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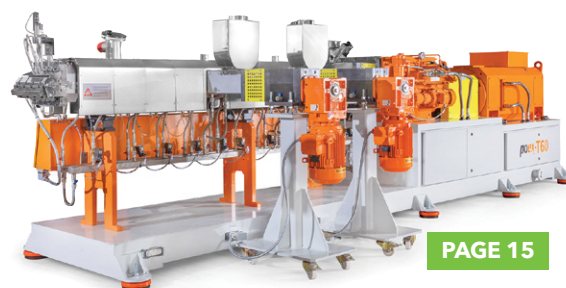
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Compounding WORLD

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Manufacturers of twin screw compounding machinery are optimising and tuning equipment to meet specific customer processing demands. COVER IMAGE: JSW



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\$5m investment at Star Plastics

US technical and toll compounder Star Plastics has commissioned a new 78mm diameter Leistritz twin screw compounding line at its plant at Ravenswood in West Virginia, its largest machine to date.

The new high torque compounding line is part of a planned \$5m investment programme that will see the installation of a new 58mm diameter extruder in April this year, as well as infrastructure improvements and the addition of a customer service centre.

According to Star, the high-torque Leistritz machine provides improved

material incorporation and dispersive mixing during production, while its optimised screw design allows higher quality and output. It will support the company's plans to broaden its product line and become a full-service supplier of engineering-grade compounds.

"Our customers asked us to expand our current portfolio and capabilities—they want our quality, service, and delivery on even more material options, and we are going to provide them with just that," said Star Plastics CEO Donald Wiseman.

In particular, the company intends to

offer a wider range of glass-filled and crystalline materials. To that end, the equipment investments support Star's partnership agreement with Italian specialty resin compounder Lati, which was established in December 2020 and will see it manufacture Lati grades at its plants in North America.

Star Plastics currently operates eight lines across its two US sites at Ravenswood and Millwood in West Virginia. The company also has additional production capacity at its licensed Star Plastics Shandong facility in China.

➤ www.starplastics.com

SI ups AO capacity in China

SI Group has increased production capacity for its Ethanox 4716 and Naugard PS48 hindered phenolic ester antioxidants at its Jinshan, China facility.

The company said the move will help address growing demand for antioxidants in the Asia-Pacific region. While the Ethanox product is predominantly used in lubricants, Naugard PS48 is a liquid phenolic antioxidant that provides good protection across a broad range of polymer applications.

The expansion follows SI Group's announcement in May last year that it was to invest more than \$50m to develop globally competitive main antioxidant capacity at three of its production sites in North America.

➤ www.siigroup.com

Avient makes LFTs from fishing nets

Avient has launched the Complèt R range of long fibre-reinforced thermoplastic (LFT) compounds, which contain post-consumer recycled PA6 reclaimed from end-of-life fishing nets.

"Historically, it has been a challenge to source streams of recycled resins that are compatible with the pultrusion process used to manufacture long fibre composites. But we're committed to leading the industry by offering sustainable options even in our performance-critical materials like long fibre composites," said Eric Wollan, General Manager



IMAGE: AVIENT/GETTY IMAGES

for Long Fibre Technologies.

According to the company, Complèt R PA6 LFTs provide stiffness, strength, and toughness performance on par with standard formulations using virgin resin. Formulations are available globally in a

standard black colour with glass, carbon fibre, or hybrid reinforcement combinations. Levels of post-consumer resin content vary according to specific performance and sustainability requirements.

➤ www.avient.com

BASF widens RegXcellence scope

BASF has extended its existing RegXcellence regulatory support service to its plastic additives customers.

Part of the company's Valeras portfolio, RegXcellence provides "targeted access to a range of global regulatory support", the company said. The service includes digital solutions and a variety of simplified regula-

tory issue management tools.

"With the extension of the successful RegXcellence service to include plastic additives, we now enable our customers to benefit from our extensive regulatory service and expertise," said Dr Thomas Kloster, President of BASF Performance Chemicals.

➤ www.performancechemicals.basf.com

Celanese agrees \$11bn deal to acquire most of DuPont ETPs business

Celanese is to buy the majority of DuPont's Mobility & Materials (M&M) business in an \$11bn deal. The move, subject to regulatory approval, includes much of DuPont's Engineering Polymers business – but not its Delrin POM business – and some of its Performance Resins and Advanced Solutions business lines.

Celanese CEO Lori Ryerkerk said the move will make Celanese “the pre-eminent global speciality materials company, significantly enhancing the breadth and competitiveness of the EM [Engineering Materials] product portfolio”.

The acquisition will give the company a portfolio of speciality materials extending to PA6, PA66, speciality PAs such as HPPA, PET, PBT, and thermoplastic elastomers and including the Zytel, Rynite, Crastin and Hytrel brands. Together they are expected to deliver an EBITDA of about \$900m in 2022. Celanese also gains a global production network of 29 facilities employing about 5,000, an IP portfolio of some 850 patents, plus customer and supplier contracts.

Celanese Senior VP of Engineered Materials, Tom Kelly said the company will “combine the product and technology leadership of M&M with the commercial



IMAGE: DUPONT

Above: Around half of the acquired material portfolio goes into automotive and growing EV applications

excellence and customer engagement model of EM to accelerate our growth in high-value applications”. The acquired materials go mainly into automotive, E&E, consumer goods, and industrial applications. Automotive accounts for about half and electric vehicles are a growing proportion of that.

“The geographic fit with EM is exceptional as M&M expands our presence in Asia and results in a combined business with a broader scale in high-growth regions. Within Asia, M&M has a significant presence outside of China with strong customer relationships in Japan and Korea that will support growth, particularly in auto,” he said.

Kelly said the deal roughly doubles the size of the Celanese EM business, adds depth in key end

markets and makes it more diversified as well as more back-integrated in some materials, notably PA66 and PBT. Celanese anticipates run-rate synergies of approximately \$450m within the first four years after closing.

Already a major player in POM, Celanese is not buying the Delrin POM business, which had net sales of about \$550m in 2021. Other M&M businesses not included in the Celanese deal are Auto Adhesives, Multibase additives, and Tedlar PVF products, which together reported \$950m in sales in 2021.

DuPont has also agreed to retain and indemnify Celanese for certain liabilities, including those relating to PFAS.

➤ www.celanese.com

➤ www.dupont.com

IN BRIEF...

Covestro inaugurated two new production lines for PC compounds at its Greater Noida Plant near Delhi in India at the end of last year. The expansion more than doubles PC compounding capacity at the plant.

www.covestro.com

Honeywell is to supply **TotalEnergies** with polymer feedstock recycled using its UpCycle chemical recycling process technology at a joint venture plant it intends to build with Sacyr in Andalucía, Spain. Due to open in 2023, the UpCycle plant will have capacity to reprocess around 30,000 tonnes/yr of plastic waste.

www.totalenergies.com

www.honeywell.com

Working with GSM Sella and Aurora Kunststoffe, **Gabriel-Chemie** has developed a masterbatch that is being used to produce 30,000 new stadium seats from post industrial recycled PA66. The masterbatch is said to guarantee mechanical, flame retardant and UV resistant properties.

www.gabriel-chemie.com

Lanxess is now offering verified environmental product declarations (EPDs) for selected groups in its Bayferrox synthetic iron oxide pigment range. EPDs are based on life-cycle assessments, in this case carried out by the Institut für Bauen und Umwelt.

www.bayferrox.com

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Autotech-Sirmax grows in India

India's Autotech-Sirmax – a joint venture between Mumbai-based Tipco Group and Italy's Sirmax – has invested INR90m (around \$1m) in new equipment to lift capacity of its compounding plant at Valsad.

The investment includes high speed, multi-port, co-rotating twin screw extruders with a capacity of 10,000 tonnes/yr, the company said.

Installed in February, these increase installed capacity to more than 45,000 tonnes/yr.

According to Autotech-Sirmax Marketing Director Ankur Betai, the new lines will help it cater for rapidly increasing market demand for high-quality engineering thermoplastics such as PA6 and PA66, ABS, PC, PC/ABS, PBT and PP compounds.

The Autotech-Sirmax joint venture was established in 2017. Tipco Group has been producing PP compounds in India since 1982. It also makes engineering plastic compounds, LFTs, biodegradable compounds and recycled materials, which it supplies to the Indian and Southeast Asian markets.

➤ www.autotechsirmax.in

Solvay announces plans to expand in polysulphones

Solvay has announced a multi-year expansion plan for its US-based sulphone polymers business "to build capacity in this field to support a growing global customer base."

The first steps will include 25% capacity increases for Udel PSU at Marietta, Ohio, and for the building block dichlorodiphenyl sulphone at Augusta, Georgia. The latter is due onstream by the end of 2022, with much of the PSU expansion expected online by early 2023.

The company said it also plans to increase capacity for Veradel polyether sulphones and Radel poly-



Above: Solvay's production site at Augusta in the US

phenyl sulphones (scale of that expansion has not been disclosed).

Key application market segments for the materials include life science applications such as haemodialysis,

medical instruments and pharmaceuticals. They are also used in water purification, where Solvay expects double-digit global demand growth.

➤ www.solvay.com

Cabot ups compounds in Asia

Cabot Corporation has broken ground on a new speciality compounds facility to be co-located with its existing carbon black manufacturing site at Cilegon in Indonesia.

Expected to operational at the end of 2022, the new facility will add 20,000 tonnes/yr of new capacity for speciality compounds, including black masterbatch and conductive compounds.

The company said the new unit will satisfy increasing demand in Southeast Asia.

➤ www.cabotcorp.com

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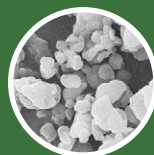
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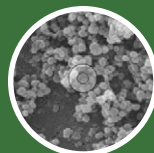
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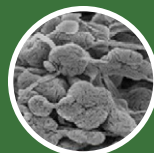
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Global masterbatch market set to grow 5% pa to 2025

The global market for thermoplastic masterbatch is worth around \$30bn and forecast to grow in excess of 5% annually to 2025, according to the latest market analysis from AMI Consulting (part of *Compounding World* parent company AMI).

Fastest growth rates – double-digit – will be seen in developing global regions, the Thermoplastic Masterbatch Global Market report says, with more moderate growth evident in the long-established markets of Europe, North America and north east Asia.

In volume terms, the main masterbatch markets – black, white, colour and additive – are fairly evenly split.

However, in value terms colour is the largest sector at around 40%.

Additive masterbatch will see the fastest growth rates, propelled by surging demand for more advanced product formulations to meet increasingly complicated customer requirements that frequently combine pigments with various additives.

The fastest growth for all product types to 2025 will be seen in China and the Indian subcontinent. The Indian market, in particular, will see double digit growth in many applications as converters adopt manufacturing technologies that use masterbatch rather than traditional colouring.

While technical performance is a key processor requirement, demand for products that are more environmentally friendly and easier to recycle is growing – a response to upcoming legislation and consumer and brand pressure. Masterbatch manufacturers are having to develop new products and adapt existing product formulations in a relatively short time scale, which means the R&D focus of many key players is now heavily on sustainability, the report says.

Click [HERE](#) for more information about the Thermoplastic Masterbatch Global Market 2022 report, or contact hanne.jones@ami.international

AF-Color up again

KD Feddersen Group company AF-Color is back in full production after fire at its plant at Niederrissen in Germany last November.

Renovation of the plant included two additional extrusion lines, increasing its total colour and additive masterbatch capacity.

> <https://af-color.com>

Durethan proves its pace

Glass reinforced PA6 compounds from Lanxess are being used in the one-piece chassis of the OKMOS SL-01 electric skateboard developed and manufactured by French company EMI.

The trough-shaped deck of the SL-01 houses all the required electrical and electronic components and also acts as the main structural element. Weigh-



IMAGE: LANXESS/EMI

ing just 2.5kg, the hybrid thermoplastic composite part is produced using a Tepex continuous reinforced PA6 sheet formed and then

overmoulded with a short glass reinforced Durethan PA6 compound.

> www.lanxess.com
> www.okmos.fr

Rifra Masterbatches teams with Microban

Antimicrobial specialist Microban has announced a distribution agreement with Italy's Rifra Masterbatches.

"Most masterbatch producers have decided to avoid an antimicrobial product portfolio because of the challenges associated with formulation and regulatory requirements," said Elisabetta Rampa, General Manager at Rifra Masterbatches.

"However, we wanted to address the needs of our customers, and have chosen to work with Microban, the global leader in the field, to achieve this goal," she said.

