Left to right: Christian Abl, Dr. Fritz Flanderka (Reclay), Lucrèce Foufopoulos (Borealis), Raffael A. Fruscio (Reclay), Chris McArdle (Borealis)

The partners said: "This combination will enable a macro view approach to identify opportunities to add value and invest where it matters, to ensure more and more plastic waste from LWP is able to stay within the value chain."

"In line with our integrated approach toward more circular plastics, Recelerate will enable significant progress in waste feedstock optimisation," said Lucrèce Foufopoulos, Borealis Executive VP Polyolefins, Innovation & Technology and Circular Economy Solutions. "Together with our partners, we are committed to reinventing the plastics system for more sustainable living."

The partnership is first starting in Germany, one of the largest European recycling markets. The agreement provides Borealis with a supply of feedstock collected by Reclay's EPR scheme in Germany.

› **www.borealisgroup.com**
› **https://reclay-group.com**

Schwarz Production expands rPET capacity

IMAGE: SCHWARZ

Schwarz Production has held a ground-breaking ceremony for an expansion of its MEG Übach-Palenberg facility located in Heinsberg, North Rhine-Westphalia, Germany.

The company will add a new extrusion line, which will increase the annual PET recycling capacity of the plant by 12,000 tpa, more than 50%.

The expansion includes additional storage areas and silos as well as unloading and sorting capacities for the recycling process.

René Witter, Managing Director Plastics at Schwarz Production, said: "Our particularly light non-returnable PET bottles made from 100% recycled material are now an equally ecological alternative to other packaging. That's why we continue to invest in research and development and in the expansion of our infrastructure."

The company produces goods and packaging for Schwarz Group retailers including the Lidl and Kaufland supermarket chains.

› **https://schwarz-produktion.com**

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IN BRIEF...

In 2021, 810,775 tonnes of PVC waste was recycled within the European VinylPlus framework, according to new figures. VinylPlus' recycling rate is above the 23.1% recycling rate estimated by AMI Consulting for overall plastics recycling in Europe in 2021.
www.vinylplus.eu

Sorema says it has supplied a PET recycling line with capacity of 9,000 kg/h of rPET flakes to a customer in the Chinese province of Fujian. A second rPET line will also be operational in the coming months. Both lines will produce rPET flakes to manufacture polyester monofilaments used for textile and sportswear garments.
http://sorema.it

PET producer Equipolymers has signed a deal in Germany to use Rittec Umwelttechnik's RevolPET technology in the production of virgin material. The technology involves dissolving waste PET into its constituent monomers, for use as feedstock.
www.rittec.eu
www.equipolymers.com

KB Recycling Industries, an Israeli company conducting business as Alkemy, has agreed to acquire 100% of the shares of Plasticos Flome, a thermoformed packaging company based in Silla, Valencia, Spain.
www.alkemy.solutions
www.flome.es

Erema reports 17% increase in revenue

Erema announced its group revenue increased by 17% to €295m in its 2021/22 financial year and the number of employees increased to over 840. Combined capacity of plastics recycling extrusion systems the group sold in the year was approximately 1.34m tpa.

The trend among recyclers of post-consumer plastics is towards larger plants, both for PET recycling and for processing polyolefins. Erema said the first Vacurema Basic 2628 T machine with an annual capacity of up to 40,000 tonnes was recently commissioned at a customer's site in Brazil. This plant features a 10m-long special geometry screw with a diameter of 280 mm and a weight of 3.5 tonnes.

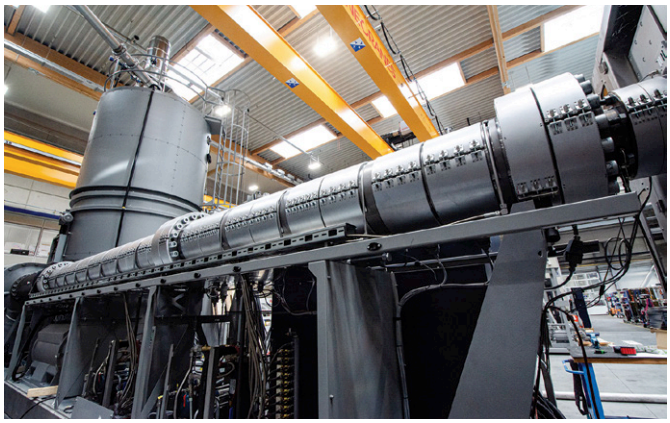

IMAGE: EREMA

Above: Erema's largest PET recycling line installed at a Brazilian customer's facility

The group said demand for previously-owned machines at its UMAC subsidiary also remained high during the past financial year. In addition to the general trend towards plastics recycling, customers are more frequently opting for previously-owned systems available at short notice due to the difficult situation in the supply chain for machine components.
› **www.erema.com**

Growth in European recycling capacity is highlighted by PRE

Plastics Recyclers Europe said new research shows the total installed plastics recycling capacity in 2020 in the EU27+3 grew by 1.1m tonnes compared to the previous year. The total capacity in 2020 was 9.6m tonnes.

PRE said: "The new figures show that the plastics recycling industry remains resilient, while continuing its path towards making plastics genuinely circular. The exceptional growth in the sector, despite the difficulties brought on by the pandemic, was possible thanks to the booming demand driven, among others, by the new legislative targets."

IMAGE: RPC

Rigid HDPE and PP registered the highest increase in recycling capacities, with a rate of over 20%, while for flexible PO it grew by 10%. Developments in collection, sorting and recycling helped the growth.
› **www.plasticsrecyclers.eu**

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US recyclers need more supply, says APR

The latest Post-consumer Plastic Recycling Data Report from the US Association of Plastic Recyclers (APR) shows 4,803.8m lb of plastics in the US was recovered for recycling in 2020. This was a 5.7% decline from 2019 due to pandemic disruptions in collection, transportation and the supply chain, plus staffing shortages.

Bottles, rigid plastics, and other plastics (excluding foam) categories all saw declines in the amount of material recovered for recycling in 2020. In aggregate, recycling of waste in these categories fell by 290m lbs in 2020 compared with 2019.

IMAGE: APR

Above: Steve Alexander, APR President and CEO

Steve Alexander, APR President and CEO, said: "We need more supply. Our industry faces significant challenges that require immediate solutions. We need to focus our efforts on technologies that are up and running today. Mechanical recyclers have the capacity to process more material but lack the supply to meet the current demand for post-consumer resin (PCR). Expanding and streamlining recycling collection programs, less confusion with labelling, and reducing contamination through design for recyclability should be key priorities."

Film waste collection increased by 8m lbs, just under 1%, in 2020. This reflected increases in PE mixed colour and PE agricultural films sub-categories.

› **https://plasticsrecycling.org**

IML tested in PP waste stream

RecyClass, the European industry organisation focused on recyclability criteria, has carried out an analysis to verify the compatibility of PP-based, printed in-mould label (IML) technologies with recycling of PP containers. It found that the labels are compatible with the coloured rigid PP recycling stream provided the total weight of the inks does not exceed 1% of the weight of the container.

The analysis also showed that IML have a low compatibility with the natural PP waste stream. RecyClass Design for Recycling Guidelines have been updated to reflect these findings.

In testing, recycled pellets of IML PP containers were reprocessed using injection moulding. The analysis demonstrated that while the IML itself does not strongly impact the quality of the recyclate, the printing ink does reduce quality.

› **https://recyclass.eu**

Huhtamaki opens plant in India

The Huhtamaki Foundation has inaugurated its first recycling plant in Khopoli, Maharashtra, India. The foundation has been set up, it said, "to work towards the conservation of the environment in India with a focus on driving sustainable packaging solutions and driving forward the circular economy by setting up recycling schemes".

The 2,000 m² plant has the capacity to recycle about 1,600 kg of post-consumer flexible plastics per day. It became fully operational on 2 May.

The recycling process includes advanced technology to enable the efficient sorting of post-consumer waste, hot washing to remove contamination, and extrusion with extra filtration and deodorisation. This ensures the recycled material can then be used for domestic appliances.

The plant was set up with an investment of INR 90m as part of the Huhtamaki Foundation's Close The Loop initiative.

› **www.huhtamaki.com**

Project helps processors optimise recycling

SKZ, the South German Plastics Centre, said it is involved in the PlastIQ project which aims to develop an AI-based system for plastics processors to forecast quantity, quality and availability of plastic waste they generate in order to achieve optimal recycling of this waste. The project is being carried out by the start-up WeSort.AI with the support of SKZ.

The simultaneous forecasting of quality, composition and availability of waste allows an automated comparison of different recycling options with regard to economic and ecological criteria, said SKZ. Subsequent matching with potential buyers simplifies and accelerates the process of further exploitation.

SKZ said companies will be able, in the future, to evaluate their plastic waste quickly and easily, to identify the best way to use and implement it.