Microban said the partnership with Rifra will begin as a distribution agreement, but both parties hope to explore opportunities for co-development. "We look forward to discovering

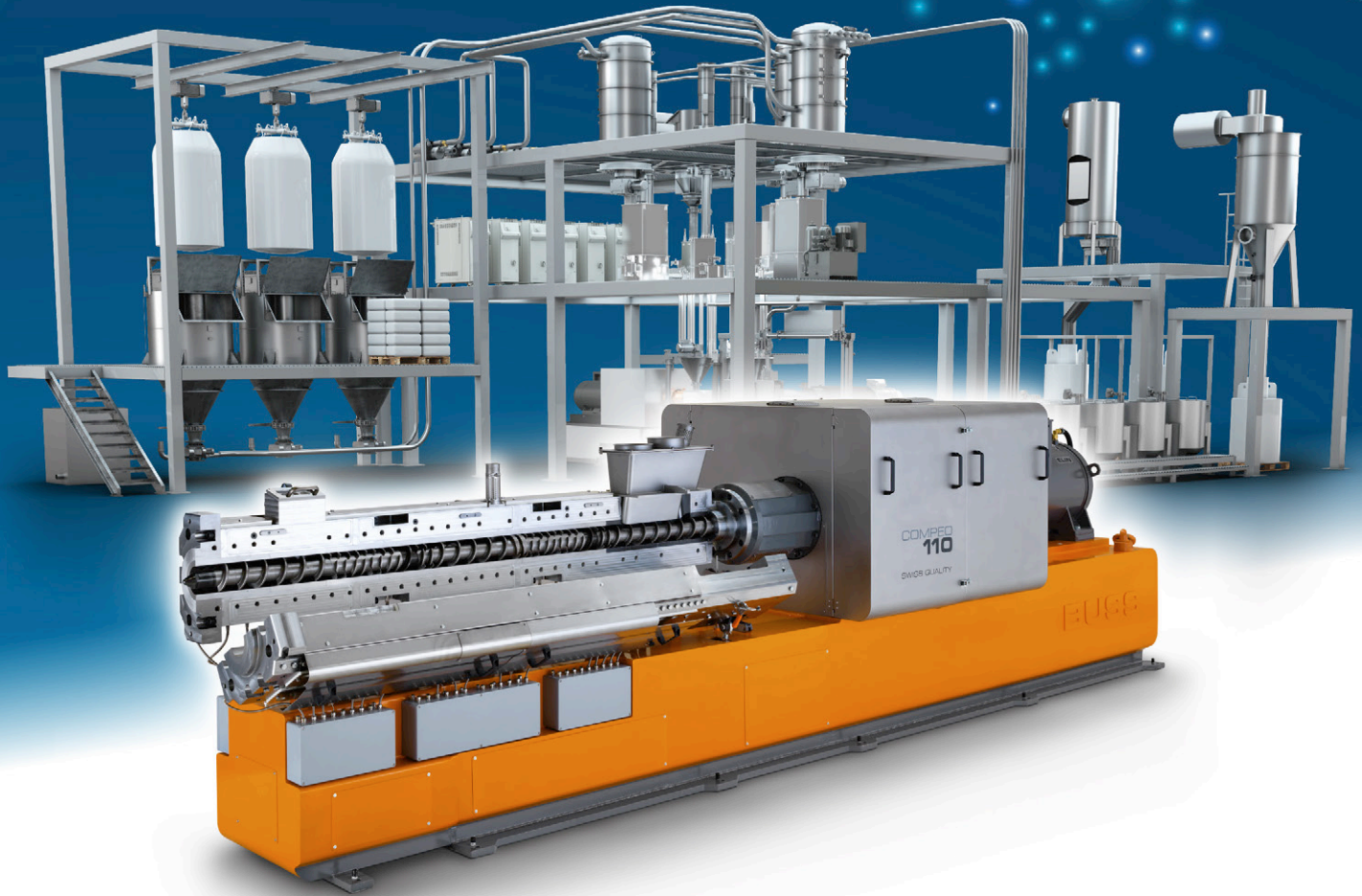
some really exciting prospects on the horizon together," said Giorgio Rimini, Director of Business Development for Europe at Microban.

Based at Molinetto in northern Italy, Rifra manufactures colour and additive masterbatches on 11 lines for use in commodity and engineering polymers.

> www.microban.com
> www.rifra.it

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Compound Company expands with Exxelor

Netherlands-based The Compound Company has acquired the production site, including product portfolio and customer base, for Exxelor resins from ESSO Deutschland/ExxonMobil at Cologne, Germany.

The company said the acquisition will increase its global production capacity to around 70,000 tonnes/yr and significantly extend its reach into new markets.

"We are very excited to welcome the Exxelor manufacturing force and portfolio in our organisation," says Frans Haafkens, major shareholder in The Compounding Company. "The acquisition...ideally comple-

ments our established offering of Yparex extrudable adhesives and EcoForte compound families. It provides great synergies to further grow our customer base, with new opportunities in several dynamic application areas such as, for example, e-mobility."

Exxelor polymer resins are chemically modified polyolefin and elastomer-based resins typically used to enhance the performance of engineering thermoplastics and other polymers. They can be used as impact modifiers to improve the toughness of compounds, as well as compatibilisers, coupling agents and

adhesion promoters.

"Our strategy is to use the addition of these performance resins as leverage for expanding into a wider range of markets," said Wouter van den Berg, Commercial Director at The Compound Company. "The production site and the brand will be maintained."

The Compound Company was founded in 2005, acquiring the Yparex extrudable adhesive resins business from DSM Engineering Plastics in 2011. Group companies include Netherlands-based Transmare Compounding and Indonesian jv Resindo.

➤ www.thecompoundcompany.com

DSM invests in China

DSM Engineering Materials is to expand capacity at its Jiangyin plant in China's Jiangsu province. Work to install an additional compounding line began in February, with completion expected during 2023.

The new line, DSM said, will help it "to meet growing demand for high-performance polymers used in a wide range of end-applications, particularly for electric vehicles and in electrics, and electronics".

The materials the new line will produce will include Akulon PA6 and PA66, Arnite PET and PBT, Arnitel TPC, EcoPaXX PA410, ForTii PA4T and PPA, and Stanyl PA46 grades.

"The Jiangyin site's new compounding line enables us to further expand our specialty materials offering for customers in China, supporting their growing demand for sustainable electrics, electronics, and automotive products," said Caroline Mitterlehner, Vice President Specialties at the company.

➤ www.dsm.com

LFT cuts weight for DonFeng

SABIC worked with Dongfeng Motors, one of China's largest truck manufacturers, to develop a plastic composite hybrid toolbox using its Stamax LFT PP.

The finished part, which is up to 30% lighter than a steel alternative and requires no painting, combines the Stamax LFT PP with a continuous composite laminate of unidirectional glass fibre-reinforced PP supplied by Chinese firm QiYi Tech.

The laminate tape inserts add stiffness to critical areas, enabling the use of thin-wall geometries that can reduce weight. The tapes are pre-heated and formed in the mould, then overmoulded with the Stamax LFT in a single operation.

➤ www.sabic.com



IMAGE: SABIC

Sumitomo Chemical adds LCP capacity

Sumitomo Chemical is to install more production lines for its SumikaSuper brand of liquid crystal polymer (LCP) at its Ehime factory in Niihama, Japan.

The company said the new lines will be in operation during the summer of 2023 and will add 30% to total capacity.

Demand for LCP is being driven by the rollout of 5G and the growth in production of electric vehicles, according to Sumitomo. It said it will consider further expansion "as the LCP market is expected to grow rapidly supported by higher-speed, larger-

volume data communications and advances in the field of mobility".

In addition to the Ehime site, Sumitomo Chemical also produces LCP at the Harima plant operated by its Taoka Chemical subsidiary.

➤ www.sumitomo-chem.co.jp

IMAGE: ORION ENGINEERED CARBONS



Above: The Orion Engineered Carbons plant at Ravenna in Italy

Orion opens Italian facility

Carbon black producer Orion Engineered Carbons has commissioned a new production unit at its site at Ravenna in Italy. The 25,000 tonnes/yr line will produce both specialty and technical rubber grades.

Alongside the capacity investment, which the company claims is the first new carbon black reactor to be commissioned in the EU in more than 40 years, the site has been equipped with a new 120 MWh electricity cogeneration unit.

The company earlier announced net sales of \$1.55bn for 2021, up by \$410m on 2020, and said it

delivered its second highest adjusted EBITDA, 34% up at \$268m for the full year. Adjusted EBITDA weakened in Q4 of last year, however, due to various planned plant turnarounds and general supply chain disruptions.

"The [Orion] team positioned us well for the future in terms of fairer pricing, product qualifications and increased growth," said CEO Corning Painter. "Even as COVID continues to affect global markets, I am confident that we have positioned ourselves very well in 2022."

➤ www.orioncarbons.com

European proposal to restrict PFAS delayed

The European Chemicals Agency ECHA said proposals to restrict manufacture and use of per and poly-fluoroalkyl substances (PFAS) have been pushed back six months due to the volume of data collected during the

consultation period. Netherlands-based RIVM, one of the agencies working on preparation of the restriction dossier, says it will now be submitted in January 2023.

➤ www.echa.europa.eu

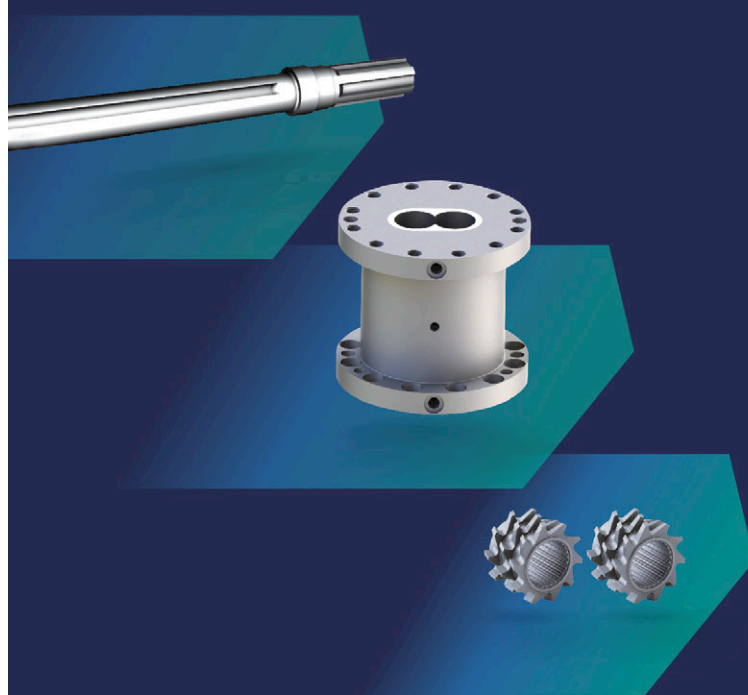
➤ www.rivm.nl

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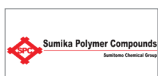
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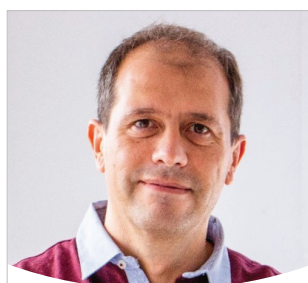
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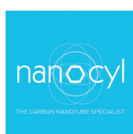


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IMAGE: ICMA SAN GIORGIO

Manufacturers of twin screw compounding machinery are optimising and tuning equipment to meet specific customer processing requirements. Peter Mapleston reports

Fine-tuning provides peak performance

Most producers of twin-screw compounding extruders today are providing customers with the opportunity to have equipment built for specific processing applications. That trend to broadening product line-ups to include machines with special features or enhanced capabilities appears, however, to be gaining pace.

A growing number of twin-screw extruder makers are adding high-torque units to their line-ups, for example. Last June, US-based **Entek** introduced its HT72 co-rotating twin-screw model, which offers a torque density of 18 Nm/cm³, placing it among the highest in the industry. Features include a 1.61 D_o/D_i screw ratio, robust construction and powerful motor intended to make it a workhorse for continuous production.

The HT72, which Entek says is the first in a new machine series, is designed for commodity compounding and masterbatching customers requiring medium-to-large batch production sizes and high production rates. The company says that, when coupled with its new Vacuum Feed Technology (VFT), the HT72 can drive throughputs even higher in processes that involve feeding of low density fillers.

Another new Entek feature available on the HT72 is the company's Vent Flow Sensor. It says that is designed to detect developing vent flow problems, giving operators the time required to correct processing issues before they become problematic. "This device will effectively reduce unplanned downtime and help reduce safety issues, including the risk of fire," the company claims. "It will also make vent flow cleaning easier."

The trend towards automotive electrification is providing an additional impulse to lightweighting initiatives such as replacement of metallic parts with polymer-based alternatives, according to **Shibaura Machine** (previously Toshiba). The company says that a knock-on effect of that is growing demand for co-rotating twin screw extruders.

The company (then Toshiba) launched its TEM-58SX ultra-high-torque twin-screw extruder back in 2011. Since then, the line-up has been expanded to include the 26SX, 37SX, 41SX, 48SX, and 75SX. The company says characteristics common to all these models are high kneading and low temperature extrusion, energy saving and production cost reduction by reducing specific

Main image:
This ICMA system for production of high-performance electrical cable compounds provides full access to the screws and barrels

Right: Entek's new HT72 extruder is its first high torque model offering a torque density of 18 Nm/cm³

energy, and improved productivity through ultra-high torque and high speed.

"The basic performance of the twin-screw kneading extruder required to achieve the above can be evaluated by three items: allowable torque, maximum screw rotation speed, and screw deep groove ratio," the company says. "These mechanical performances continue to advance year by year in response to diversifying market needs."

Shibaura says allowable torque is an indicator of how much mechanical energy can be applied in order to sufficiently distribute, disperse, mix and extrude the raw materials supplied to the twin-screw kneading extruder. The mechanical elements that determine allowable torque are the drive system component, the screw shaft and the screw element. In particular, it highlights the use of a special spline on the screw shaft to reduce stress

Right: The TEM-41SX from Shibaura is part of its high torque compounding extruder series

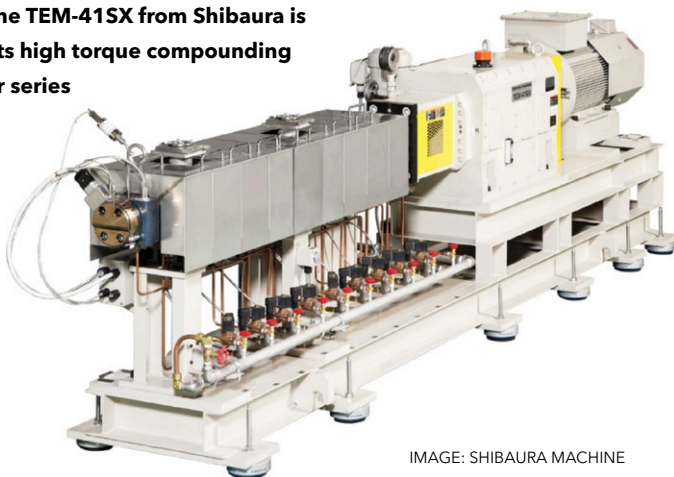


IMAGE: SHIBAURA MACHINE



IMAGE: ENTEK

concentration. High strength and high toughness alloys and special manufacturing methods are used to ensure fatigue resistance and enable high torque transmission without increasing the shaft diameter.

The TEM series is now in its sixth generation. The latest TEM-SX series machines provide 3.6 times greater allowable torque compared to the TEM-A series. An increase in torque density means greater extrusion mass at constant screw rotational speed, or a decrease in screw rotational speed at constant extrusion mass. Further productivity improvement and quality improvement are possible compared with the conventional machine, according to the company.

"Approximately 10 years have passed since the launch of the TEM-58SX, the first TEM-SX series, and it is our intention to further improve mechanical performance in order to contribute to the benefit of users by responding to the needs of adding new functions to plastics or increasing their functions," Shibaura says.

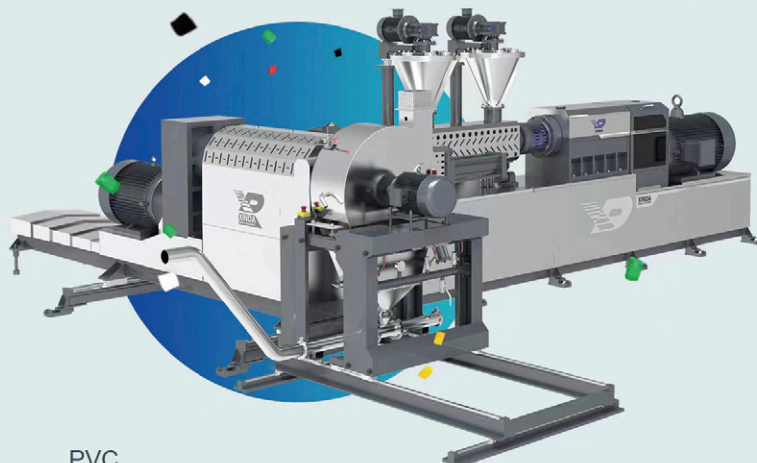
Around the beginning of this year, Turkish compounding machinery maker **Polimer Teknik** says it successfully tested a new line for processing glass fibre reinforced compounds. The line was based on a Poex T60HT unit with 58 mm screws

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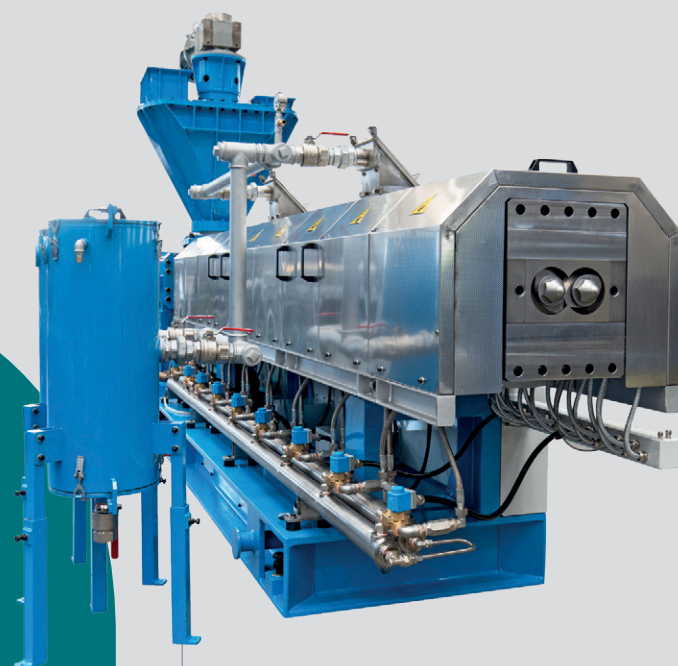
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Right: The Poex T60HT from Polimer Teknik provides a torque density of 16 Nm/cm³

and a maximum speed of 900rpm capable of providing a high torque density of 16 Nm/cm³. The company says this design provides 50% more capacity than the standard T60 series, which provides 12 Nm/cm³ torque density.

In this new application, the extruder is equipped with two side feeders to enable addition of a variety of fillers. The line uses Brabender gravimetric feeders, each handling up to four components, while the strands are cooled in a water bath and dried with a suction dewatering system. The bath and dewatering systems are both built by the company, as are the accompanying strand pelletiser and vibrating screen. Polimer Teknik says the strand die was developed by its engineers to ensure stable strand flow and uniform pellet shape.

Output capacity for the line running a 30% glass fibre reinforced PA is up to 1,300 kg/h. The company says it will show a smaller Poex T40HT extruder with the same high torque density at the K2022 trade fair in Dusseldorf in Germany in October of this year.

Right: JSW's V-kneading elements incorporate grooves to intensify melt flow at the tip

Easy opening

Italy's **ICMA San Giorgio** says it recently completed two highly customised co-rotating twin-screw extruders for customers producing specialty high value compounds. The first unit, intended for production of high-performance electrical cable compounds, features a special maximum access barrel opening system. This was required in this application because the material is highly heat-sensitive and requires an extreme clean of both cylinder and screws at the end of each production cycle.

The company's opening solution makes the entire surface of the barrel and the two screws fully inspectable and cleanable. ICMA says it is a sophisticated and refined technical solution that

Below: ICMA purpose-built this extruder with slide-away barrel for processing of fluoropolymers

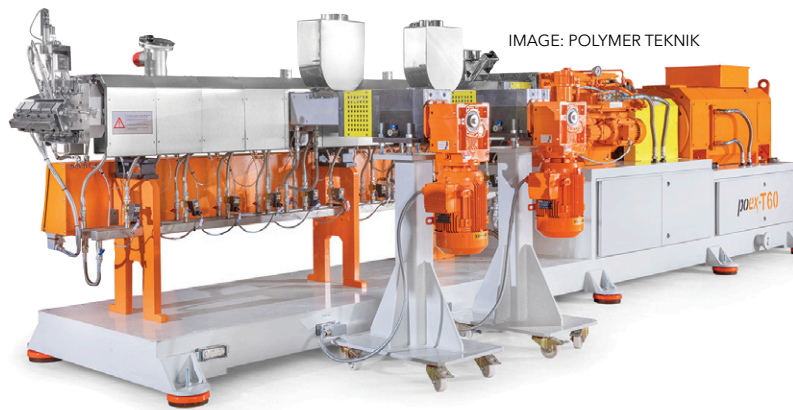


IMAGE: POLYMER TEKNIK

means additional cost. However, it says it has proved to be particularly efficient in specific high added value processing applications where the risk of contamination is elevated and the self-cleaning capacity typical of the co-rotating system is not sufficient for the purpose.

The second extruder, intended for a customer processing fluoropolymers, employs a

different barrel opening arrangement with a "sliding" movement. Again, it enables complete inspection and cleaning of the screws and the barrel surfaces. In this application, the extruder operates at high process temperatures and the steels used are selected to ensure maximum resistance to corrosion.

Japanese compounding equipment maker **JSW** has developed a new

kneading element for its TEX twin screw extruder. Named the V-kneading element, it features a V-shaped flight tip that forces the polymer flows to merge into one, so creating high localised pressure and increasing the polymer flow passing through the tip clearance area. The company says this makes it possible to achieve better dispersion performance compared to a conventional kneading element.

According to JSW, recent experiments have shown that the V-kneading has conveying and distributive mixing performance similar to conventional kneading elements. "Its behaviour is simple and predictable, and no special technique or philosophy [is] required to utilise it," the company says.

The V-kneading element can be applied to a variety of processes, from general compounding and polymer alloys to reactive processes. JSW says it already delivered V-kneading prototypes to several customers during 2021 and says feedback has been positive. Elements are now available for customer trials and rental purposes.

At India-based **Steer**, Managing Director and Chief Knowledge Officer Babu Padmanabhan says

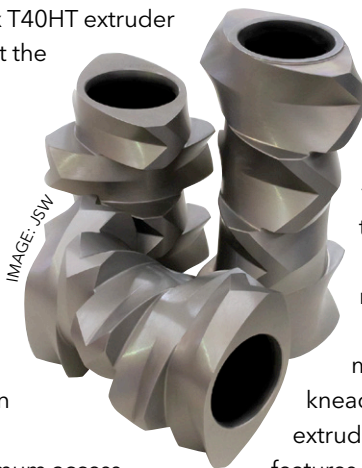


IMAGE: JSW



IMAGE: ICMA SAN GIORGIO



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Step-by-step tips on element removal

Removing elements from extruder shafts is a necessary task but not always an easy one. Leistritz Extrusion Technology provided some tips on removing stubborn elements in its latest extrusion newsletter.

1. Work on the screws immediately after cleaning off the outer surfaces and, if possible, while they are still hot. If they have cooled, put them back into the hot extruder barrel for 20 minutes or so to heat up again. The separate them and work on each one at a time.
2. Support large screws evenly using blocks as long shafts can deflect and cause assembly issues.
3. Unscrew the tip (wear gloves) then try to slide off the final element. If it will not slide off, heat it with a propane torch. This may take some time. Apply heat evenly.
4. Remove the warmed element by sliding it straight toward the shaft end. If it still doesn't move, an off-the-shelf pneumatic impact hammer fitted with



IMAGE: LEISTRITZ EXTRUSION TECHNOLOGY
Above: Removing elements for cleaning or screw reconfiguration can be simplified using a structured approach

- a brass tip may be needed.
5. When using the impact hammer, angle the brass punch against the screw flight and in the direction you want it to move and give it a few hits. Continue the heating and hammering cycles until the element moves.
 6. Once the element is off, repeat the above process for the next. As each element is removed, brush-clean and scrape the exposed shaft to make it easier to remove subsequent elements.
- <https://extruders.leistritz.com/en>



IMAGE: LEISTRITZ EXTRUSION TECHNOLOGY
Above: An impact gun with a brass tip can help loosen stuck screw elements without risk of damaging elements or shafts

the company has made a "critical breakthrough" in enhancing fatigue strength of working components and in particular those in dynamic movement such as screw shafts, gearbox shafts and screw elements. "We have also advanced metallurgies, material treatment and hard facing solutions to ensure that the most stringent and demanding applications for wear and corrosion can be addressed with maximum life expectancy," he says.

On the business front, Padmanabhan likely speaks for many when he says the company sees a considerable amount of pent-up demand being released in 2022, giving rise to investments as well as better utilisation. "We see business willing to experiment and try alternatives in the "new normal," able to question and justify changes specifications that were never changed for decades in component drawings. We see that the business leaders are less risk averse and more risk aware since the advent of the pandemic," he says.

Germany's **Coperion** has optimised its SK92 die head for improved throughputs, incorporating a number of "smart" features. In a single row configuration, the optimised die produces 100 strands; double row versions produce 160 strands.

The company says the new die head uses an intelligent heating/cooling concept to ensure highly homogeneous temperature distribution is achieved across its full width. In addition, flow geometry has been optimised to enable uniform output with only minimal pressure loss.

Smart features on the SK92 are said to greatly simplify its maintenance and operation. For example, all mounting bolts can now be loosened in a single circular motion while a telescopic rail on the swing arm makes moving it aside a simple task that can be carried out by one technician. It also reduces the time required to gain access to the process area, helping to make screw changes and die head cleaning very fast.

After exiting the die head, extruded strands transfer to an automatic strand conveying system (ASC) where they move to the pelletiser's feed mechanism via a cooling water chute and then a conveyor belt. Start-up is fully automatic, as is the conveying and rethreading of broken strands, eliminating product loss and without interrupting production. Coperion's largest automatic strand conveying system, the ASC 700, is said to be appropriate for compounding systems running at

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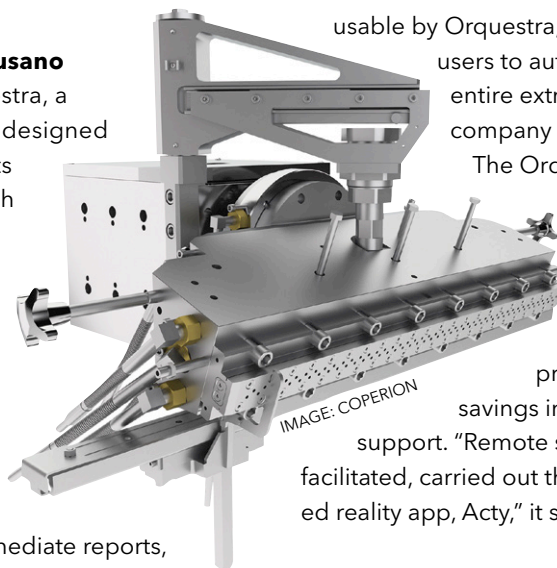
Coperion's optimised SK92 die head is said to achieve even flow across the entire width of the die

up to 6,000 kg/h.

Italian manufacturer **Bausano** recently introduced Orquestra, a centralised control system designed to integrate all components of the extrusion system with Industry 4.0 technologies, such as smart diagnosis and predictive maintenance.

According to the company, the Orquestra system ensures continuous and real time monitoring of all production parameters and can generate immediate reports, using easy-to-understand graphs to present performance indicators such as machine status, quantity of waste produced, and working hours.

"Thanks to the Bausano IIoT Data Manager, it is possible to connect all the machines present on the site, integrating them with corporate management systems, such as ERP, MES and CRM, [for] automated management of production recipes. The analysis of raw data, collected and made



usable by Orquestra, makes it possible for end users to autonomously optimise the entire extrusion process," the company says.

The Orquestra system is also enabled to support predictive maintenance programmes, which Bausano says should guarantee higher productivity levels and savings in time and technical support. "Remote support operations are also facilitated, carried out through Bausano's augmented reality app, Acty," it says.

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The introduction of electric vehicles is presenting opportunities for long fibre reinforced thermoplastics while new lightweight applications continue to emerge. Mark Holmes reports



IMAGE: POLYPLASTICS

Long fibre thermoplastics stretch their potential

Long fibre thermoplastics (LFT) technology continues to develop. While automotive applications maintain their market dominance, other industry segments are increasingly attracted by the promise of low weight and high strength – LFT PP compounds can, for example, provide lower cost alternatives to metals but also to more costly technical engineering polymers.

According to a report published in September 2021 by **AMI Consulting** – a division of *Compounding World* publisher AMI – market penetration of PP continues to rise. The report quantifies the use of both granular form LFT PP (LFT-G) and direct in-line compounded LFT PP (LFT-D) and tracks use around the world. It says LFT PP is used widely in automotive front-end carriers, instrument-panel carriers, door-panels, consoles, pedals, underbody shields and many other automotive applications. A feature of many of these applications is that LFT PP is replacing steel – thereby

reducing weight – or substituting for more expensive engineering plastics.