› **www.skz.de**

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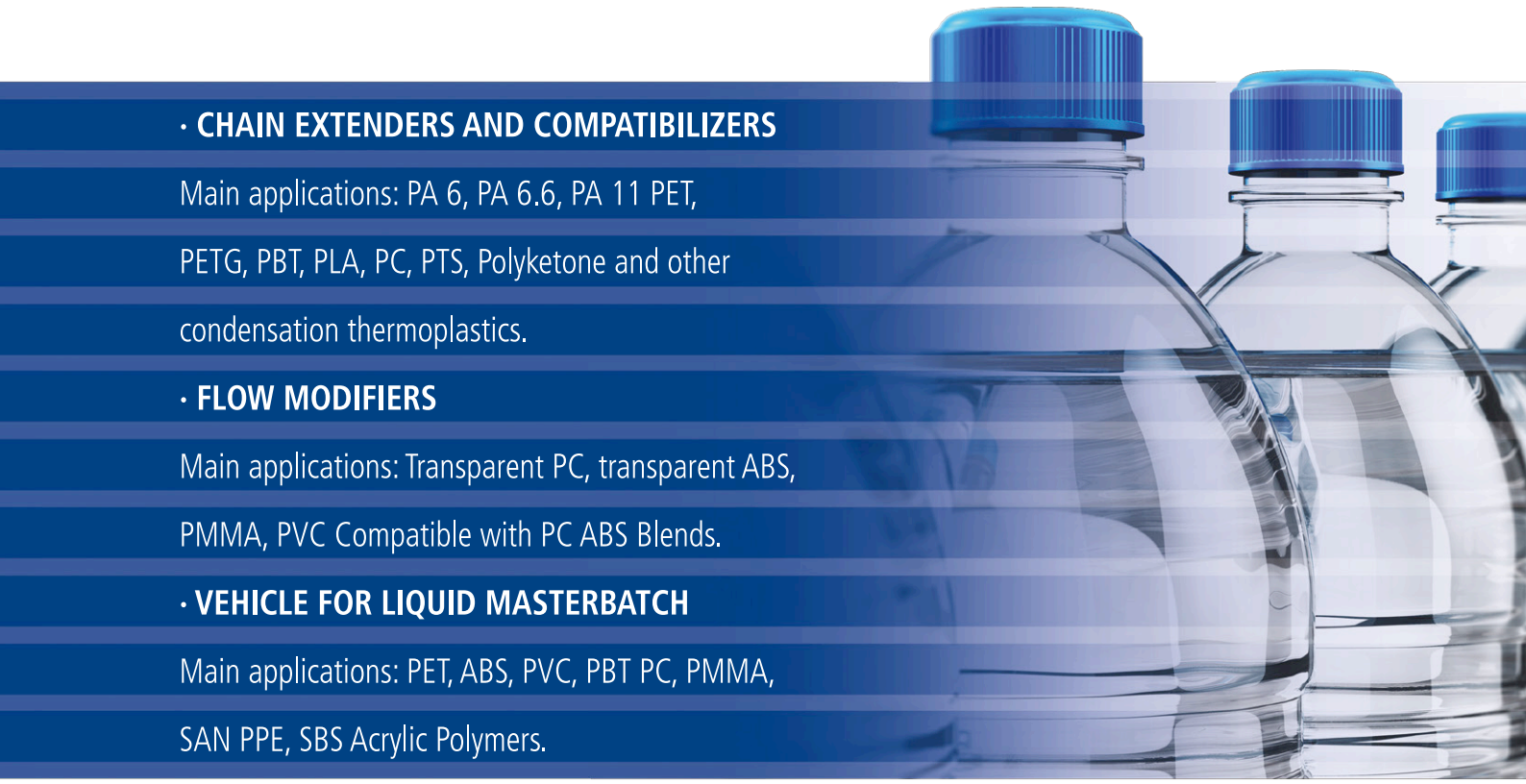

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Circular Plastics Australia's new food-contact rPET facility

Starlinger technology has been installed at a new joint venture PET recycling facility in Albury-Wodonga, New South Wales, Australia.

Circular Plastics Australia (PET) is a joint venture partnership between four partners. Cleanaway Waste Management supplies the plastics to be recycled through its collection and sorting network; Pact Group operates the facility and provides technical and packaging expertise; while Asahi Beverages, Coca-Cola Europacific Partners and Pact buy the recycled plastic from the facility to use in their packaging.

CPA plans to recycle 30,000 tpa of post-consumer PET collected via container deposit schemes and kerbside recycling and use the food-grade rPET pellets as raw material to produce new beverage bottles and other food and beverage packaging.

Starlinger said the facility is using its RecoSTAR PET 215 HC iV+ PET bottle-to-bottle line producing 2.5 tph of rPET. The process starts with a two-stage heating and drying process of the hot-washed flakes for optimum preparation for the extrusion process. After extrusion, thorough filtering and underwater pelletising, the produced rPET pellets undergo vacuum treatment in the downstream SSP reactors to increase intrinsic viscosity and perform decontamination that readies the pellets for food-contact applications.

The output of the Albury-Wodonga plant will help to increase the amount of locally sourced and recycled PET by two thirds from around 30,000 tpa to over 50,000 tpa.

CPA is building a second PET recycling facility in Altona North in Melbourne, Victoria, which will be equipped with a Starlinger RecoSTAR PET 330 HC iV+ recycling line featuring the largest SSP reactor currently installed worldwide. It will have the capacity to recycle the equivalent of around 1bn PET beverage bottles each year when it opens in 2023.

- **www.recycling.starlinger.com**
- **www.pactgroup.com**
- **www.cleanaway.com.au**
- **www.asahi.com.au**
- **www.cocacolaep.com/au**

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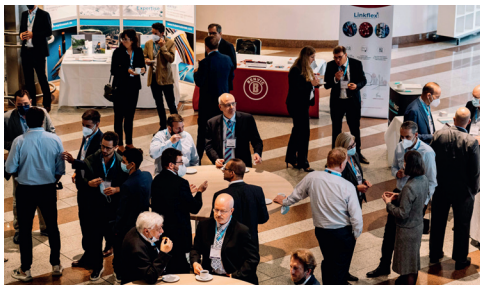

GET INVOLVED TODAY

IMAGE: HERBOLD MECKESHEIM

Shredders are no longer just size reduction machines, but now need to precisely cut plastics while providing high throughputs, reliability, flexibility within a robust construction. Mark Holmes reports

Shredding advances lead to greater precision

One of the initial phases of the plastics recycling process, shredding is essential because a reduction in size is required prior to washing and the secondary sorting phase. "However, until recently shredding has been a considerably rough process," says Giorgio Santella, Managing Director of **CMG Granulators**. "Size reduction – the commonly called process of shredding plastics – is no longer what the recycling industry is attempting to do. In fact, size reduction is a process that belongs in the past, linked to the objectives of waste management and volume reduction. Recycling is for valorisation of plastics at the end-of-life cycle, to be turned back into usable polymers. With such an objective in mind, shredding has progressed from crushing or shattering larger pieces of plastics into smaller parts to cutting large pieces of plastics into smaller pieces instead."

Santella continues: "With such an objective, shredders have evolved from multiple-shaft to single-shaft technology. In addition, single-shaft shredders have recently been provided with design features that allow precise cutting, homogeneous dimensions of shredded material and high energy efficiency. Two of the main technical developments that give modern shredders superior performance are blade design and improved controls. New blade design allows precise cutting – dimensional homogeneity without dust – while advanced controls allow self-adaptability for shredding the feedstock at the highest operational efficiency."

CMG Granulators adds that it is one of the few suppliers of recycling equipment producing both granulators and shredders. The company's range of shredders covers small to medium capacity applications, from 200-1,500 kg/h. The TRM series has four models – TRM600, TRM900, TRM1200 and TRM1500 – all equipped with advanced blade design and intelligent PLC based controls. The

Main image: The 60/210 single-shaft shredder from Herbold Meckesheim

IMAGE: CMG

Above: CMG Granulators supplies high-capacity shredding and grinding systems

CMG Granulators' shredder blade design provides a high degree of cutting precision. The blade is inserted in a V-shaped slot on the rotor, with the assembly providing high resistance to mechanical stress and delivering optimum cutting performance. The company's Adaptive Motor Power (AMP) controls allow the shredder to self-adjust motor power and rotor RPM, to obtain the highest quality of the shredded plastic with the lowest energy use.

The market for shredders and shredding technology in plastics recycling is particularly good at present, according to German machinery manufacturer **Weima**. "There is a continuing rise in the importance of recycling as environmental awareness is increasing," says Sales Director Patrick Henzler. "Furthermore, resources are limited and there is no alternative to the use of plastics in many industries. To make plastics more sustainable, we need to ensure circular products and so more recyclate is going to be required. At Weima, we are at the start of the recycling chain with our shredding machines and, as a result, can make an important contribution. In post-consumer recycling, we have seen a trend towards steadily increasing processing volumes for years. Consequently, we have adapted our machines in such a way that they enable higher throughput rates, while also being more cost-efficient."

Henzler adds that the constant development of materials and rising demand for processing post-consumer materials worldwide is leading to increased requests for special solutions. These include solutions for improved cost-efficiency in terms of lower operational costs and minimised downtime. Specific problems for which Weima has developed solutions include the shredding of highly contaminated materials, such as stretch films with sand, soil and stones or metal pieces. Other projects have involved solutions for voluminous objects like pipes and water tanks to be shredded in full, tear-proof contaminated materials, and fishing nets. Current technical areas of development include the drive-train, cutting geometry and accessibility.

To meet these needs, Weima's latest developments for shredders have included various drive systems for all applications, and the company now offers four different options. These include: an electromechanical drive with Weima WAP gearbox; electromechanical drive with belt; electromechanical drive with belt and multi-pole synchronous torque motor (high-torque drive); and a direct drive with hydraulic motor (hydraulic drive). Other developments include easy access for maintenance from large inspection flaps to ensure fast removal of

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IMAGE: WEIMA

Above: Weima shredder with conveyor belts at Netherlands-based Healix

foreign objects during the shredding process and quick maintenance for short downtimes, as well as a wide variety of special options and tailor-made designs for demanding applications.

Weima has recently been involved with Netherlands-based company **Healix**, which is active in recycling fishing nets and ropes. The Healix recycling centre in Maastricht, the Netherlands was established in 2020 by CEO Marcel Alberts to address the problem of ghost nets – discarded, floating fishing nets and ropes polluting the world's oceans. The company's objective is to turn this waste into a product on-site. At the centre of the production line is a Weima W5.22 single-shaft shredder with hydraulic drive.

The operation collects discarded and broken nets, ropes and cords from fishing and farming to recycle them. The waste plastic fibres, primarily PP and HDPE, are procured from national collection centres and used to create something new. The plastic waste includes fishing nets, packaging products such as big bags, ropes (particularly tear-resistant yarn) and other fibre-based materials from the agricultural industry. Healix's aim is to transform 6,000 tpa of marine plastics into regranulate.

Healix uses the Weima W5.22 single-shaft shredder with a working width of 2,200 mm for the first step of shredding. It is equipped with a powerful hydraulic drive from Hägglunds Bosch Rexroth, weighs just under 12 t, and provides good maintenance access that makes getting to the interior of the rotor easy. "It all starts with the shredder," says Alberts. "If it is not robust and reliable, all the subsequent production steps suffer. We run the Weima shredder continuously over three shifts. The result is ideal for subsequent washing, drying and extrusion. Precisely cut lengths and uniform pieces are very important to us."

The market for shredders continues to grow, according to **Herbold Meckesheim**. "Modern washing plants for plastics in particular require sophisticated shredding technology to be able to process high throughputs and challenging feed materials," says Achim Ebel, Vice-President Sales. "Flexibility in configuration is in demand and competition in this market segment is particularly fierce. The demanding processing requirements of post-consumer material requires adapted technological solutions. Shredders are requested that can mill large quantities of plastics with a high degree of contamination and various mineral impurities, for example. At the same time, the machines should be largely wear-resistant and as simple as possible to operate and maintain."

He continues: "Heavily contaminated plastics from the post-consumer sector also require specific shredder solutions. Integrated into modern washing plants, stage concepts are requested with technology adapted to different processing steps. A frequent request is high throughput capacity and low wear. In addition, there is a focus on energy efficiency and a need for different motor and transmission configurations – classic drives with gears, as well as belt drives or sometimes hydraulic drive systems."