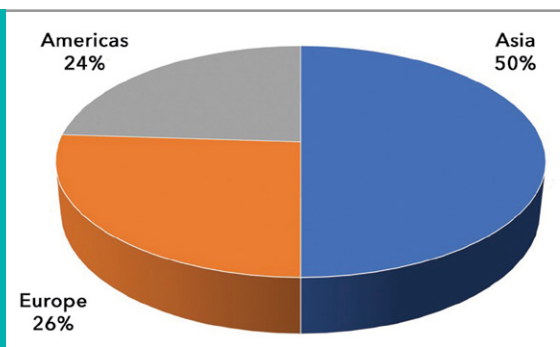
AMI Consulting forecasts strong growth for LFT PP through to 2025, although it says the pace of growth varies across different application sectors, automotive OEMs, and geographical markets. In the past, Europe was the volume leader in LFTs but that has changed. The report says that in 2020 Asia accounted for 50% of global demand for LFT PP, compared with 26% in Europe and 24% in the Americas (Figure 1).

One of the fastest growing application areas is liftgates, where designs range from all-metal to virtually no metal. In metal-free designs LFT PP is used to provide structural strength and is complemented with high performance PP to provide a paintable exterior skin. In the most demanding applications, the structural interior LFT PP elements are exposed so a good aesthetic finish is required. Plastic liftgates are particularly valuable to electric

Main image:
Potential to provide integrated one-piece weight-saving alternatives to conventional metal or even ETP designs is driving new interest in LFTs

Figure 1: The global market for LFT PP

Source: AMI Consulting 2021



vehicle producers as a new way of saving weight.

The shift towards electric and hybrid vehicles, while threatening some existing polymer applications, is creating new opportunities for LFT PP as designers rethink concepts and adopt new approaches. The report cites the example of the Tesla 'frunk' – the trunk, or storage compartment, at the front. This makes use of the space at the front of the vehicle for storage but needs to be designed with the conventional automotive front-end ability to absorb impact in a collision.

The strong interest in LFT materials is confirmed by US-based **RTP Company**, which offers an extensive range of LFT materials. "Replacing metal parts or over-engineered short glass fibre compounds remain the primary growth opportunities," says Zach Halverson, Structural Products Business Manager at the company. "For example, short glass fibre polyamide compounds can often be successfully replaced with long fibre polypropylene compounds, offering a lower cost and lower density solution."

RTP also offers long fibre technology in engineering and high-performance base polymers such as PEEK, PPA, PEI and PPS. These combine the desirable mechanical and thermal attributes of the polymers with the additional benefits of long fibre reinforcement. They are said to be good options for metal replacement in especially demanding environments, such as in the oil and gas industry, where other materials fall short (Figure 2).

Halverson says the automotive industry continues to be the largest consumer of long fibre thermoplastics and that any disruptions in that sector inevitably influence usage. 2021 was a particularly volatile year for the car industry, especially with supply chain issues, but he expects RTP to see strong demand through 2022 as the automotive industry works through its build backlog. He also expects to benefit from further organic growth and additional parts being converted to LFTs to meet weight reduction and fuel efficiency goals.

As the major end-user of LFTs, the performance

needs of the automotive industry are a key driver in LFT development. Current challenges include increasingly stringent VOC limits, the ability to withstand long-term heat ageing for more than 1,000 hours at 150°C (Figure 3), more robust UV resistance, and the ability to achieve highly aesthetic Class A surface finishes directly out of the mould. Often several of these requirements are demanded in one application.

To address these automotive challenges, RTP says its Product Development Team works in close collaboration with leading additive technology suppliers, performing extensive experimental compounding of new formulations. The company says it is also highly invested in the best compounding processes, while regional availability enables it to offer the same product consistently in any region of the world.

"One of the latest products developed by RTP Company is a 40% long fibre polypropylene compound for automotive liftgates," says Halverson. "Automotive liftgates require good UV resistance and mechanical properties, Class A surface finish with no visible fibres, long flow paths, low VOCs, and be colourable to tight colour targets. This material flows very well to fill large parts with long flow paths while achieving excellent aesthetics and good mechanical performance."

Alongside performance, sustainability is now very often a mandated requirement, according to Halverson. "RTP Company has been working on a line of sustainable long fibre polypropylene products to support these initiatives. Our Product

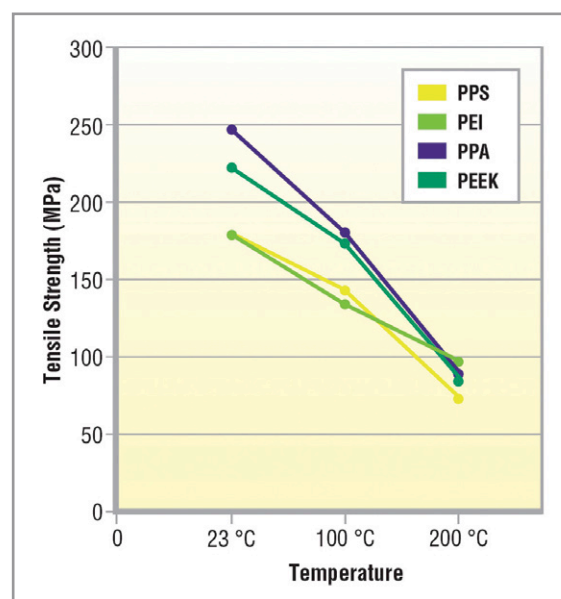
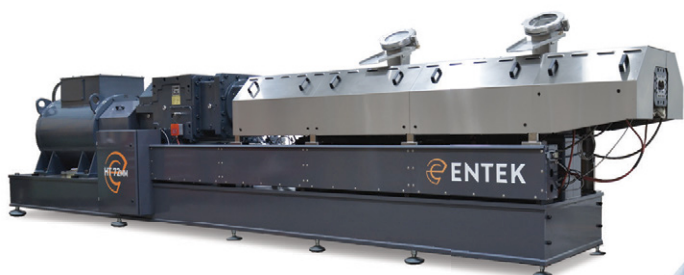


Figure 2: Tensile strength values for a range of VLF 40% long glass fibre reinforced performance polymer compounds from RTP

Source: RTP Company

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Right: RTP has developed a high flow 40% long fibre reinforced PP compound for automotive liftgate applications

Development Team can customise our long fibre polypropylene materials to specific physical properties, recycled content, and cost, which can be used as drop-in replacements for prime grade materials in some applications." He says the aim is to be able to offer cost-effective, turnkey solutions to customers looking for sustainably-sourced raw materials beyond PP, adding that RTP is already well positioned to provide similar solutions in other base polymers, such as PA6 and PA66.

Long fibre technology is now an established sector of the thermoplastics market, according to **Avient**. "It has been nearly 40 years since the first long fibre reinforced thermoplastic materials were introduced in the early 1980s. So the industry is definitely at, or reaching, a mature stage, especially in the commodity segment for materials like long glass fibre polypropylene, which has a plethora of suppliers," says Eric Wollan, General Manager of Long Fiber Technologies.

"Most market research reports indicate the market for long fibre materials will continue to grow with a CAGR in the high single-digit range for the foreseeable future. Growth has always been



IMAGE: RTP COMPANY

prominent in the automotive industry, where long fibre materials are valued for their lightweighting capability in metal replacement scenarios. The growth of materials usage is in tandem with increasing global car and truck builds," he says.

Transportation is not the only market segment that values weight reduction. Wollan says that discretionary consumer products, particularly sporting goods, and industrial equipment are moving towards more portable devices to reduce user fatigue.

While lightweighting is often high on product designers' wish lists, there are many other benefits that come with metal-to-composite material changes. Cost reduction is a primary driver and is easy to achieve when switching from metal fabrication to injection moulding production. The metal-like performance of long fibre composites, combined with their outstanding durability, also enables the production of very robust products that do not have the "disposable" connotation often associated with lower-performing plastics. He says that is an essential consideration in a world that is increasingly looking at the life cycle of materials.

However, he says LFT suppliers must continue to innovate to meet changing demands. "Long fibre

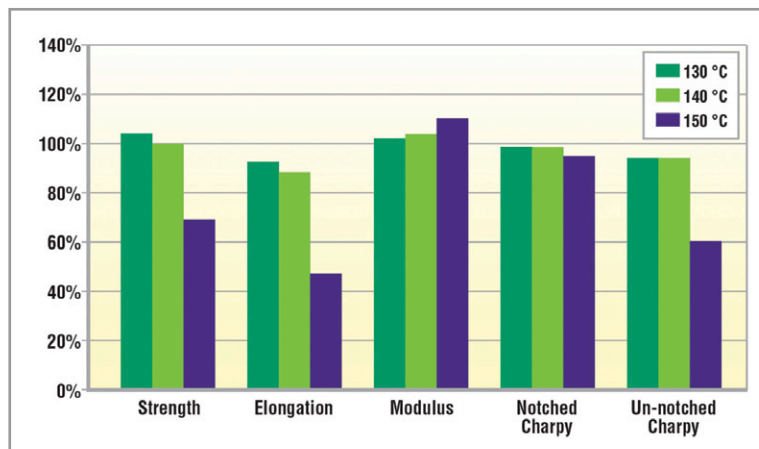


Figure 3: Long term 1,000 hour heat ageing data at different temperatures for a 40% long fibre reinforced PP compound from RTP
Source: RTP Company

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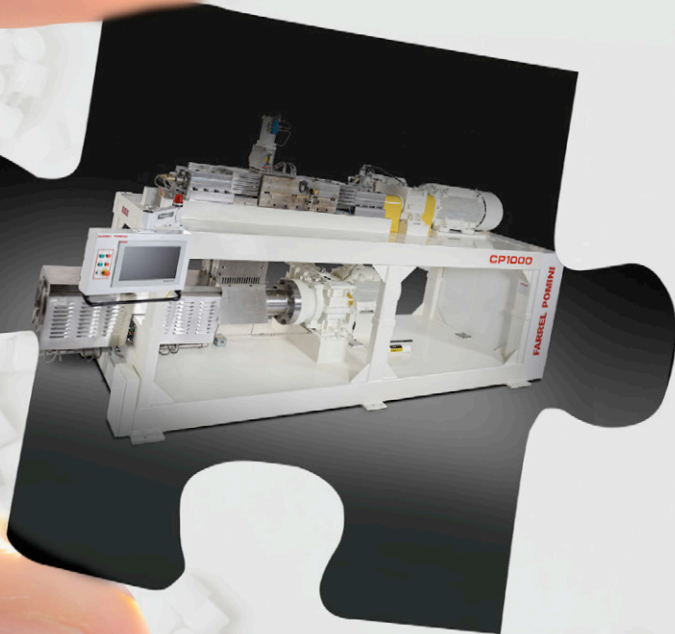
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Right: LFTs are valued for their lightweight and strength in applications such as off-road vehicles

manufacturers need to address the lack of sustainable material options quickly to meet evolving consumer preferences. Not just any recycled or bio-derived thermoplastic can be fibre-reinforced due to the precise nature of the pultrusion process used to manufacture long fibre materials, Wollan says.

"We cannot just sit around and wait or throw our arms in the air either. A lot of work remains to be done by suppliers to locate and develop methods to clean up streams of recycled thermoplastic feedstocks so that sustainable options are available that can provide the consistent performance required of materials offering structural performance," he says.

Avient recently introduced a series of moisture-resistant PA6 and PA66 materials reinforced with long glass or carbon fibre that address the conditioned performance degradation concerns that arise when PA is intermittently exposed to water or used in environments with changing humidity. The new Complēt materials are said to offer significant cost savings over traditional speciality PA options yet meet the expectation that a product will perform the same whether used in a humid coastal location or an arid inland one.

The new long glass fibre variants also offer a surface finish free of visible fibre, which makes them suitable for use in exposed applications where the industrial appearance of standard long fibre materials would be unappealing to many consumers. Surface gloss levels greater than 70 can be obtained in polished moulds without the use of high mould temperatures, so cycle times are not extended.

The Complēt moisture resistant PA6 and PA66 products are stabilised to slow moisture uptake and to moderate environmental performance degradation where consistent performance is required in a range of climates. They provide conditioned structural performance at a level



IMAGE: AVIENT

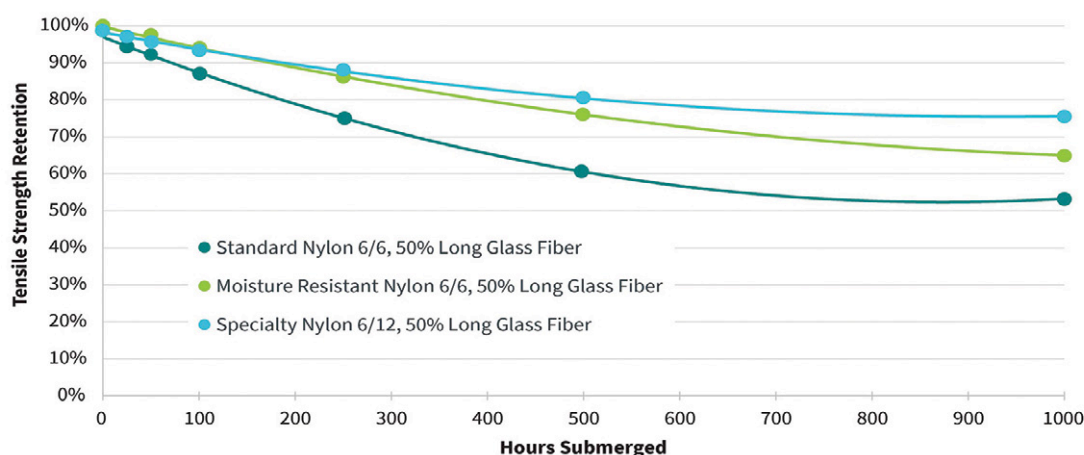
between standard and speciality PAs, and are expected to find application in lightweighting initiatives in the automotive or powersports industries (Figure 4).

The grades are claimed to provide improved flow at high fibre content levels, which eases filling of thin wall sections or long flow lengths. In addition, they exhibit up to 30% less cross-flow shrinkage, which minimises warp distortion. Formulations are available with varying percentages of long glass fibre, long carbon fibre, or hybrid combinations.