Ebel says: "Maximising the longevity of the machines is also important, even in heavy duty operations. For example, there needs to be high resistance to contaminants, long service life of cutting blades, and significant robustness to damage. This is achieved by good accessibility to all machine parts, especially the rotor, and easy replacement of wear parts, such as knives and plates. Efficient overload protection combined with short downtimes are also needed to meet today's requirements."

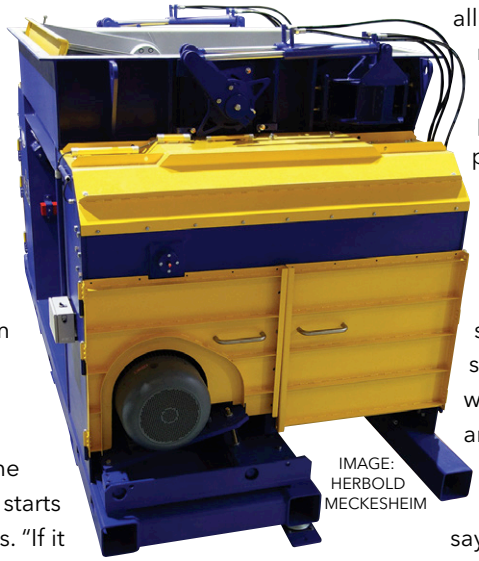

IMAGE: HERBOLD MECKESHEIM

Right: The 60/210 single-shaft shredder from Herbold Meckesheim

Herbold Meckesheim cites a good example of a modern solution in washing plants as the single-shaft 60/210 shredder, which handles high throughputs and entire bales of plastics and is suitable for both dry and wet size reduction. The company says that it combines a robust and

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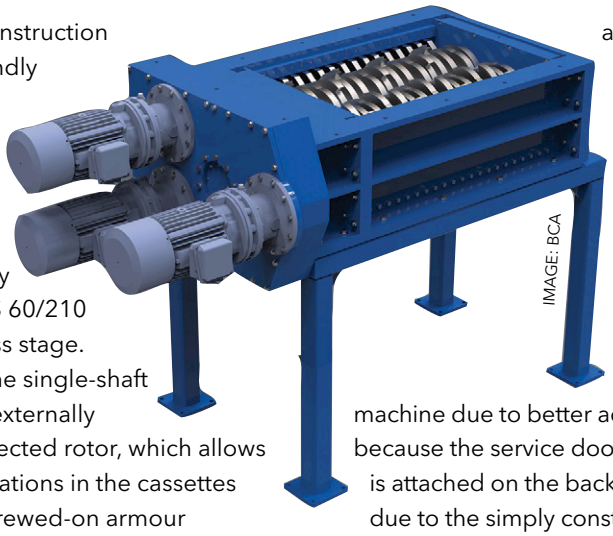
IMAGE: BCA

Right: Electric powered shredders like the BCA 2000 from BCA Industries feature design advances that can deliver the necessary torque and chamber size to shred bulky, recyclable materials quickly

durable welded steel construction with a maintenance-friendly design and good accessibility through a large double-wing door and a hydraulically swing-away grinding chamber trough. In many washing plants, the EWS 60/210 serves as the first process stage.

A special feature of the single-shaft 60/210 shredder is the externally mounted and wear-protected rotor, which allows individual knife configurations in the cassettes and is equipped with screwed-on armour plates, which eliminates time-consuming hard facing. The rotor also allows replaceable stator knives, and a second row can be fitted as an option. Due to large flywheel masses, the double-sided belt drive is energy-efficient and requires little maintenance because of a failure-free gearbox. An overload clutch protects against unshreddable feed material that could cause damage to the machine.

Herbold Meckesheim has recently worked with Chilean company Virutex on the recycling of agricultural waste, such as irrigation and drainage hoses, agricultural films and post-consumer foils. The quantity of waste to be processed by the company had increased significantly in recent years. The single shaft EWS 45/160 shredder that had been used was no longer generating enough throughput and was prone to intensive servicing due to overloading. After consulting with the Herbold team, Virutex decided to replace the EWS 45/160 with a new EWS 45/200 machine, which would shred waste more efficiently. The requirements were met and the EWS 45/200 now processes 1-1.5 tph with 80 mm sieve perforation. The appliance is maintained in good condition through regular servicing and cleaning. A new servicing plan allows the blades to be used for two months and are turned every 15 days. Machine servicing advantages include easier access to the blades, with blade changes taking only 3-4 hours compared with 7-8 hours previously. There is simpler cleaning of the machine due to better access to the rotor and because the service door on the top of the funnel is attached on the back. There is effective cooling due to the simply constructed hydraulic unit and the belts sit better with no slippage on the pulleys.

Ebel adds that future developments at Herbold Meckesheim will include further refinement and enhancement of wear protection and ease of maintenance of shredders and reduced labour requirements. This will include further developments to the rotor drafts, as well as modular design and adaptation to flexible configurations for washing lines.

According to John Neuens, Industrial Consultant of **BCA Industries** in the US**,** the current market for the company's Triplus shredding technology, which allows recyclers to get a desired size without screens or fines, is good. He adds that important trends in shredders include automation and quicker sizing, which helps save labour that is hard to find and increases throughput per hour. Current developmental areas include the shredding of whole bales using shredder programming without the need for bale breaking prior to processing, as well as the separation of colours and different chemistry in plastic products.

BCA Industries has developed Triplus knife technology and a range of programs for all shredding processes – destruction and reduction before separation. "The Triplus system allows our

machines to shred-chip and size in a single pass without screens or recirculation," says Neuens. "Our programs also allow a 'nip function' to take whole bales without a bale breaking process."

When used in the shredder, the knife technology can uniformly cut to any size in a single pass without a screen to reduce scrap quickly to a reclaimable proportion. The company adds that the technology utilises a unique bed knife design in a dual shaft shredder to cut the width of the material of the shredder. The size of the end-product is based on the size and geometry of the rotary and fixed knives, as well as their gap distances.

A shredder using this design can produce over 85% correctly sized material in one pass with less than 10% oversized material, according to Neuens. He notes that the knife system can reduce plastics scrap to the appropriate size with much less energy than typical shearing and grinding equipment. Power efficiency approaches 150% over any standard shredder, the company says.

Triplus shredder technology can also be powered electrically for plastics recycling. Designed to handle large, bulky plastic recyclables, electric shredders are cost-effective, quiet, and eliminate the potential for hydraulic fluid leaks. For plastics processors that recycle in-house waste plastic or large recycling facilities that need to handle bulky or voluminous scrap efficiently, such as totes and barrels, the traditional shredding option has been hydraulically powered due to the high torque and power delivered. Although this is important for oversized parts and other hard materials, it is not necessary for most plastics like PP, PE or PET.

According to BCA Industries, Triplus electric powered shredders have design advances that can deliver the necessary torque and chamber size to shred bulky, recyclable plastic materials quickly. Electric power offers some key advantages over hydraulic power. Firstly, electric shredders are generally less expensive than comparable hydraulic units. They also eliminate the maintenance and inspection associated with hydraulic systems, such as fluid leaks and ruptured hoses. By eliminating hydraulics, when large cutting chambers are still needed, facilities ensure a cleaner, safer work environment and prevent the potential slip and fall hazard represented by leaked hydraulic fluid on the plant floor.

Electric shredders are also much quieter. This

IMAGE: UNTHA

Above: LRK 1400 shredder from Untha

lowers the noise level in decibels in already loud facilities. Consequently, it is easier for workers to communicate verbally. The quieter operation of an electric unit also facilitates compliance with US OSHA's permissible occupational noise exposure limit. "Processors that recycle oversized product scrap have expressed a preference for large chamber, electric shredders that are quieter, eliminate the potential for hydraulic fluid leaks, and cost a bit less," says Neuens.

Although electric shredders provide slightly less torque than hydraulic models, those designed to handle large, recyclable, plastics scrap can still deliver more than 100,000 ft. lbs. (135,600 Nm) of torque per knife. With chamber sizes from 48 × 48 to 48 × 72 inches (1.22×1.22 to 1.22×1.83 m), the electric shredder provides 100-800 HP (75-597 kW). "Applying over 100,000 ft. lbs. of torque per knife in a large chamber is more than enough to efficiently shred sizeable or voluminous plastic scrap, including defective product," says Neuens.

BCA Industries designs the electric shredder to many of the same specifications as its hydraulic models to maximize durability and longevity in the field. "We designed the electric shredder to be extremely durable even if the intended use is plastics, in the event the manufacturer pushes the envelope of what feed materials are placed into it in the future," says Neuens.

For example, the electric shredder is designed with 24-inch (61 cm) AR500 base alloy knives with a hard-face weld, the same as the hydraulic alternative. The knives can be selected in a wide variety of sizes and specifications, which allows customisation to suit the plastics processor's specific application.

Several features are designed to increase the electric shredder's useable life and reduce maintenance. Instead of 7-inch (17.8 cm) shafts, 8-inch (20.3 cm) chromoly shafts are utilised – the same as the hydraulic unit. In place of the old HEX shaft design or a double key round shaft, the unit also uses an eight key design where the knife rides on disposable keys, not directly on the shaft. With the keys taking any abuse instead of the shaft, the design eliminates shaft washout and simplifies knife changes.

The electric unit is designed with a double labyrinth style drop zone and outboard bearings, which eliminates any direct path to the shaft bearings. It also allows compressed material a path to exit the shredder, eliminating the costs associated with bearing and shaft replacement. Large chamber electric shredders are also easy-to-use for plant operators. The latest offer touch screen programmable functions and diagnostics and are PLC controlled with auto-reverse and overload protection.

"Manufacturers of oversized plastics product that needs to be recycled finally have an electric-powered option that makes shredding onsite much easier, quieter, cleaner and cost-effective," says Neuens. "Although hydraulic power has been the default choice, large chamber, electric-powered units are an attractive alternative for plastics processors."

Untha reports that plastics shredding continues to be a major area of interest in the recycling industry and that it is constantly looking for improvements

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and ways of processing more difficult plastics through smarter engineering and technological innovation. "As is the case in any environmental sector, we are seeing operators demand greater throughputs, particle precision and material flexibility, while driving down energy consumption and maintenance to reap environmental and financial gain," says Marcus Brew, Managing Director, Untha UK. "This is exactly what technological innovation should achieve – more, with less. Things are no different when it comes to shredding plastics."

He says: "An area that seems to be attracting particularly increasing conversation is persistent organic pollutants (POPs), found in some WEEE. Due to the specific physical and chemical properties of these substances, they can have a long-lasting impact on environmental and human health if not managed correctly during the waste disposal process. The UK Environment Agency's updated guidance on POPs has caused ripples throughout the industry, but as is often the case, innovation is already driving change."