Looking to the future, Avient says it is evaluating different streams of recycled resin from both the post-industrial and post-consumer spectrums. "This is to determine which are compatible with the pultrusion process used to manufacture long fibre composites without degrading structural performance," says Wollan. "There are several promising candidates across the range of polymers commonly used to manufacture long fibre materials. We want to be a leader in this space and meet our customers' sustainability goals without compromising long-fibre performance."

Figure 4: Tensile strength retention of Complēt moisture resistant PA66 after extended water submersion to 1,000 hours compared to speciality PA6/12 and standard PA66 LFT alternatives

Source: Avient



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Owens Corning committed to LFTs

Glass fibre producer Owens Corning announced in October last year that it was to review strategic options for its thermoplastics dry-use chopped strand business (DUCS), which supplies producers of short glass reinforced compounds.

Part of the company's composites division, the DUCS business generates sales of around \$270m and includes production locations in North America, Europe and Asia. A spokes-

person for the company said the review process, which could involve divestment or repurposing of assets to other product lines, is still ongoing.

"We expect to be able to provide substantive progress updates near the end of the first half of 2022; however, this timeframe will ultimately be determined by the path of what is a comprehensive review process," the spokesperson said.

The DUCS review does not extend

to Owens Corning's composite activities in the LFTs sector, which the company supplies with its T30 line of single end glass fibre rovings. T30 products are supplied to a broad range of composite markets, including LFT-G and LFT-D production and continuous fibre reinforced thermoplastic tapes as well as thermoset applications such as wind blade, rebar, and pultruded construction profile production.

➤ www.owenscorning.com

Last year, Japan's **Polyplastics** launched its first LFT products under the Plastron LFT brand. Developed by Polyplastics' parent firm Daicel, the new product line will be available in PP, PA6, PAMXD6 and PA9/T base resins with the option of glass or carbon fibre reinforcements at levels from 40-60%. In line with the growing interest in more sustainable materials, it says it is also offering a long fibre cellulose reinforced LFT PP with a 40% fibre content.

The company says key attributes of the Plastron materials include high stiffness and impact resistance, good dimensional stability and creep performance, and retention of physical properties at elevated temperatures. It claims that, due to the reduction in fibre fracture surfaces in the LFT materials, users will also see a reduction in wear.

Target application sectors include industrial pump housings, pipe fittings, and automotive components.

While most injection moulders use pre-compounded LFT materials, there is growing interest in direct technologies where the materials are compounded at the point of use.

German injection machinery maker **Arburg** continues to develop its Fibre-Direct Compounding (FDC) process. According to Manuel Wöhrle, lightweight construction expert and Team Manager Technology Sector Sales, the FDC process targets the equally important trends of innovation, lightweight construction, reduced unit cost and sustainability.

The FDC process is carried out on the injection moulding machine so it eliminates the pultrusion step used to manufacture LFT pellets. According to Arburg, direct compounding gives the processor maximum flexibility in material selection and tailored properties, as well as providing a reduction in carbon dioxide emissions, thermal stress on the resins, and material costs.

The FDC process involves feeding a continuous supply of glass fibre through a cutting device that chops the strands into application-dependant lengths, then via a side feeder directly in to the liquid melt in the injection machine barrel where it is homogenised. The system has a fully integrated control system for key parameters, such as run time, fibres per cycle and weight unit of rovings.

Arburg sees the technology being applied to replace the use of pre-compounded LFT pellets, as well as to substitute other engineering plastics technical materials or to upcycle recycled polymers. When substituting technical materials, the company claims up to 60% material cost savings can be achieved, as well as a weight reduction of up to 30%. ➤

Right: Arburg claims its direct FDC LFT process technology gives processors more flexibility in material selection and properties, as well as providing potential cost reduction



IMAGE: ARBURG



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Above: Leistritz twin screw compounding equipment is used in this Dieffenbacher LFT-D production system

The company claims a key benefit of the FDC process is the flexibility it gives to optimise fibre length in the final part. According to Frank Fischer, Senior Application Manager Composites, relatively short fibres are sufficient to improve E-modulus or stiffness. Where improved strength is required then long fibres equal to or greater than the critical fibre pull-out length are required.

German press maker **Dieffenbacher** is cooperating with twin screw extrusion machinery maker

Leistritz in a project for direct moulding of LFTs from recycled materials. Dieffenbacher is currently building a high throughput production line for manufacture of large-sized LFT-D components in the US using Leistritz extrusion technology.

For typical LFT-D processes incorporating 30-50% fibre content, two twin-screw extruders are used. Polymer and additive components are fed gravimetrically into the first extruder where the melt is plasticised before transfer to the second extruder, where a special die is used to achieve optimal incorporation and impregnation of the continuous glass fibre rovings. In the current development project, however, the required fibre content is only 10-20%. Leistritz Regional Sales Manager Frederick Huck says this means the process can be carried out with single-machine technology.

LFT-D technology is also being used in an LFT project between **Lanxess** and **Kautex Textron** to develop a manufacturing solution for battery housings for electric vehicles. The companies have developed a near-series technology demonstrator component with length and width of around 1,400mm as part of a feasibility study. The goal was

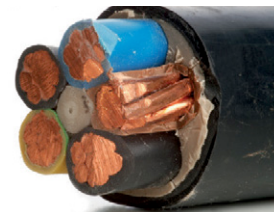
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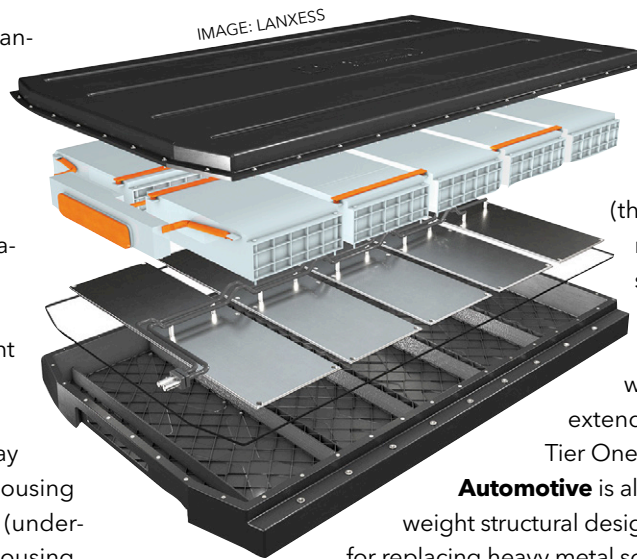
Right: Lanxess and Kautex Textron developed this demonstrator EV battery housing to prove the feasibility of LFT construction

to demonstrate the advantages of technical thermoplastics over metals in terms of weight and cost reduction, functional integration and electrical insulation behaviour.

Based on a battery housing for a C-segment electric vehicle, the demonstrator part consists of a housing tray with crash structure, a housing cover, and an underrun (underbody) protection. The housing components are produced in a single-stage LFT-D moulding process using an optimised Durethan B24CMH2.0 PA6 from Lanxess that is compounded with glass fibre rovings by Kautex Textron. Local reinforcement of the housing structure is carried out during the production process using Tepex continuous fibre-reinforced thermoplastic composites, also from Lanxess.

Currently housings for high-voltage batteries are primarily made of extruded steel or aluminium profiles. Depending on the vehicle class, housing length and width dimensions can be more than 2,000mm and 1,500 mm, respectively. The size and the number of components and manufacturing and assembly steps involved make metal housings very costly. In addition, the metallic components must be protected against corrosion in an additional process step, using treatments such as cathodic dip coating.

Lanxess and Kautex Textron say that by using plastics and integrating functions such as fasteners and thermal management components, the number of individual components in a battery housing can be greatly reduced, which simplifies

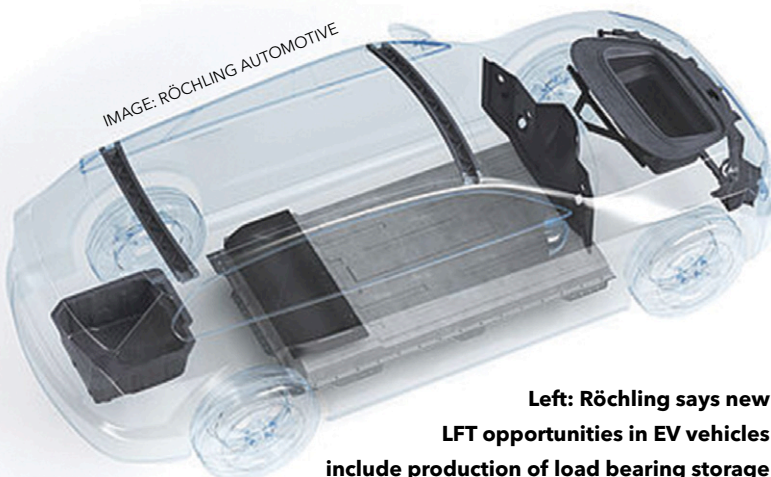


assembly and logistical effort. Plastics are also corrosion-resistant and electrically insulating (the latter ensuring reduced risk of the system short-circuiting) while their lower density provides weight savings to help extend vehicle range.

Tier One supplier **Röchling Automotive** is also developing lightweight structural designs using LFT-D materials for replacing heavy metal solutions in battery applications as well as body-in-white components. The company says LFT technology offers significantly better design and integration options while the lightweight designs support the strengths of alternative drive systems. Target applications include load-bearing tubs and troughs, battery covers and under-ride guards, and other structural components.

The company cites front-end carriers as an example where, through functional integration, the quantity of individual parts has been reduced. Lamps, sensors and active grille shutters can be directly integrated and installed at the factory, making handling easier and minimising production costs. The lower weight of the components also extends the range of electrically powered vehicles or reduces fuel consumption and carbon dioxide emissions.

Röchling is currently conducting research on further increasing the strength and stiffness of LFT designs through the use of continuous fibre reinforcement tapes. These allow reinforcing elements, which consist of continuous glass or carbon fibres embedded in a plastics matrix, to be placed into components along the load paths. This is said to ensure optimum use of materials to create higher performing components at a relatively small cost premium.



Left: Röchling says new LFT opportunities in EV vehicles include production of load bearing storage

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Turnkey routes to LFTs

Compounders looking to enter the LFTs market can now select equipment from a growing number of turnkey systems suppliers. Chris Smith learns more



IMAGE: FEDDEM

LFT compound production may be a niche market sector but it is a niche that is attracting increasing attention from compounding equipment makers. A number are now offering turnkey production systems that make joining the ranks of LFT compounders a much less challenging decision than in the past.

German compounding extruder maker **Feddem** says when it decided to enter the LFT market it decided to take a detailed look at the entire production approach to ensure the highest level of quality. "The technology of LFT pultrusion lines for the production of LFT-G long pellets had been around for several years," says Klaus Hojer, Business Development Manager at the company.

Part of the Feddersen Group, the machinery maker worked with sister company Akro-Plastic – a leading player in engineering compound production and particularly in performance PA-based materials. It is now using a number of Feddem LFT lines at its plant at Niederzissen in Germany.

"Feddem has taken a fresh look at the details of the line components to improve performance, quality and handling," Hojer says. "The result is not

only unprecedentedly tight tolerances from the fibre content in the pellets, but also the repeatability of the achievable material properties of the LFT compound produced on different lines and line sizes with haul-off speeds of up to 60 m/min."

A key element in the Feddem LFT production system is its die. "Impregnation establishes close contact between the filaments and polymer melt," says Hojer. "Thorough wetting of all filaments with melt is the goal of the process."

Feddem's die uses a modular construction. This allows it to be run using half the die without physical reconfiguration, which is said to be a useful benefit for production of development batches or small orders. The company currently offers 300mm and 600mm wide options, both said to provide optimised and uniform melt distribution to minimise variation in the polymer/reinforcement ratio.

The roving feeding system is also an important element in any LFT production system. The simplest systems allow the rovings to unwind from static spools mounted directly on the creel rack. This, however, results in twisting of the rovings,

Main image:
Compounding extruder manufacturer Feddem is one of a number of companies offering turnkey LFT-G production systems

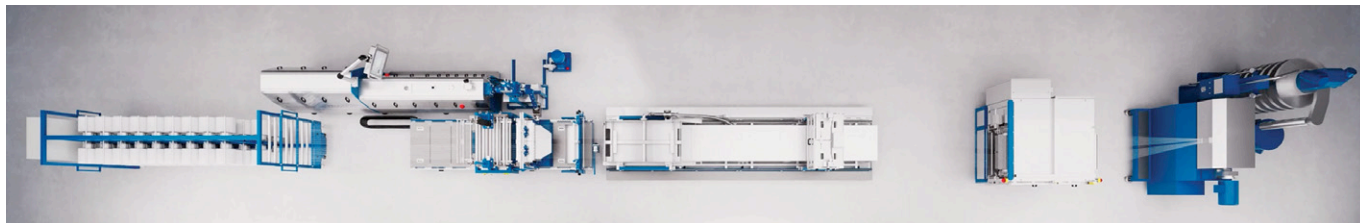


IMAGE: FEDDEM

Above: The parallel arrangement of the extruder in Feddem's LFT production line minimises system footprint

which results in potential quality issues in the final injection moulded part, according to Hojer. The Feddem systems use actuated unwinding systems to overcome this (turn-table systems for inside unwinding or tension-regulated hubs for outside unwinding). The unwound rovings are then pre-heated and tensioned prior to entering the die.

Downtime can be a major issue in LFT production as the line has to be halted when roving spools need to be replaced. Feddem claims that its system features – such as easy access to the fibre path in the tensioner and impregnation head, fast heat up times, and a computer-assisted start and restart procedure – allow typical changeover times to be halved without sacrificing pellet quality.

The numerous components of an LFT line also means they can take up a considerable amount of floor space in the compounding plant. Hojer says its design minimises footprint by arranging the extruder (Feddem is unusual among turnkey LFT system providers in using its own extruder design) parallel to the roving line. This takes the overall width of the line down to less than 3m rather than the 5-6m typically required where the extruder is placed at 90°.

Feddem says it took particular care to ensure this space-saving arrangement did not compromise maintenance so all the key components – including cartridge heaters, solenoid valves and digital I/O units – can be accessed without needing to enter the space between extruder and impregnation unit.

Germany's **ProTec Polymer Processing** – probably best known for its plastics materials handling and preparation systems – made its first move into the LFT sector in 2015 when it acquired the

German LFT equipment and technology developer PolymersNet. Since then, the company has sold more than 20 turnkey lines, according to Managing Director of Marketing Tim Rudersdorf.

This year, Protec installed a production-sized line at its plant at Bensheim, which it is making available to customers for formulation development work and for production lots. "In the case [that] you buy a line from us, you can use [our] capacities to overcome delivery time and enter your market even before your line is set up," Rudersdorf says.

Protec says thermal management of the incoming glass and finished pultruded strands, together with optimised die design and pelletising equipment, are among the key factors in achieving high output rates in LFT-G production. Rudersdorf says its lines – which can also be configured to produce continuous fibre reinforced thermoplastic tapes – now offer LFT output rates up to 1,000 kg/hr.

Rudersdorf says that, in terms of materials, the main drivers in the LFT global market today are PP and PA. Interest continues to grow in Europe, Asia-Pacific and North America but the highest growth rates, he says, are expected in Asia-Pacific. Protec has already supplied LFT production equipment to Chinese compounders Suzhou Sunway and Suzhou Hechang.

Germany's **IPS Intelligent Pelletizing Solutions** says it decided to enter the LFT systems as a result of a growing level of enquiries for LFT pelletising systems. "Our main business is still the manufacturing of pelletising systems and compounding equipment," says Managing Director Simon Weis. "We already had most devices of a LFT plant in our portfolio; due to that we decided to develop the remaining units for a complete system."

The company partnered with Cetex Institut, which is located in Chemnitz in Germany and is a specialist developer and manufacturer of fibre handling systems. It supplies the tangential unwinding technology for the LFT HP system; IPS is responsible for the remainder of the line.

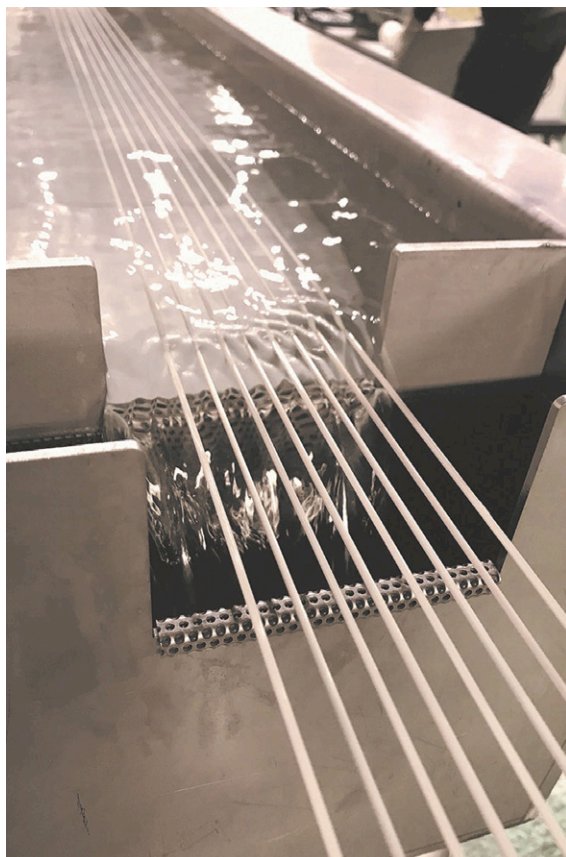
The company has an 8-strand pilot plant available for customer trials at its plant at Niedernberg. "We haven't installed any production line with our customers yet, but we are optimistic to change this situation in the next few months," Weis says. "We have a couple of LFT projects which are running."

Below: Protec has delivered more than 20 of its LFT-G production systems to date



IMAGE: PROTEC POLYMER PROCESSING

IMAGE: INTELLIGENT PELLETIZING SOLUTIONS



Weis describes the LFT-G market as "a niche market, which is getting bigger and bigger." He says the company has, to date, seen the highest level of interest from European companies and largely from organisations that already have some presence in the sector.

While interest is growing, getting the true value of LFTs across to many end users remains a challenge, according to Weis. "Unfortunately, most of them just compare the material prices and the data sheet values of LFT products and standard compounds. That is, in my opinion, the complete wrong way," he says. "Customers should evaluate the material behaviour under the realistic boundary conditions of the final application."

Weis says he believes the true potential of LFTs is in their thermomechanical behaviour, which delivers real gains in the most demanding metal replacement applications requiring outstanding crash behaviour and long term structural stability.

Left: IPS has an 8 strand pilot LFT line in operation at its plant in Germany

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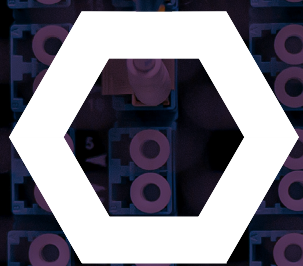


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Special effect pigments and masterbatches can provide unique looks as well as improving sustainability. Jennifer Markarian reports on some of the latest developments

Delivering effects to shimmer and shine

The impact of social media on our everyday lives has been huge, changing the ways people communicate but also calling for new considerations in product presentation that meet the needs of the digital age. Packaging is no exception. While the aesthetics of packaging and consumer goods have long been important for shelf appeal, today's craze for posting images to social media is adding a new dimension for plastic compound formulators to consider.

"The packaging industry is impacted by the 'Instagram effect,' which necessitates high sparkle effects to enhance products so they will photograph well," says Dr Breeze Briggs, Technical Industry Manager for Colour Materials at **Sun Chemical**. "We see more requests coming in for our brilliant and colour-travel effect pigments. Effect pigments must provide a 'wow' factor for such applications."

Briggs points to Sun Chemical's SunMica Lux, which she says achieves this packaging wow factor, particularly in the high-end cosmetics packaging sector. The product is based on synthetic mica,

which makes it cleaner and whiter due to a lower level of naturally occurring minerals than typically found in natural mica. It is also optically pure, ultra-smooth, and available in a range of various particle sizes to give product developers options for creating different looks, she says.

Sun Chemical – a division of DIC Corporation which last year acquired and integrated BASF's global Colors & Effects business – also recently added several effect pigments to the Lumina Royal series. "Lumina Royal Sparkling Blue is a high chroma, blue-shade effect pigment with intense colour. It delivers exceptional chromaticity and unmatched lightness to style vibrant new colours throughout the aqua to violet colour areas. Its strong sparkle provides an attractive eye-catching appearance for economical solutions," says Briggs. "Lumina Royal Blue Russet is a semi-transparent bluish-russet shade effect pigment based on synthetic mica. It provides intense colour in applications that have demanding weathering requirements."

Main image: Sparkle and gloss are proving increasingly attractive options for plastics used in applications ranging from packaging to consumer goods

Right: New additions to the Royal Lumina range of sparkling pigments include aqua blue (left) and magenta



Recycling requirements

Recycling –or the ability to recycle – is fast climbing up the list of pigment selection criteria. The impact of colours and effect pigments on recycling depends on many factors, including the type of pigment and base polymer, as well as the recycling sortation technology and the markets for the recycled material. It is a complex situation that is evolving, both as new technologies become available (for example, NIR-sortable dark-coloured pigments) and as organisations make decisions about how to improve plastics recycling.

Some of the colours and effects used in certain polymers are not unrecyclable, but may be considered detrimental to recycling. According to the US Association of Plastic Recyclers (APR) Design Guide, for example, an optical brightener effect used in HDPE is considered detrimental to recycling because it can create “unacceptable fluorescence for next uses of recycled HDPE.” The guide adds that “it is difficult to identify material with this negative effect until extremely late in the recycling process.”

According to APR, opaque colours are not a problem in HDPE because there are markets for coloured recycled material and it is economical to process. However, for PET recyclate, APR lists opaque coloured and white and transparent colours other than blue or green as “detrimental” because of reduced market value (while the mixed-colour stream is currently less valuable, it is not inconceivable that a future market opportunity may change the economics of recyclability in the future).

Effect pigments do not prevent recycling, but the pigmented parts will typically become part of the mixed-

colour recycle stream. That aside, both conventional and effect pigments can also be used to create aesthetically pleasing colours even from mixed-colour recycled material, says Briggs. “For example, by covering sparkle with large particle size effect pigments, we can hide existing effects. Or, when presented with darker coloured polymer in the mixed recycle, we can create a pop of colour with transparent effects that can create a product that is both aesthetically pleasing and a good use of mixed colour recycle material,” she explains.

Briggs says that Sun Chemical continues to research pigments that can improve plastic packaging recycling and reduce carbon footprint.

Another major consideration is the durability of effect pigments. **Shepherd Color Company’s** Starlight effects, for example, can stand up to multiple processing cycles. “Starlight FL grade special effects are especially resilient to physical degradation due to their robust and inherently inert borosilicate-glass substrate and passivated silver effect layer,” says Mark Ryan, Marketing Manager for The Shepherd Color Company.

The appeal of gold

There is also an ongoing trend towards the use of gold colours, extending from a reddish-gold tone up to a white-golden hue or tint, says Thomas Hummel, Head of Technical Department at masterbatch producer **Gabriel-Chemie**. The company is using a new metallic effect pigment from **Schlenk** –Zenexo GoldenWhite WB 21 YS. These effect pigments are based on Ultra-Thin-Pigment (UTP) technology, which creates a thin aluminum substrate encapsulated with silica. It is said to give a deep and high-gloss surface, creating a metallic lustre that enables coloured plastics to replace metallized plastics. Hummel says the driver to replacing metallizing is to reduce the number of production steps and the associated costs. The pigment and masterbatches made with it are suitable for food and cosmetic packaging, as well as for more durable goods.

Lifocolor Group has launched a series of highly reflective pigment masterbatches that create a brilliant gold effect that it says is in high demand for cosmetics, beauty and personal care packaging.

The effect masterbatches provide high opacity in polyolefins, even at low levels (between 2 and 3%), which gives a vibrant, rich appearance even for thin-wall packaging,

Right: Gabriel-Chemie’s Zenexo GoldenWhite WB 21 YS aims to replace metallization in packaging closures



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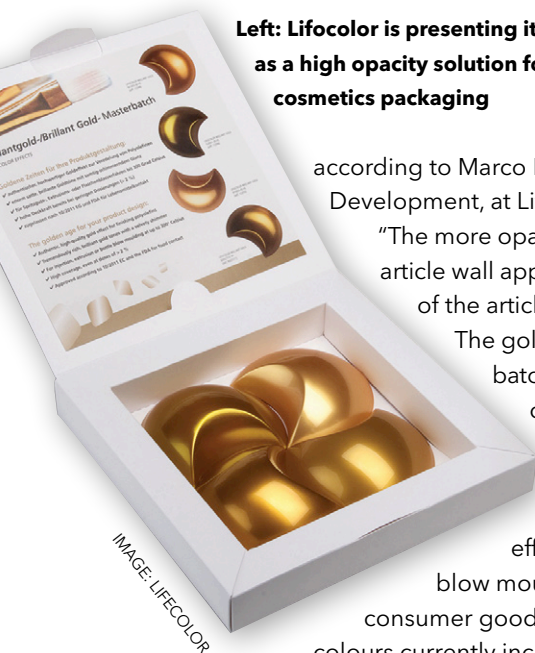
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Left: Lifocolor is presenting its Brilliant Gold as a high opacity solution for polyolefin cosmetics packaging

according to Marco Meixner, Head of Research and Development, at Lifocolor.

"The more opaque the effect, the thicker the article wall appears and the higher the quality of the article itself appears," says Meixner.

The gold effect, PE-based masterbatches are available in four different nuances of gold tones.

The Gemstone Collection masterbatch palette from **Ampacet** creates a reflective effect for PET, HDPE, and PP

blow moulded and injection moulded consumer goods and packaging. "Gemstones colours currently include the golden presence of Citrine, the soothing aquatic value of Coral, the royalty of Ruby, the brilliance of Sphene and the radiance of Sapphire and Moonstone. All of the colours provide the shine and upscale look of metal without the added cost or secondary processing required with typical metal finishes,"

according to the company.

Meanwhile, Ampacet's Galaxy Collection creates dramatic, patterned metallic effects. "Mimicking naturally-occurring structural colour, this collection embodies light-refracting clusters and extra-terrestrial patterns," says Linda Carroll, Ampacet Director of Global Insight and Innovation.

Optimised metallics

Germany-based **Tosaf Color Service** has introduced new metallic masterbatches in different carrier systems that are available in a range of customised shades. The effect pigments have a three-dimensional, round geometry rather than a flat shape, which is said to optimise the appearance of the effect in the final product, according to Andreas Kruschinski, Head of Sales and Marketing at Tosaf Color Service in Germany.

During injection moulding, when material flows around a hole or boss the effect pigments can create a dark streak on the other side where the divided material flow comes together again. The streak is a result of the alignment of the flat edges of two-dimensional pigments, Kruschinski explains. When using a three-dimensional pigment, the

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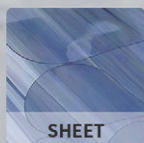
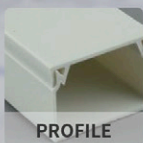
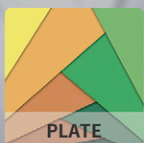
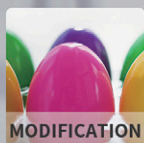
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Right: Colloids says its “aged glass” effect masterbatches provide an upcycling option for PET

round shape does not show dark edges and as a result eliminates undesirable streaks and surface defects, he says.

The effect’s brilliance is at its most pronounced in transparent thermoplastics, but the new products are also suitable for opaque plastics. They can be used in a wide range of applications, including automotive interior and exterior parts; office electronics such as keyboards and laptop housings; large and small kitchen devices; and household items and toys. Special effect pigment producers are also likely to benefit from the trend to more easily recycled parts – plastics with metallic colours are more easily recycled than plastics that use metallized chrome or lacquer surface layers.

Another sustainable effect from Tosaf employs natural fibres (such as grass fibres, for example) to achieve a natural effect that portrays ecological and sustainable behavior, says Kruschinski. This type of effect is in demand for a number of applications, particularly toys, cooking equipment, and household appliances. It is best suited for the processing temperature range of polyolefins.