Untha highlights plastic recycler **3R Technology** as a good example of what is possible in the complex plastics shredding arena. With more than

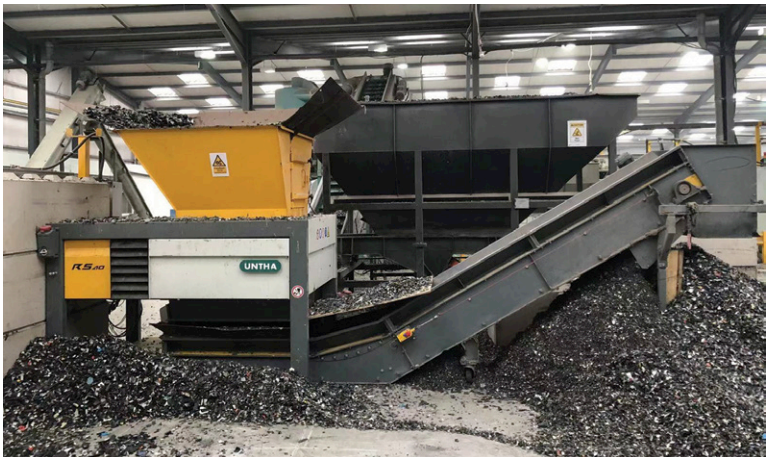

IMAGE: UNTHA

Above: RS40 shredder from Untha

20 years' experience – particularly in the Belgian market – the company's attention recently turned to the UK and the WEEE plastics processing challenge. The scrap handler has recently invested in new technology to bolster its UK operations where approximately 2,000 tonnes of shredded small domestic appliance (SDA) plastics are now being handled every month at its 5,000 m^2 warehouse in Preston.

The plant has two Untha shredders. A single shaft LRK plastic shredder processes PS fridge

IMAGE: LINDNER

Above: The Micromat 1500 from Lindner Recyclingtech

plastics, while a four shaft RS40 with screen achieves a refined 30 mm fraction after processing SDA mix. Particle homogeneity is ensured by both machines. The shredded plastic is then transported via conveyor belt to the washing line with floating tank, to be cleaned and dried. ABS/PS and PP/PE material is then run through an electrostatic separator to create pure, high value ABS and PS flakes for re-manufacturing.

Having rigorously tested the processing line, 3R Technology is now looking for more material for next year and beyond, with the site capable of recycling various plastics, including flat-screen TV cases, computer monitor housings, and computer-based peripherals. The goal is to reach an annual processing milestone in excess of 5,000 tonnes this year, with plans to open two further plants in the south of England and Scotland, in the near future.

According to 3R Technology's founder and chief executive officer Yu Lin Wang: "The UK's WEEE recycling capabilities are continuously improving. However, the focus is usually the processing of metallic content. We are therefore partnering with WEEE and scrap metal handlers, to tackle the 50% mixed plastic that typically remains once redundant appliances have been shredded. This still has a significant resource value, which often is not realised in the UK."

This is not 3R Technology's first Untha investment. According to Wang, the company uses Untha at its Dutch plant also. He adds that Untha shredders make the job of the downstream technology much easier – a further 3-5% clean metal can be segregated from the floating table, which boosts the revenue stream. 3R Technology also has WEEE recycling facilities in Serbia and the Netherlands.

Lindner Recyclingtech has developed the Micromat to shred waste materials reliably and efficiently. The Micromat series features the Mono Fix rotor, which guarantees universal applicability by enabling different or mixed rotor configurations. Various pointed or flat knives and special counter knives can be fitted to the same rotor as required, depending on the input material. As a result, the Mono Fix technology ensures a high and consistent throughput with a wide range of materials that are often classified as difficult.

Vecoplan has developed the high-performance VIZ 1700, one of the largest and most energy-efficient shredders in its product range, offering a high level of availability, low operating costs and maximum throughput. The company says that the system gives users a great deal of flexibility because it can shred completely different plastics. The shredder can be precisely adapted to different input and output requirements by selecting the right rotors, knives and screen. Shredding performance can be matched to the interface. However, due to the concept of bolted tool holder plates with variable cutting tip sizes, rotor changes are no longer required. Users only need to exchange the tool holder plates to adapt the cutting geometry quickly and easily to different output grain sizes. HiTorc drive is available for the VIZ, which offers a high level of start-up power and high torque.

Hellweg Granulators has equipped its full product range with the digital Smart Control System. The control system detects parameters such as power consumption, motor speed and bearing temperatures, as well as the state of blades, screens and V belts. The recent implementation of the Ethernet-based, cross-system OPC UA standard means the machines can now be integrated into control centre systems. In addition to providing component monitoring and interconnection with other machines, the control system also has a 'boost' mode for adapting grinding capacity to production-related fluctuations. Adaption of operating parameters to defined plastics means that even temperature-sensitive grades can be straightforwardly processed without water cooling. The 'eco' operating mode adjusts machine speed to the prevailing input volume, so reducing power consumption.

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Overcoming differences: what's new in compatibilisers

IMAGE: SHUTTERSTOCK

Getting immiscible polymers from mixed waste streams to work together requires the input of specialist additives companies. Peter Mapleston reports on their latest offerings

One day in the not-too-distant future, automatic sorting equipment that can create single-polymer streams from mixed post-consumer waste may be a commonplace feature. Until then, recycling and compounding companies will continue to call on special additives to compatibilise plastics that are normally immiscible in order to provide improved, consistent, performance. If you relish a challenge, somewhere in the wide range of solutions available to you could be the answer you are looking for. Here are just a few of the latest developments.

A solution for compatibilising polyethylene with polypropylene – two non-polar polymers that are incompatible nevertheless – is now being upscaled from the laboratory. **Intermix Performance Materials** in Ithaca, New York, is a start-up that was founded last year on ethylene-propylene multi-block compatibiliser additive technology licensed from Cornell University in the US. One of its founders, Principal Investigator Ting-Wei Lin, says: "High-density polyethylene and isotactic polypropylene (*i*PP), the world's most manufactured commodity plastics, share similar optical properties, which makes the sorting process between these two plastics challenging in large scale. Despite the resemblance in chemical structures, HDPE and *i*PP are immiscible with each other and therefore result in brittle and valueless materials when melt-blended. This has hampered the recycling efficiency of these plastics. Only less than 7 wt.% and 1 wt.% of HDPE and *i*PP, respectively, are reportedly recycled."

Working with plastics recyclers, Intermix obtained

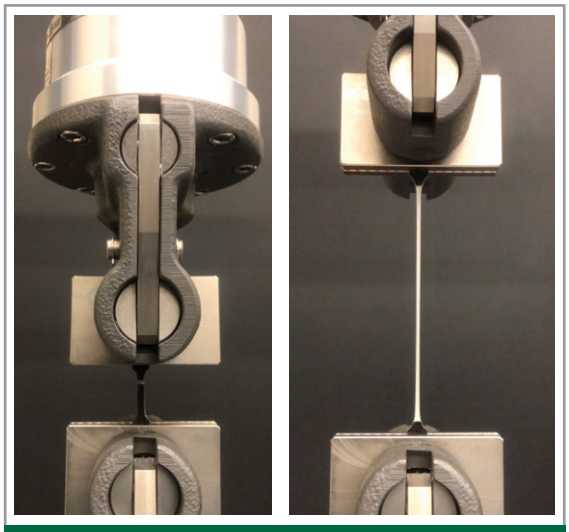
Main image: Teaming up polymers can benefit recycling

a batch of pellets mainly processed from used ropes and nets that were recovered from the ocean. The composition of the ocean plastics was approximately 1:1 weight ratio of HDPE and *i*PP. They displayed brittle mechanical properties, and break upon stretching without much elongation. By adding 2 wt.% of the compatibilisers developed by Intermix, toughness was significantly improved to over 800% elongation at break.

Lin says compatibilised HDPE/*i*PP blends "now become promising materials which could be reprocessed into products, regardless of the composition and inseparability of the recycled HDPE/*i*PP blends. This can significantly decrease the cost for plastics recycling and enhance the recycle efficiency."

Intermix Performance Materials is collaborating with toll manufacturers to scale up the productivity of the compatibilisers from gramme scale to kilogramme scale. "Products made of recycled HDPE/*i*PP blends may soon be realised," says Lin.

Nexam Chemical has developed a product concept it calls Reactive Recycling for improved performance in mixed recycled polymer streams that are difficult to recycle. One example is recycled PP containing HDPE. "Nexamite R201 provides compatibilisation of PP and PE by reacting the polymers together creating a PP/PE hybrid," says Chief Marketing Officer Lars Öhrn. "Tensile testing is showing less variations when R201 is added to an 85% rPP and 15% rHDPE mix."



Tensile testing of tensile bars composed of (left) uncompatibilised ocean plastics (note the break at the middle of tensile bar), and (right) ocean plastics compatibilised with 2 wt.% compatibilisers developed by Intermix Performance Materials
Source: Intermix

Another example is PE containing polyamide. Tensile testing has shown improved mechanical performance and surface appearance when adding Nexamite R405 to a mix of 93% HDPE and 7% PA 6, yield stress is improved, and break strength is on a par with pure HDPE.

Öhrn says details of the reactive chemistry are confidential, saying only that "it functions in polyolefins but can also bridge and react with

Comparisons of properties of blends with and without Nexamite compatibilisers

	Yield Stress (MPa)	Yield Strain (%)	Break Strength (MPa)
100% HDPE	25.6	12.9	42.7
93% HDPE /7% PA6	23.7	10	34.2
88% HDPE/7% PA6/ 5% Nexamite R405	27.3	10.6	42.6

	Yield stress (MPa)	Yield strain (%)	Break Strength (MPa)	Break Strain (%)	Break Strain Std dev	MFI (g/10min)
100% rPP	27.6	11.3	33.1	632	62	2.5
100% rHDPE	34.7	8.8	30.3	747	123	1.2
85% rPP/15% rHDPE	27.1	10.2	24.9	505	150	2.4
80% rPP/15% rHDPE/5% Nexamite R201	27.2	12.5	30.1	648	18	1

Source: Nexam

Photos of tapes extruded with different materials, extruded on a Brabender lab 25D, 20 mm, single-screw extruder. Images show sections of tape approximately 3.75cm across

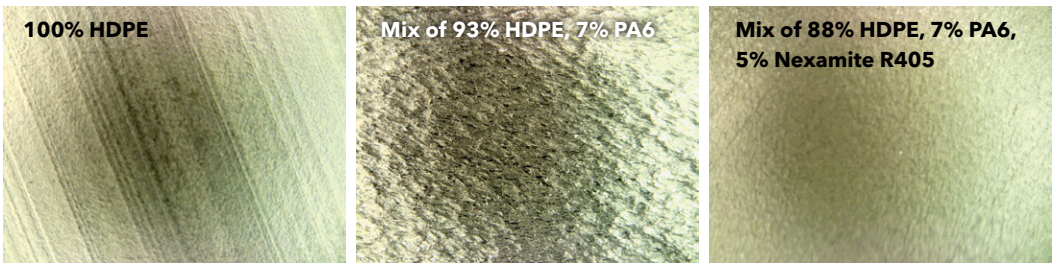


IMAGE: NEXAM

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polycondensates. As with all reactive extrusion you need to have proper mixing and energy input for best results." Both Nexamite R201 and R405 are offered in masterbatch form.

Evonik says that its organo-modified siloxane technology can be used to improve compatibility of distinct polymer domains, improving properties such as elongation at break, impact strength, stress crack resistance, and weld line strength, as well as processability. "The organo-modified backbone is allowing recycled polymers mixed with our compatibilisers to have improved moulding properties, higher throughput, and even a higher surface quality of finished products (shark skin prevention, surface smoothness, etc.)," says Ido Offenbach, Americas Segments Manager for Specialty Additives.

"While already commercial with two of our solutions, TEGO XP 21024 (used for PP-in-PE compatibilisation) and TEGO XP 21025 (PE-in-PP, but also PA-in-polyolefin compatibilisations), we are continuing our investigations into new compatibilisers that are even more versatile – particularly between hydrophobic and hydrophilic polymer domains."

Weld line behaviour under tensile stress: r-HDPE containing 6% PP from PCR stream with and without Evonik Tego XP 21024 compatibiliser. Test bars made without compatibiliser break at the weld line at low elongation
Source: Evonik

IMAGE: DOW

Right: Stretch film contains 30% PCR, made possible by creating a blend with Dow's Revoloop, which contains 70% PCR

Dow says it is aiming to help film and packaging producers meet challenges in using recycled content in their products with its recently-launched Revoloop, a technology platform that enables mechanical recycling and also includes a new line of resins incorporating high PCR content levels.

"Revoloop stands for a single-pellet solution that enables a simpler PCR process integration for film producers, thanks to the resin's consistent quality and processability performance," says Dow. "There is no sacrifice in the material quality and functionality in the final application. Furthermore, the resins' optimised mechanical properties enable the incorporation of PCR into demanding applications and without increasing material thickness."

Initially developed for use in secondary and tertiary packaging, new developments show the potential for use in other non-food contact applications, says the company. Examples for the commercial use of Revoloop include collation shrink films with Revoloop XZ 89169.00, artificial turf applications with Revoloop XZ 98612.00 and the latest development, Revoloop XZ 98615.00, a grade containing 70% PCR, which enables the production of high-performance machine stretch wrap film containing more than 30% PCR.

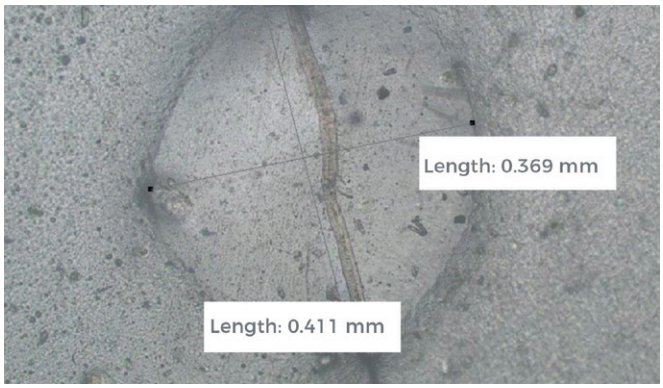
Technologies within the Revoloop platform include RecycleReady, which incorporates Retain polymer modifiers. A stand-up pouch made with Retain polymer modifiers was the first package of its kind with barrier film that can be recycled in a PE recycling stream when it was introduced several years ago. "When combined with other polyethylene resins in a flexible packaging structure containing a barrier layer such as PA or EVOH, the Retain compatibiliser offers a recyclable solution with enhanced optics and mechanical properties for films with barrier characteristics," the company says.

"Retain uses innovative recycle compatibiliser technology developed by Dow. Polar components are coated and encapsulated and disperse well. With further blending, resulting resins allow converters to fabricate new recycled films without sacrificing physical or optical properties – and in some cases possibly improve upon them."

Dow has a second range of polymers for recycling, Fusabond functional polymers, which can be added during the recycling-compounding step of multilayer films containing non-polar and polar components compatibilising the two phases and leading to improved processing, optics and mechanical properties.

Maleic anhydride grafts

Acti-Tech compatibiliser 16MA11F is the latest addition to **Nordic Grafting Company's** portfolio. It is based on a Vistamaxx semicrystalline copolymer from **ExxonMobil**, grafted with maleic anhydride (MA). NGC, a licensee of ExxonMobil technology, says the new additive, which is compliant with the EU 10/2011 food contact regulation, offers recyclers and processers an easy-to-add and universal compatibiliser for blends containing various diverse



Gel in PE recyclate without compatibiliser added

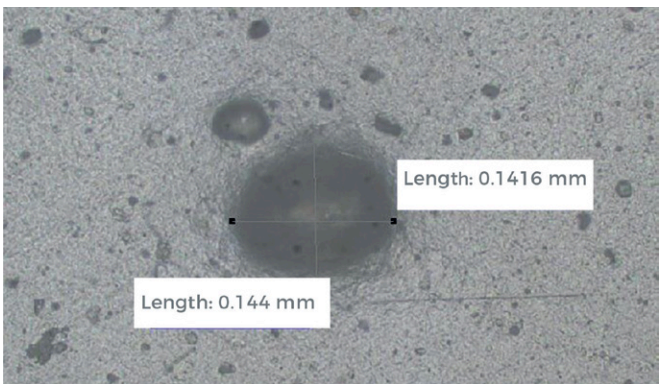


IMAGE: YPAREX

Gel in PE recyclate with 10 w% Yparex 0H17 added

polymers typically found in packaging, such as polyolefins, EVOH, polyamides and PET, to enhance the value of recycled and virgin materials.

"It represents an ideal solution to upcycle mixed polymer feeds from post-industrial recycling or post-consumer recycling, but also from in-house waste, enabling the use of these recycled plastics into new or existing products without lowering end-properties," says the company.

The product can be added at various stages of the recycling process: at the converter (in-house and pre-consumer recycling), during repelletisation with or without filtration at recyclers, or during reformulation at recyclers and at compounders.

NGC says Acti-Tech 16MA11F has shown improved dispersion and decreased domain size of polyamide and polyester particles in polyolefin matrices (typical PA/PE ratio of 40/60). "Moreover, the addition of 4% Acti-Tech compatibiliser 16MA11F in recycled barrier film – LDPE(60%)/PA(30%)/EVOH(10%) – demonstrated a high recovery of film and optical properties compared to non-compatibilised mixtures, as well as cost saving compared to virgin material," says Business Development Manager Quentin Le Piouff.

The additive is being tested on various pre-consumer, post-industrial and post-consumer waste streams, not only multilayer barrier film packaging but also shrink sleeves, blow moulded cosmetic and plant protection chemical containers, rigid packaging, reinforced/multiwall tubes and hoses, as well as fish nets, mats and carpets.

Another part of ExxonMobil's polymer modifier range, the Exxelor portfolio, was acquired by **The Compound Company** in March. Exxelor grades are chemically modified polyolefin-based resins (MA-functionalised PP, for example) used to enhance the performance of engineering thermoplastics and other polymers. They can be used as impact modifiers as well as compatibilisers, coupling agents and adhesion promoters, where they increase the bonding strength of non-polar polymers with polyolefins, fillers and reinforcements as well as metals, thermoset rubbers and most polar substrates, including glass.

"We are in the middle of embedding the new business into our existing workflow, while keeping customers happy," says Business Development Manager Frank Huijnen. "We have many plans regarding adapting our coupling agents. Tight-

ened regulations for free MAH in end-products is a driver for those developments as well as sustainable materials."

The Compounding Company has lined up a portfolio for a wide variety of mixtures of thermoplastic materials for mechanical recycling, Huijnen says. "Yparex, as part of The Compound Company, always has shown its capability to develop a range of MAH-modified polyolefins for thermoplastic processing. Since mechanical recycling has gained volume, Yparex has adapted to the needs to have compatibilisers which enable plastic processors to generate new value from their plastic waste streams.

"With these compatibilisers we can cover recycling streams for injection moulding, but also for the more critical film processing." Yparex compatibilisers are used in industrial waste stream recycling and also in PCR.

Polyscope, whose core business is based on styrene-maleic anhydride, says it has grown its market share in SMA-based products significantly over the past decade. The company's search for a new owner that could support future growth ambitions ended in January when it was acquired by Vertellus.

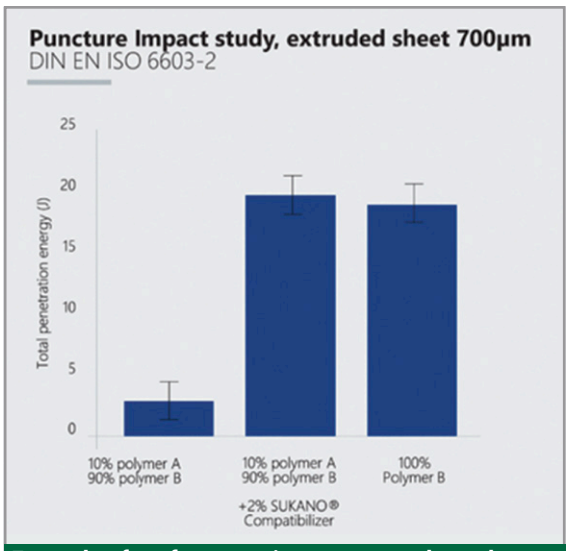
"With this acquisition, Polyscope has expanded its reach within the specialty additives market," says Patrick Muezers, Polyscope CEO. "We increasingly see opportunities to offer solutions for the upcycling of various polymers. Some of our customers have even found that our compatibilisers can contribute to making blends from plastic soup in combination with ABS, enabling PET/ABS blends that can be used in applications such as in housings for electrical appliances."

Olebond products from **Tisan Engineering Plastics** in Turkey are maleic anhydride grafted polymers produced (as are several others described here) by reactive extrusion. "According to grafting level and polymer type, Olebond help to improve compound performance by acting as compatibiliser, coupling agent, impact modifier and adhesive agent," says the company.