IMAGE: COLLOIDS

Considering aesthetics

As the use of recycled plastic feedstocks grows, their aesthetics have to be considered, according to Graham Cotton, Head of Sustainable Product Innovations at **Colloids**. “Virgin PET is almost colourless, and when used in packaging it allows the colour of the articles to be seen by the consumer as brands intended it. When PET is recycled, the colour of the polymer changes and is greyer; when

Tips for creating striking effects

Special effect pigments—including pearlescents, metallics, glitters and fluorescents—add an additional dimension to the colour of plastic products, says Graham Cotton, Head of Sustainable Product Innovations at masterbatch and compound producer Colloids. But he advises there are considerations to make.

“Effect pigments create the best aesthetics in transparent and semi-transparent polymers where light reflectance occurs not only on the surface but further below the surface. For example, ABS is an opaque polymer and, whilst it is possible to create a great effect, the concentration of effect pigment is twice that what would be required from using SAN or

MABS. It’s a balancing act between commercial costs, physical properties and aesthetic values,” he says.

Processing conditions in masterbatch production and part conversion should also be considered. Cotton says that aluminium flakes and pearlescents can be damaged by processing shear. He says it is important to “match the melt viscosity of the masterbatch carrier to the host polymer to maximise the distribution whilst limiting flow lines” and to carefully select extrusion screw profiles with low shear.

“Damaging these extremely thin flakes, with shear in the process, can reduce their reflectance, resulting in higher addition rates to offset the damage. Or, more critically, [damage]

can interfere with the base colour, in particular with aluminium flakes and gold pearlescents, such as making the colour appear darker and greyer or redder and brownish respectively,” Cotton says.

The base colour of the part also plays a role. “It is important to avoid using opaque colourants such as titanium dioxide, which can mask the effect pigment,” he says. “Interference pearlescents can give a wide colour play when using a contrasting base colour. It is also possible to discretely use pearlescent pigments to enhance a base colour, making it appear brighter and more lively, especially using a gold pigment in green base colour.”

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Above: Careful consideration is key in achieving the most successful special effect solutions

IMAGE: COLLOIDS

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Right: Part of Avient's ColorForward 2023 palette, Todes nosotres uses the company's Tschùmbia! multicoloured confetti effect

used at 100%, it affects the colour of the packaged article," he says.

Colour and effect additives can be used to help correct aesthetic issues in recycled plastics. For example, Cotton says the company's "aged glass" effect masterbatches used in rPET can "upcycle the polymer, making it appear cleaner, albeit translucent instead of transparent."

Natural materials can also be used to create a recognisable, sustainable effect. In 2021, Colloids launched its patented line of BeaNused masterbatches, which contain up to 30% used coffee grounds. "The R&D team developed a range of colours that are enhanced by the different colour flecks from the larger coffee flakes. Using these materials adds sustainability to plastic products and it is easily identified by consumers as being made with recycled content," says Cotton.

The New Aesthetix initiative at **Avient** involves a team working on specific projects intended to meet industry needs for aesthetic effects in thermoplastics that cannot be met by the conventional development route, says Daniele Conti, Polymer Scientist, New Aesthetix. The company says the team, which is part of Avient's global ColorWorks network, combines polymer science with "creativity and unconventional ways to look at processing and formulation."

An example New Aesthetix development is the Toukelín effect, which creates natural-looking gold or black speckles in virgin and recycled polyolefins and styrenics. Another is the Tschùmbia! effect, which is a discrete multicoloured confetti effect for injection moulding of polyolefin or TPO parts. "Tschùmbia! can contribute to answer the growing demand of the product designers for non-homogeneous colouration solution, which traditionally poses multiple challenges to converters," says Conti. The team is currently studying applicability of the effect in styrenic polymers and PC.

Below: Colloids creates this wooden aesthetic using recycled coffee grounds in its BeaNused range



IMAGE: AVIENT

Effective forecasting

Two of the confetti effects are featured in Avient's latest colour forecasting guide for the plastics industry – ColorForward 2023. Created by the Avient ColorWorks team, Conti says the guide presents "four global trend stories that capture the emotions that can be expected to influence consumers' response to colour over the next few years ... to help plastic product designers and marketing professionals make more informed colour choices for new products and packaging."

One of the colours in ColorForward 2023 incorporating the Tschùmbia! effect is Todes nosotres, a transparent pink/red combined with multicoloured particles. The colour represents "equality and unicity" and is one of the five colours belonging to the theme Catalyst. This puts the focus on Generation Z and other young generations, on their acute fears for the future and on their push for action on a whole range of issues that will shape the world," according to Conti.

The Cybertschumbia effect is a plain white colour that changes to speckles of light under UV light. It is part of the theme "Meet-your-verse, which opens the doors to the exploration of the uncharted metaverse," says Conti.

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IMAGE: COLLOIDS



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IMAGE: SHUTTERSTOCK



Getting on top of odour

Upcycling post consumer recycled plastics into demanding applications means dealing with the challenge of unwanted odours. Peter Mapleston looks at available options

Demand for plastic recyclates containing material from post-industrial and post-consumer waste is certainly growing. And the level of quality of that can be achieved from these materials is increasing too. One challenge that still needs to be overcome, however, is the unpleasant odour that some recyclates bring with them. Removing that is a prerequisite if plastic recyclates are to continue to substitute virgin plastic and if recyclates from different sources are to be used for the manufacture of new products.

Odours are the result of volatile components that vaporise during processing or migrate out of finished parts over time. The volatile components may result from thermal breakdown of the plastic during processing, from impurities in the plastic, or from contamination by food products, oil residues, natural fillers, fragrance oils and more. To resolve and eliminate these odour problems it is important to identify the source and isolate the cause the problem.

Some are quite familiar to polymer processors – oxidation of a polymer such as HDPE as a result of multiple heat histories, for example, gives rise to a smell of burnt wax. An effective way to eliminate this odour is addition of an appropriate antioxidant and odour elimination masterbatch, according to US-based **Addisperse**. It offers its ON108 (pellet form) or ON106 (powder form) product for this purpose.

Additives and fillers (especially natural fillers) are

a further common source of odour. They can break down during processing, developing low molecular weight volatile components. Addisperse says its odour elimination masterbatch ON103 (pellet form) or ON104 (powder form) will effectively tackle odours based on a variety of chemicals containing sulphur and amines.

The Addisperse masterbatches are said to work in the vapour phase, chemically interacting with volatiles. The company says it is currently developing an odour elimination masterbatch that will be acceptable for use in food packaging applications, such as trays, boxes and film.

Fighting mould

Some odours can be attributed to a build-up of bacteria, moulds and mildew within raw materials that may not have been stored or handled properly. Recycled plastics hold onto and can intensify unpleasant smells, which is understandably a prime issue with items such as storage containers, bottles and packaging specifically associated with food and drink.

The Covid-19 pandemic has increased awareness of and raised concern over microbes and cleanliness. While adding antimicrobials has been on the radar for plastics compounders for some time, until recently there hasn't been a real push to overcome the challenges associated with reworking formulations and meeting regulatory requirements,

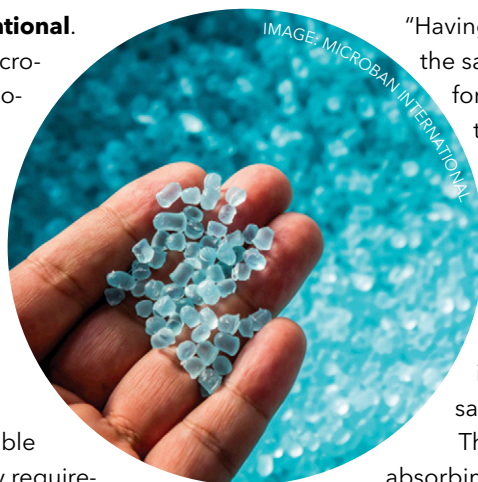
Main image:
Upcycling PCR plastics for applications in demanding markets such as automotive means dealing with unwanted odour

Right: Microban's antimicrobial additives can help tackle odour in plastics caused by microbial action

according to **Microban International**.

As a leading player in antimicrobial product protection technologies, Microban says it has invested a great deal of time and effort to address this need. The company has considerable expertise in incorporating antimicrobial additives into recycled plastic products to help reduce microbial growth and eliminate odours. It also claims considerable knowledge of global regulatory requirements – it says all of its antimicrobial solutions are registered with the Environmental Protection Agency (EPA) in the US or notified with the Biocidal Products Regulation (BPR) in Europe.

Recently, Microban partnered with GE Appliances to develop its UltraFresh System dishwasher and line of front-loading washers with antimicrobial technology. Antimicrobial additives were incorporated into the formulation of various plastic-based components known to be vulnerable to microbial growth, including high touchpoint handles and control panels, as well as gaskets, pumps and filtration systems.



"Having the capability to incorporate the same technology into various formulations, without impacting the plastic properties, is an important step forward for the future of the compounding and additives industries, and a promising prospect for bringing odour control and antimicrobial technologies into the fight for sustainability," says Microban.

The Tego Sorb series of odour absorbing additives from **Evonik** are designed to address odours from degradation products and contaminants in recycled plastics. Tego Sorb PY 88 was the first in the series, designed for incorporation via compounding and/or masterbatch processing. It is said to be especially suitable for polyolefins, as well as rubber compounds. More recently, the company has introduced masterbatches based on Tego Sorb PY 88 with PE and PP carrier resins.

Locking out odour

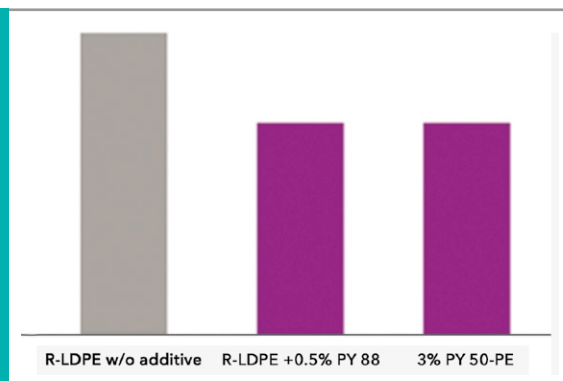
Evonik says the additives are based on zinc ricinoleate chemistry, which it says is effective at eliminating odours evolving from products like hydrogen sulphide, mercaptan, thioether, isovaleric acid, amines, and ammonia. "Differently from other odours control additives in the market, the Tego Sorb series work in accordance with the 'lock and key' principle by irreversibly binding odour-causing molecules rather than covering up or masking odours with a scent," says Ido Offenbach, Americas Segments Manager, Specialty Additives. "The Tego Sorb series enables an increase in the percentage of recycled materials in different application such as film packaging, automotive, and others."

Offenbach says two new masterbatches will soon come onto the market – Tego Sorb PY 30 PE and Tego Sorb PY 30 PP. Unlike the other Tego Sorb additives, these suppress and eliminate malodour via two mechanisms – zinc ricinoleate and evaporation promotion of low molecular weight odour substances during processing using open vents via twin screw extruder.

Masterbatch producer **Ampacet** has extended its OdorClear range of odour-absorbing masterbatches for use with post-consumer recycled material. Originally introduced as Odor Scavenger, the newly-expanded range is designed to keep odour inside the polymer. The company says OdorClear masterbatches outperform conventional inorganic scavenging solutions and are designed

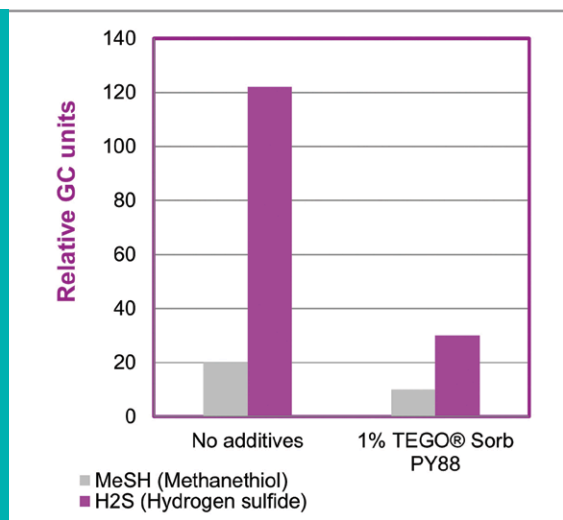
Sensory panel test results showing malodour reduction in recycled PE film using Evonik's Tego Sorb PY 88 odour absorbing additive

Source: Evonik



VDA-Norm 278 odour reduction results for methanethiol and hydrogen sulphide in recycled PA 6 compounds with and without Evonik's Tego Sorb PY 88 additive

Source: Evonik



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Right: Odour-absorbing masterbatches enable post-consumer recycled material to be used in applications where smell is critical

for use with a broad range of recycled polymers.

Ampacet says OdorClear grades can also be used in combination with its R3 Sustainable Solutions products, including ThermProtect BlueEdge and ReVive. This allows formulators to ameliorate issues such as thermal degradation, inconsistent colour or product uniformity, all of which can occur when using high quantities of recycled material.

Physical solutions

Additives are not the only way to tackle unwanted odour; various equipment-based solutions are also available or under development. One area of interest is in multilayer film recycling. While monolayer solutions are beginning to replace coextrusions in some packaging applications, quantities of multilayer barrier films entering the waste stream are still significant and likely to remain so. Italian extrusion machinery maker **Bandera** has developed solutions using its RevoTech Twin system that are said to be capable of recycling barrier film material with high percentages of EVOH and PA (up to 30% PA, for example).

The company says in-house tests using post-industrial scrap from high-barrier film production



IMAGE: AMPACET

have shown the suitability of the use of the recycle in various types of films – even thin films – at levels up to 100%. Smell is practically absent from the new film, it says, despite the presence of EVOH and PA. It puts this down to the high degassing and processing capabilities of the RevoTech Twin equipment.

For companies regularly recycling packaging film, Bandera has supplied RevoTech “VOC and Odour Removal” systems. These use a patented and highly energy-efficient microwave technology to reduce odours to levels that it says production using traditional single-screw or high-speed twin-screw extruders fails to reach. The purification process typically takes a couple of hours and can be performed on batches of granules that have been cooled after granulation.