Olebond 7401 grades based on PP and with high maleic content are used in PP compounds as a coupling agent between polymer and fillers. "At the same time, Olebond 7401 helps to form blends with high mechanical values with PP and immiscible polymers such as PA," says Tisan.

Olebond 7402 grades improve the interphase adhesion of polyethylene to other polymers such as polyamides and polyolefins. It also promotes adhesion between metal, polyolefins, cellulose, glass and foil.

Other Olebond grades are ABS and EVA based



Example of performance improvement through use of compatibiliser
Source: Sukano

products that can be used as compatibilisers in different products. Olebond 7404 is an MA grafted ABS and Olebond 7405 is MA grafted ethylene vinyl acetate (EVA).

SK Functional Polymer (SKFP) offers a full range of compatibilisers and recycling boosters that it says can be used to convert mixed plastic waste streams into high value materials. Lolita Hauguel, Business Development Manager, says: "SKFP has focused significant research efforts on developing reactive polyolefins to compatibilise plastic blends by mechanical recycling. Lotader reactive terpolymers and Orevac grafted resins are widely used as compatibilisers of a wide range of blends. SKFP has solutions for recycled blends such as rPET/rPE, rPET/rPP, rPA/rPE, rPA/rPP, rPA/rPET... but also PE/EVOH blends."

Lotader 4210 maleated grade has been commercialised to upcycle polyethylene and EVOH multilayer wastes, even if the final compound is limited to non-food applications. SKFP says another successful example is the use of Lotader AX for recycled PET contaminated with polyolefins not eliminated by the sorting process or introduced intentionally in order to develop blends with improved properties.

SKFP has also demonstrated that its new range of highly heterogeneous Lotryl T acrylate copolymers are efficient booster solutions for styrenics recycled resins. The use of these Lotryl T copolymers enables a significant increase in the impact performance of rABS. SKFP also provides solutions to improve the impact resistance and at the same time adjust the viscosity of the rABS compounds by combining non-reactive Lotryl highly polar copolymers and reactive Lotader AX. "The combination of

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polarity and reactivity of these resins is key to successfully upcycle plastics wastes," says Hauguel.

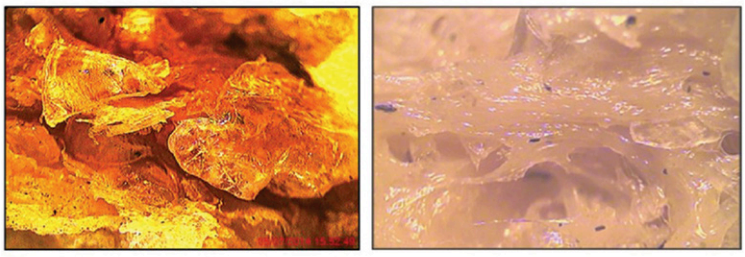
Sukano, which specialises in additives and colour masterbatches for polyesters, biopolymers, and engineering resins, says it developed a new compatibiliser masterbatch that allows rPET to be blended into ABS, which would normally be incompatible, in response to a call from a customer wanting to give a second life to PET bottles collected from shorelines. The customer wanted to find a way to use the rPET in durable applications, such as kitchen appliances, which are typically made from ABS. The masterbatch contains active components consisting of a portion with chemical affinity to ABS and a portion which offers affinity to PET.

Parts made from blends of ABS with 15% rPET have the same mechanical properties as 100% ABS. There are even benefits to the polymer blend, says Sukano: "Due to the presence of rPET, there is an increased gloss compared to 100% ABS parts, creating a premium look and feel on external parts. The additive masterbatch is also neutral in colour and can easily be combined with a colour masterbatch of choice, allowing the end application to stand out of the crowd. It offers designers greater freedom to apply the latest colour trends in the market."

Sukano has also carried out tests using recycled ABS in place of the virgin ABS. "The customer at this moment is using only rABS and rPET for this application," says Onno Treur, Business Development Manager at Sukano. "The rABS comes from own production of other parts, but since the demand for the application is growing and therefore the demand for rABS is also increasing, the rABS from its own collection will soon no longer be sufficient."

Salvatore Monte, President of **Kenrich Petrochemicals**, compares his company's technology with rival technologies for recycling PCR: "In simple terms, there's advanced recycling using depolymerisation and chemical techniques such as pyrolysis to remake virgin-like recycled polymers with known properties. The disadvantage is in the process, as it's a chemical plant, it's energy intensive, and focuses on narrow feedstocks such as PET and PP."

He continues: "There's mechanical recycling that relies on collecting, sorting, separating, cleaning, and size reduction of PCR to make a feedstock that is either baled, or granulated for making large parts such as furniture, or worked off at low percentages with virgin polymers. There are many issues such as: intrinsic polymer incompatibility of addition (olefins) and condensation (nylon, PC, PET) polymers; lower mechanical properties due to chain scissoring; negative impact property effects of fillers; etc."



Recycled polymer blends with and without a Ken-React additive
Source: Kenrich

Monte says Kenrich offers advanced mechanical recycling using titanium chemistry of filler coupling and in situ polymer catalysis in the polymer melt causing repolymerisation rather like the titanate catalysts used to make condensation polymers and the Kaminsky metallocene and Ziegler-Natta catalysts used in the polymerisation of addition polymers.

"Mechanical plastic recycling is complicated. For example, HDPE used for milk bottles and PP in yogurt cups are both addition polymers in the olefin family. However, more than 5% PP in HDPE will cause delamination during injection moulding. Carpet fibre made from recycled PET bottles must be filled with CaCO3 to make commercial carpet having heft and wearability. 95% of worn-out CaCO3/PET carpet is considered a contaminant in PET recycling and goes to landfill."

To test the efficacy of titanate catalysts, recyclate from LLDPE from a fractional melt film, PP copolymer from mixed 20-35 MFI injection moulded caps, and PET from thermoformed clamshell food packaging were prepared and mixed in a Brabender Plasticorder at the University of Waterloo Chemical Engineering Department, Waterloo, Ontario, Canada. The difference between blends with and without a Ken-React additive from Kenrich are significant (see photos).

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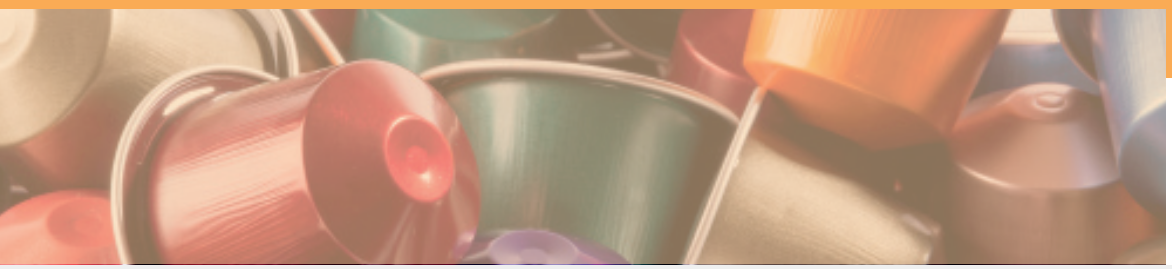

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IMAGE: SHUTTERSTOCK

Getting more from in-house recycling

*By recycling process waste, plastics manufacturers can reap business benefits and contribute to the circular economy agenda. **David Eldridge** reports on new developments and technology*

Post-consumer recycling takes the leading role in efforts to align the plastics industry with circular economy objectives. But post-industrial recycling is a longer established activity and is one which continues to grow, as plastics processors strive for resource efficiency by converting production waste into feedstock. Packaging film extruders are ramping up the amount of process scrap they reuse and converters are increasingly seeking closed loop solutions for post-production waste such as heavily printed stock. Film extrusion and packaging conversion are key areas targeted by recycling technology suppliers, although other process areas and market sectors are emerging that require post-industrial recycling options.

"Everyone is talking about the circular economy, and not only in terms of post-consumer recycling," says Andreas Dirnberger, Business Development Manager Application Inhouse and Industrial, at **Erema Group**. "Manufacturers and processors of plastic products such as packaging films are also pursuing a zero waste strategy. By recycling production waste, costs can be saved, and the use of energy and the number of transport journeys can be reduced, which in turn helps to protect the climate."

Each type of in-house waste presents its own challenges. A typical application is the recycling of clean, unprinted film waste, such as edge trim. But processors must also deal with other waste types.

Main image: Film extruders have to face various process waste challenges, including off-spec reels

IMAGE: EREMA

Right: Erema Group's Pure Loop business makes an integrated shredder-extruder system that is used for recycling bulky and large-volume waste

Dirnberger says the processing of roll stock and loose, large quantities of waste are also part of the job. "The customer's choice of extrusion system depends primarily on the plastic used, the throughput requirements and the on-site logistics," he says.

The recycling of biaxially oriented film production waste made of PP, PET, PA and increasingly also PE, is another growing area of interest. "Here, too, the trend is towards larger recycling systems processing up to 2 tonnes per hour because highly specialised film plants operate at increasingly higher output rates," he says. "Additional production waste categories for which the Erema Group offers customised recycling solutions include hygiene films, foamed materials, fibres, nonwovens, parts for the automotive industry and even fibreglass reinforced components."

The trend for multilayer films to switch to monomaterial construction is in order to make post-consumer recycling easier. But this presents new challenges for film processors wanting to recycle production waste. Dirnberger says: "In order for recycled pellets from such materials to be fed back into production, recycling plants must process the material gently, be easy to use, and offer a high level of automation."

Particular difficulties arise with in-house recycling film products that have gone through secondary processes, such as printing, laminating and metallising. Dirnberger says: "Erema has developed the Intarema TVEplus extruder system especially for this purpose, with triple degassing and melt filtration upstream of extruder degassing."

Erema Group has subsidiaries that have developed integrated technologies specifically for in-house recycling. Its Pure Loop business makes an integrated shredder-extruder (ISEC) that is used especially for bulky and large-volume waste that needs to be pre-shredded. Plasmac offers its Alpha direct extrusion system and Omega shredder-extruder system for lower throughput volumes. They are used, for example, in applications where they can increase efficiency in combination with production lines for blown or cast films.

Customer requirements for recycling technology, according to Erema, include compact design, low energy consumption, simple operation, high system uptime, and the availability of spare parts and technical support. It also highlights the potential of digitalisation in collecting and analysing machine data to improve processes and product quality. Erema's BluPort customer portal is designed to facilitate access to these tools.

IMAGE: STARLINGER

Above: Starlinger Recycling Technology offers machines for process scrap and post-industrial material, for example the RecoSTAR universal recycling line

Starlinger Recycling Technology says film extrusion companies have faced ever-growing technical expectations in packaging. Now they must also consider recyclability and the incorporation of recycled polymers in their products. "Choosing the right technology helps plastic film producers and recyclers to get the most out of film production scrap or post-consumer film waste," it says.

Film producers usually recycle their in-house production scrap, but they are now widening their sources to include post-industrial waste (following secondary or conversion stages), as well as post-consumer waste.

Starlinger says: "The [film production] technology has to be flexible to be able to process different and varying input streams, but also due to unpredictable future developments. High automation and optimised maintenance procedures are needed to fulfil high uptime rates. Upcycling through adding additives also plays an increasingly important role."

Film producers must deal with production scrap throughout the production chain, no matter if the production process is for blown film or cast film, or the film structure is either mono-material or a mixture of polymers. Starlinger says the scrap can occur continuously as edge trim, or discontinuously as solid start-up lumps, loose film, off-spec reels and cut-outs. Secondary processes mean that

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the waste film may be printed, laminated or metallised. "In the best case, the scrap is clean and dry," says the company, but "often it might have become humid during outside storage, or be contaminated with paper labels or metals."

Independent recyclers of post-industrial waste, which often recycle material for packaging producers, also face these challenges. Film scrap may vary from delivery to delivery. The material might be wet from outside storage, or printed, or dirty from inappropriate materials handling. Additionally, the film scrap might be a mixture of unidentifiable polymers, or laminated with other materials such as paper or aluminium, says Starlinger.

In order to provide technical solutions that lead to the best results, Starlinger says it offers a spectrum of innovative machinery solutions for the efficient recycling of all kinds of film materials.

"Depending on machine design, eg air-flushing of the feeding unit or extruder degassing, it is possible to process materials with humidity levels of up to 10%. Special solutions such as the C-VAC degassing module and special melt filters are available in case of organic contamination such as paper or wood. If desired, additives for upgrading the regranulate can easily be added."

Film producers continue to face a variety of economic factors like rising plastics prices, pressure to reduce costs, and stronger competition, which has led to them becoming more aware of the costs of production scrap. Starlinger says: "In-house film waste requires simple and cost-effective setup of the recycling equipment for fast ROI. The choice of the right equipment is fundamental in order to increase the regranulate content in the primary product up to 100%. The result: higher competitiveness, resource conservation and a high-quality end product."

But film recycling is no longer just about film companies saving costs or raw materials. "It is a significant contribution to more sustainability in the plastics industry and an important step towards a circular economy in the packaging sector," it says.

The new Greenplast exhibition, which took place in Milan, Italy on 3-6 May, provided an opportunity for technology companies to show their recycling innovations for plastics processors. **Reifenhäuser Blown Film** featured its EVO Ultra Fusion extrusion process, designed to make blown film producers less dependent on the input quality and which can also dispense with the need for regranulation of the recycling material. The company says the technology can reprocess film shreds (fluff) as well as all types of production waste and PCR material in a direct extrusion process.

Even the lowest quality recyclates can be reprocessed by Ultra Fusion into functional films, due to its twin-screw technology enabling better melt homogenisation in a stable process. For processing better quality regranulates, Reifenhäuser recommends the EVO extruder in the 33L/D variant. "Thanks to optimised barrier as well as shear and mixing parts, this extruder processes recycled material as reliably and naturally as other raw materials – the ideal prerequisite for success in the growing market for products with a high recycled content," says the company.

At Greenplast, Reifenhäuser also highlighted a fully recyclable mono-PE pouch equipped with R-Cycle technology. This traceability system crosses plastics processes and has been developed by European companies including Reifenhäuser (extrusion), Arburg (injection moulding) and Kautex Maschinenbau (blow moulding).

R-Cycle automatically stores recycling-relevant information during production and makes it available as a standardised data record for the waste sorting process. Reifenhäuser says: "This enables data-based and thus more precise sorting for high-quality recycling. Production machines along the entire value chain can thus record relevant data, such as the type of plastic, printing ink, adhesive, additives and also the use of the packaging (food/non-food), and make this information available on the end product via appropriate marking (eg digital watermarks)."

Bausano showed its E-GO R extruders at Greenplast, which are designed for use in both post-consumer and post-industrial recycling. The company says the technology is suited to recycling

IMAGE: REIFENHAUSER

Left: Reifenhäuser says its EVO Ultra Fusion extrusion technology makes blown film producers less dependent on the material input quality

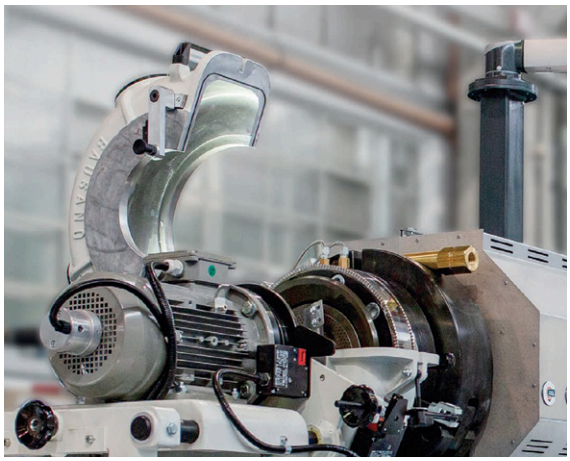

IMAGE: BAUSANO

Right: E-GO R extruder from Bausano

not only lightweight and moist materials, but also heavy film and materials with low water content. The system includes a forced feeding system specifically designed for the E-GO R. During reprocessing, volatile substances and moisture are removed via a high-performance degassing system that prevents defects in the granules such as bubbles arising from gases in the starting compound or formed during the extrusion process. The melt is filtered and fed to the granulation head. The line is complemented by a liquid ring or immersion cutting system.

Bausano says: "The constant speed, combined with a sophisticated screw design, ensures that each product meets high quality standards."

The company also highlighted its technology for recycling rigid and flexible PVC, including plumbing pipes, tiles and other applications. "In this regard, the extrusion lines of the MD Nextmover series, which, on request, can be fully customised even with additional components, stand out for being flexible when it comes to recycling various types of PVC waste, according to the level of contaminants, percentage of humidity and grind size," says Bausano.

Beier, a China-based plastics recycling machinery group, reports the success of its machinery recently installed at film recycling customers in South Africa and the UK. It says its technology – which ranges from crushing-grinding, washing, separating and drying to pelletising extrusion – is used by customers for industrial scrap and post-consumer waste.

One of its customers is a plastics recycler in South Africa dedicated to supplying high-quality plastic packaging which has installed a complete pelletising line for PE film recycling. The line includes a densifier, two-stage extruders and water-ring pelletising and has production capacity of 500 kg/h. Beier says the customer is satisfied with the line's performance and service from the company, and has placed an order for three more Beier lines for delivery in 2022.

Below: Installation of Beier recycling and pelletising line

IMAGE: BEIER

In the UK, an unnamed company which recycles LDPE films has recently installed a similar pelletising line with output capacity of 600 kg/h. The customer intends to continue to expand production capacity and seek greater cooperation from Beier, says the machinery group.

Morssinkhof-Rymoplast is a pioneer in recycling post-industrial plastic waste, having started its plastics operation in the 1970s. Since then, the company has expanded significantly and now has 10 facilities in Netherlands, Germany, Belgium and Poland which recycle well-defined post-industrial and post-consumer waste streams such as LDPE, HDPE, PP and PET. The group is expanding again in response to growing demand in the film recycling sector.

It is investing €30m in a 8,700 m² state-of-the-art facility in Markranstädt, Germany that will have capacity to recycle 30,000 tpa of plastic film. The facility is an addition to an existing plant the company has in Markranstädt and will enable further growth into the eastern part of Germany.

The new facility is under construction and is planned to be operational by the first quarter of 2023. After completion, Rymoplast will have an annual recycling capacity of more than 100,000 tonnes of rLDPE which is suitable for use in new film applications.

Rolf Morssinkhof, co-owner of the Rymoplast group, says: "As a European leader in plastic recycling, Morssinkhof-Rymoplast services a wide range of businesses. And the demand for plastic recycling continues to grow exponentially. This strategic investment enables us to grow along with our customers."

A similar motivation is behind an expansion on another continent by **Sirmax**. The Italy-based producer of compounds – including compounds with recycled content – has invested $30m in a

Benvic ups its game in PVC recycling

Compounding company **Benvic** has steadily grown its in-house recycling and compounding capabilities in PVC and other materials, particularly since it acquired French recycler Ereplast in 2018.

Initially the post-industrial and post-consumer recyclate from Ereplast was used to offset and reduce the amounts of virgin material being compounded through Benvic's main PVC plant in Chevigny, France. It says this was useful in supplementing in-house scrap from Benvic's main PVC production areas and also in extending synergies with Benvic's other manufacturing sites in Poland, Italy, Spain and the UK. In 2020, Ereplast was responsible for producing more than 3,000 tonnes of PVC recyclate to distribute to all Benvic customers in Europe.

Eric Grange, Benvic's Product Marketing Manager, says: "Our initial positioning involved a low-cost and low-performance approach by mixing all incoming recycling material." But this very quickly changed as Benvic sought to integrate recyclate in compounds and maintain the polymer performance to be as good as a prime material.

Benvic is learning from its experiences and acknowledges the difficulties of working with different PVC markets. Grange says the majority of applications are from the construction industry – window and door profiles and pipe technology. Other markets are more difficult to cover due to limited collection, for example. Rigid PVC grades are currently much more recycled as soft PVC has the problem of plasticiser additives.

greenfield facility in the USA to recycle PP from post-industrial waste. SER North America, the group's 13th plant, is located in Anderson, Indiana, next to its Sirmax North America plant which was built in 2015 and produces compounds based on polyolefins, ETPs, TPEs and bio-based materials.

SER North America has a production capacity of 33m lbs, adding to 100m lbs of capacity at the existing plant in Anderson. It has two production lines dedicated to recycled materials.

Sirmax says: "Incoming waste material is controlled at the source through stringent supplier selection and later processed to obtain high-quality output materials. SER North America's recycled PP is intended both for industrial applications and to be processed by Sirmax North America as a secondary raw material for hybrid compounds marketed under the Green Isofil and Green Isoglass brands. These materials contain mineral fillers or are reinforced with glass fibre and are intended for the production of durable goods for the household appliance and automotive sectors. Though their performance is equivalent to high-grade compounds, they contain varying percentages of green material (depending on client specifications), which ensure they have a lower environmental impact."

Lorenzo Ferro, US country manager at Sirmax Group, says: "SER North America marks a new stage in Sirmax's sustainable growth. These new green products give us the opportunity to enter sectors where we do not yet have a presence, such as industrial packaging or garden furniture. Our production processes and the fact we have full control of supply sources also means that we are ready to bring post-consumer mechanical recycling technology to the United States by 2024. The vertical integration we have undertaken with SER allows us to differentiate ourselves in the market and meet Sirmax client demands for more sustainable materials in the automotive and household appli-

IMAGE: CMG

Right: New GT30 machine from CMG Granulators

ance sectors – all without compromising on traceability and the high quality standards required for premium materials, which are already being supplied today."

Suppliers of auxiliary equipment to processors continue to help them deal with production scrap. **CMG Granulators** has introduced a new in-line granulator series for thermoformers, suitable for use with scrap sheet, skeletal sheet and reject parts. The new GT series comprises four models, suitable for small to medium capacities, to cover applications ranging from 200 to 1,000 kg/h.

The company highlights the blade set-up design: "The rotor blades are positioned at a high degree of inclination, 50°, in respect to the bed blade, so to guarantee the best cutting precision, the highest dimensional homogeneity of the regrind, the lowest sound emissions and absence of powder."

The cutting chamber does not utilise cast or welded components but is "bolt and dowel" assembled. Energy usage is 20 Wh/kg, compared to over 40 Wh/kg that a conventional unit consumes, says CMG. The GT models are low profile to be positioned underneath the finished product conveyor belt.

Conair says that its redesigned ScrapSaver fluff feeder offers higher film scrap capacity and better reclaim efficiency. The device feeds granulated film scrap (fluff) into a stream of virgin material, which is then delivered to an extruder for processing. Designed for use with in-line granulation systems, the latest version has a larger main hopper and top plate – for greater fluff surge capacity. It also boasts an improved auger and auger shaft – to deliver higher fluff-to-virgin ratios to the extruder.

The twin-chamber hopper holds granulated film fluff in a large main chamber and virgin material in a smaller side chamber – keeping both separate until just before they are introduced into the screw flights. To prevent fluff from bridging, the new unit uses a longer, stronger one-piece auger that can drive higher fluff re-feed ratios to the extruder throat. The ScrapSaver unit mounts, via an adapter, directly to the extruder feed throat.

Extruded thermoplastic elastomer edge trims can be efficiently recycled with **Getecha** RotoSchneider granulation technology. In this context, Getecha provided its RS 2402-E granulator as a solution for a customer that manufactures drive belts and conveyor belts which needed to grind TPE and TPU edge trim. Tailored to the special requirements of the customer, the RS 2402-E was equipped with 4 kW drives, which give the infeed mills a crushing capacity of up to 80 kg/h of regrind.

The RS 2402-E has a two-part funnel in front of the infeed opening which enables two edge trims to be fed into the roller infeed at the same time, without them crossing over. It also has an intelligent controller for regulating the infeed speed, which also includes an automatic switchover to buffer mode. If the feed speed falls below the minimum, the control system developed by Getecha prevents the formation of disruptive fine material and unwanted dust particles.

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IMAGE: GETECHA

Right: The two-part funnel of the RS 2402-E granulator from Getecha enables two elastomer edge trims to be fed into the roll feeder at the same time

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MARKET REPORT: The European Waste Plastics Value Chain and Mechanical Recycling Industry

This is the second edition of AMI Consulting's report on the European mechanical plastics recycling industry. Expanding on the previous edition, the report will provide a comprehensive analysis of the market for recycled commodity polymers, with essential insights to understand trends, address industry challenges and assess future growth potential within the region.

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MARKET REPORT: Recycling of Flexible Polyolefin Films in Europe 2021

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

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MARKET REPORT: Chemical Recycling, Global Status

This report defines and analyses three different forms of chemical recycling; solvent based purification (dissolution), depolymerisation and thermal processing. This authoritative report provides you with an independent quantitative analysis of the global chemical recycling industry status in 2020, it reviews the existing technologies and forecasts how the sector will develop over the next decade.

> Click here for more info

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

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

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

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

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

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

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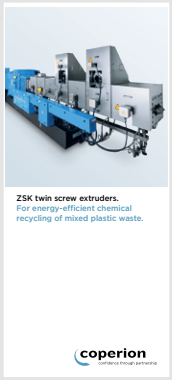
COPERION: CHEMICAL RECYCLING



Chemical recycling promises a new way to handle certain end-of-life plastics. Learn how Coperion's high performance ZSK twin screw extruders can be effectively applied in this fast developing plastics processing sector.

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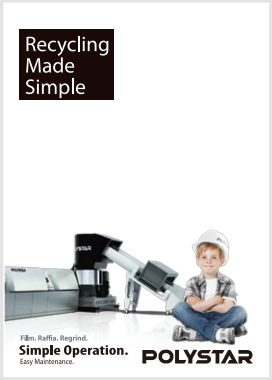
POLYSTAR: PLASTICS RECYCLING



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

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GLOBAL COLORS GROUP

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

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STRUKTOL: CREATIVE RECYCLING

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

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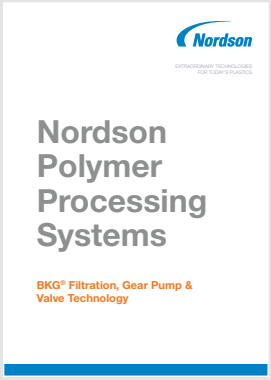
NORDSON: FILTRATION SYSTEMS



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

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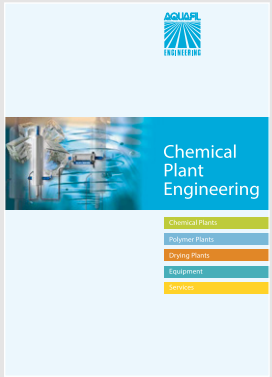
AQUAFIL: PLANT ENGINEERING



This 12-page brochure from Aquafil Engineering details its comprehensive range of chemical plant engineering capabilities, which include polyamide polymerisation, polyester condensation and polymer drying installations.

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

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Plastics Recycling World March/April 2022
The March/April edition of Plastics Recycling World takes a look at the challenging area of wind turbine blade recycling. It also explores the latest developments in melt filtration and additives for recycling and reviews the rPET market.

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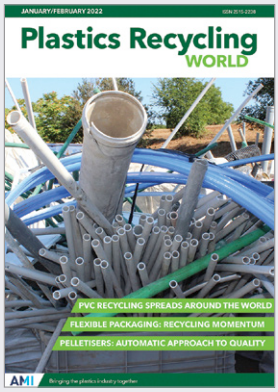

Plastics Recycling World January/February 2022
The January-February issue of Plastics Recycling World looks at how PVC recycling is spreading around the world and the growing momentum in flexible packaging recycling, plus new developments in pelletisers.

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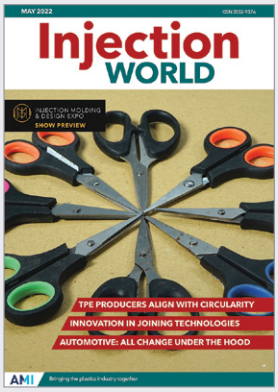

Injection World May 2022
The May edition of Injection World magazine takes a look at how TPE producers are responding to the needs of the circular economy. It also explores some of the latest innovations in plastics joining technologies and under-the-hood automotive.

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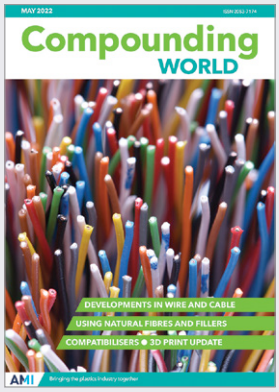

Compounding World May 2022
The May issue of Compounding World looks at how electric vehicles and other growth markets are supporting demand for wire and cable. Plus features covering plant-derived natural fibres and fillers, compatibiliser additives, and 3D printing materials.

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Pipe and Profile May/June2022
The May-June issue of Pipe and Profile Extrusion examines corrugated pipe, how it continues to find use in cutting-edge projects, and how machinery producers look to improve speed, performance and control. Plus features on recycling/ granulators and pressure pipe.

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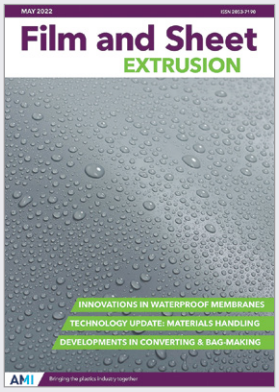

Film and Sheet May 2022
The May edition of Film and Sheet Extrusion has features covering advances in waterproof membranes, how polymer processing can be improved through materials handling and developments in converting and bag-making.

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

GLOBAL EXHIBITION GUIDE

2022	**20-23 June**	Plastics Recycling Show, Amsterdam, Netherlands	www.prseventeurope.com
	20-24 June	Wire, Dusseldorf, Germany	www.wire-tradefair.com
	22-23 June	Solids, Dortmund, Germany	www.solids-dortmund.de
	28-30 June	Foam Expo North America, Novi, MI, USA	www.foam-expo.com
	26-30 September	Colombiaplast, Bogota, Colombia	www.colombiaplast.org
	27-29 September	Fachpack 2022, Nuremburg, Germany	www.fachpack.de
	3-7 October	Plastex, Brno, Czech Republic	www.bvv.cz/en/plastex/
	19-26 October	K2022, Dusseldorf, Germany	www.k-online.com
	9-10 November	Recycling World Expo USA, Cleveland, USA	https://na.plasticsrecyclingworldexpo.com
	1-3 December	Plast Print Pack West Africa, Accra, Ghana	www.ppp-westafrica.com
2023	**17-19 January**	Swiss Plastics Expo, Lucerne, Switzerland	swissplastics-cluster.ch
	1-5 February	PlastIndia, New Delhi, India	www.plastindia.org
	17-20 April	Chinaplas 2023, Shenzhen, China	www.chinaplasonline.com
	13-16 May	Moulding Expo, Stuttgart, Germany	www.messe-stuttgart.de/moulding-expo/en/
	30 May – 2 June	Equiplast, Barcelona, Spain	www.equiplast.com
	14-15 June	Recycling World Expo Europe, Essen, Germany	https://eu.plasticsrecyclingworldexpo.com

AMI CONFERENCES

7-8 June 2022	Compounding World Congress, Cologne, Germany
7-9 June 2022	Plastic Closure Innovations, Barcelona, Spain
14-15 June 2022	Chemical Recycling Europe, Cologne, Germany
28-30 June 2022	Polymer Sourcing & Distribution, Hamburg, Germany
16-17 August 2022	Agricultural Film, San Diego, CA, USA
13-15 September 2022	Plastics Recycling Technology, Vienna, Austria

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

www.ami.international

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