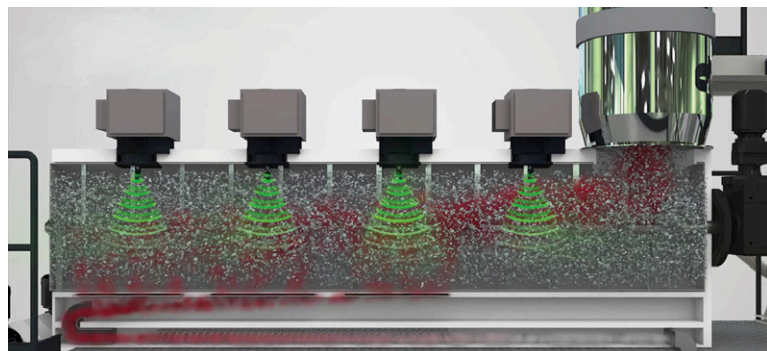
Various technology solutions to remove unpleasant odours from recycled plastics are also available from **Coperion**, including systems to remove odour from bulk materials downstream of the extrusion process. The company recently developed a mobile unit, allowing odour reduction trials to be carried out on freshly produced recycle products at the customer’s site under real production conditions.

“There is no need to spend a great deal of time and effort on reproducing production set-up in Coperion’s Test Centre,” says the company. “The Coperion mobile deodorisation test unit can be integrated into real production. The customer thus obtains the test results in the fastest possible way – without loss of time and without loss of quality.”

Coperion uses the mobile unit to determine the optimum odour reduction parameters necessary to achieve the quality desired by the customer. The degassing medium can be varied (air, steam, wet air with high moisture) and the temperature at which odours are most effectively removed can be adjusted – temperatures up to 150°C are possible.

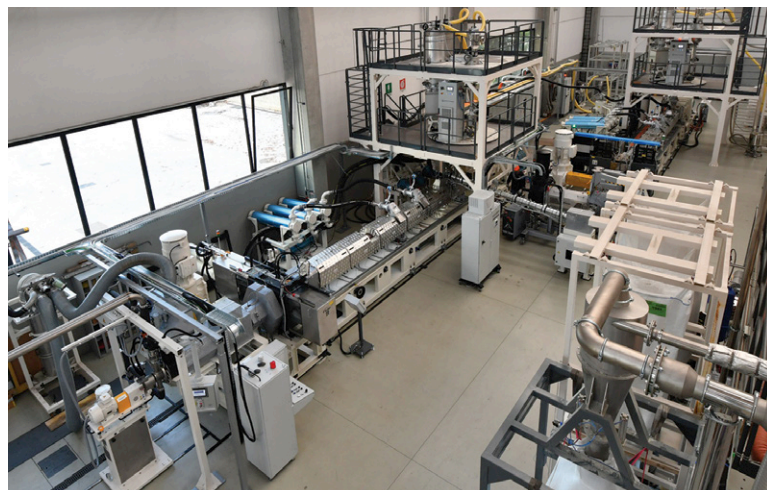
Deodorisation can be performed with very small amounts of product (as little as 10 litres per test run) using the mobile unit. Product samples can be taken

IMAGE: BANDERA



Bandera’s RevoTech VOC and Odour Removal system uses microwave technology to reduce odours in batches of granules after granulation

IMAGE: BANDERA



A cascade pelletising process for recycled polyolefins by Bandera incorporating venting for VOC removal



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during the odour reduction cycle and the customer can analyse them directly their own laboratory.

Austrian recycling systems specialist **Erema** reports a noticeable increase in demand for recycling plant incorporating its ReFresher technology for reducing odour downstream of the extrusion process. "Odour is a typical problem with contaminated household waste such as polyethylene films, containers and closures. It is essential that odour is removed if the PCR material is to be reused in high quality packaging for cosmetic products or food," says Clemens Kitzberger, Erema Group Business Development Manager for Post-Consumer Applications.

Kitzberger says growth in demand for odour reduction systems is driven both by the ambitious recycling goals set by the European Union, as well as the fact that recycling technologies are becoming increasingly efficient. "Both of these factors have made applications possible for PCR that were unimaginable a few years ago, and this trend is set to continue," he says.

An established example of a high-end product made from post-consumer recycle, he says, is a shower gel bottle for Werner & Mertz launched in 2019 in 100% PCR HDPE. The recycle is produced by an Intarema TVEplus Re grindPro machine plus the ReFresher module.

Erema says this recycling process was certified by the FDA two years ago as suitable for production of material for use in milk and juice bottles, as well as meat trays, disposable tableware and cutlery, provided the input material comes from milk and juice bottles. In November 2020, the FDA confirmed an additional input stream – now HDPE closures used on HDPE, PP and PET beverage bottles can also be processed and recycled material can be used in production of containers for direct contact with food of all kinds at up to 100%.

"While the high degassing extrusion system removes mainly highly volatile, low molecular weight substances, the ReFresher ensures a significant reduction of the low volatile, high molecular weight organic compounds in the recycled pellets," says Thomas Hofstätter, Erema Process Engineer.

Erema has an extruder-ReFresher combination for industrial-scale customer testing in its expanded customer centre at Ansfelden in Austria. It also has mobile ReFresher module that can be integrated into on-site recycling processes for trials.

In August last year, **Starlinger Recycling Technology** received two "Letters of No Objection" from the FDA for its HDPE food grade recycling technology, including odour reduction. These say



IMAGE: EREMA

Left: Erema's ReFresher technology provides a significant reduction in low volatile, high molecular weight organic compounds

that post-consumer recycled HDPE regranulate produced using the process is suitable for food-contact applications at levels of up to 100 % recycled content (this applies for HDPE from bottle-to-bottle and cap-to-cap recycling processes). The resulting HDPE regranulate can be used for food-contact packaging such as milk and juice bottles and caps, meat trays, disposable tableware and cutlery.

The Starlinger process consists of three main steps – material preparation, degassing, and post-treatment – and is said to eliminate even deeply embedded odours. "Compared to methods which merely bind odours through the use of additives and thereby enclose them in the final pellet, the Starlinger process removes the foreign substances that cause the smell and delivers permanently smell-improved pellets," the company says.

The machine concept comprises a recoSTAR recycling line with a C-VAC module combined with downstream odour reduction equipment. The machine setup may vary individually depending on the plastic (it can handle a variety of polymers), its source, and the type and intensity of the odour, as well as the specific requirements on the end product.

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Research work carried out in Spain and the UK is addressing the challenge of removing odour using modified compounding processes.

Peter Mapleston
learns more



Identification and process key to eliminating odour

Unwanted odours and emissions can be a challenge in all compounding applications, but especially so when handling recycled feedstocks. Identifying the presence of a bad odour can be pretty easy; understanding how and why such a volatile component is present and developing an appropriate processing solution to reduce or eliminate it can be a lot more difficult.

"Besides screw profile, melt sealing, applied vacuum, and machine-related topics, sometimes we don't know if we generate volatiles because of high temperatures or we don't remove them because of low temperatures, but the result is the same: a high level of volatiles in our compound," says Luis Roca, leader of Compounding at Spanish research organisation Aimplas. "Understanding the origin of volatiles is key to designing an appropriate set up for devolatilisation."

To evaluate at which temperatures and what volatiles are released Aimplas uses coupled FTIR-thermogravimetry, a technique that allows the identification of gases released directly from the sample during a thermal treatment. This simulates behaviour within the extruder and gives references on what melt temperatures should not be exceeded.

The use of recycled plastics in the automotive industry has been always a challenge, says Roca. Problems with obtaining the right mechanical properties, colours, rheology, together with issues over volatiles and odours have been traditionally put the brakes on growth. But circular economy policies and new consumer perceptions over environmental issues mean the foot is coming off the pedal.

Roca highlights various examples of recycled plastics being used by major OEMs: wheel covers (Chrysler), bumpers (Honda, Ford, Nissan), and radiator covers (General Motors). But there are very few examples in interior applications - he cites seat cushions made from recycled polyurethane foam (Chrysler) and fibres for upholstery (Ford, Nissan).

"The main reason is that OEMs have strict restrictions on the quality of materials used in the vehicle interior. Most of the published standards refer to virgin materials and the requirements are the same for virgin and recycled materials," he says.

Recycling methodology

To address this, Aimplas has developed a methodology to improve the recyclability and recovery of PP waste for incorporation into interior components,

Main image:
Removing volatile odour components from recycled plastics is key to upcycling in automotive interior parts

Right: James Vincent, Technical Lead for the Odour Control project at Luxus, works on a modified compounding line set up to support the deodorising process development

taking care that emissions comply with the requirements of air quality inside the vehicle established by the vehicle manufacturers.

During the project, Aimplas says it improved the devolatilisation process in the twin screw extrusion process by adding different percentages of water. "The optimisation of the processing conditions combined with the screw profile modification makes the difference to reduce volatile contents and hence odours," Roca says.

To determine the efficiency of recycling and possibility of reuse in car interior parts decontaminated post-consumer PP materials supplied by two different recyclers (rPP1 and rPP2) were analysed in accordance with three automotive standards: VDA 277 (to determine the total content of VOCs), VDA 278 (to determine VOCs and SVOCs by thermal desorption), and VDA 270 (to determine the intensity of the odour emitted by the materials).

In the VDA 277 tests, the initial concentration of volatiles for the two samples were measured at 124 and 80 µg/g respectively; after devolatilisation this was reduced to 2.97 and 0.83 µg/g. The VDA 278 tests showed the rPP1 resin had initial VOC and fog contents of 88 and 252 mg/g and rPP2 57 mg/g and 166 mg/g. After decontamination, rPP1 values dropped to 7.1 and 38 mg/g respectively, and rPP2 to 9.5 and 49 mg/g. Odour intensity tests (VDA 270), showed the rating in rPP1 dropped from 4 to 3 after devolatilisation and rPP2 fell from 4.5 to 3.5.

The VDA 277 decontamination rates of 97.6% and 98.8 for the rPP1 and rPP2 resins respectively, together with the good VDA 278 and VDA 270 results, demonstrate high potential of for this process as a decontamination methodology, according to Roca.

Compound opportunity

The use of PCR plastics in demanding automotive applications has also been under investigation at UK-based compounder Luxus, for which automotive is a major market. The company, which is a long-established producer of technical compounds containing recycled content, estimates the ability to remove odours from otherwise unusable PCR plastics could divert 25,000 tonnes of waste from landfill or incineration in the UK annually. The net saving in CO₂ emissions could be around one tonne per tonne of polymer recovered, it says.

Luxus is nearing the end of a 33-month Innovate UK-funded R&D project – Odour Control – that aimed to develop validated prototype processes to provide cost-effective methods for identifying odour and deodorising recycled polymer. Managing Director Peter Atterby says the company and its project partners have developed "two or three"



IMAGE: LUXUS

technologies that can be implemented at different parts of the production process to purge odours from waste materials.

The project was managed by Luxus in collaboration with the University of Lincoln, which carried out the testing and identified and quantified the VOCs most likely responsible for the odours. Consortium partner Matrix Moulding Systems developed the processing system in conjunction with Luxus, while processor IPL Plastics performed injection moulding trials on experimental materials from the deodorising process.

"We have been able to identify and quantify a significant amount of the VOCs that are responsible for the odours in various recycling waste streams," says Atterby. "We may in future be able to be more precise about how odour is measured and make it less subjective."

James Vincent, Technical Lead for the project at the company, says: "Gas chromatography can yield hundreds of volatiles from a single piece of plastic. For any source of material, we are identifying up to around five different VOCs that seem to be working in combination with each other to produce the odour. We are using this information to be able to remove the VOCs in question."

The intention is for the technology to be adopted as a retrofit option at Luxus and for other UK plastics compounders under a licensing process.

CLICK ON THE LINKS FOR MORE INFORMATION:

➤ www.aimplas.net

➤ www.luxus.co.uk

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Mixaco has been driving innovation in PVC mixing technology for more than 50 years and has 7,500+ machines installed worldwide. This brochure explains some of the details that make its HM and KMH heating cooling mixers stand out.

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The Compeo is the latest generation of kneader extruder from Buss and is designed to provide the utmost flexibility in application. This 12-page brochure details key features and model specifications.

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CHEMOURS: PROCESSING AIDS



In this brochure, Improving the Efficiency and Quality of Polyolefin Extrusion, Chemours explains how issues including melt fracture and extrusion instabilities can be addressed with its Viton FreeFlow products, the next generation of polymer processing aids.

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KLK OLEO provides a series of products for industrial applications. PALMOWAX and PALMESTER provide green lubricant solutions for polymer processing; PALMERE and PALMERA are green ingredients for PVC additives/plasticisers.

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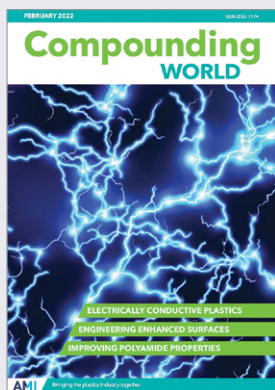
Heat dissipation has become an important consideration in many plastics applications. Find out how the thermal properties of Huber's Martoxid, Magnifin and Martinal fillers can be used to create thermally conductive polymer compounds.

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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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Compounding World February 2022

The February issue of Compounding World reports that for polymer compounders, the route to a low carbon future is likely to mean a greater use of electrically conductive carbon additives, while other features focus on polyamide additives and surface modification.

[CLICK HERE TO VIEW](#)



Compounding World January 2022

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

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Injection World March 2022

The March edition of Injection World magazine looks at how furniture designers are using plastics - especially recycled some of the latest grades. It also explores developments in thin wall moulding and material drying technology.

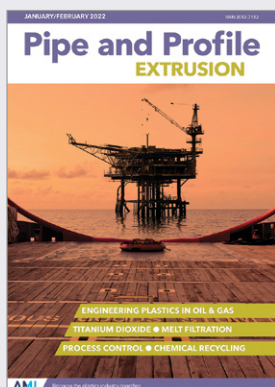
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Plastics Recycling World January/February 2022

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.

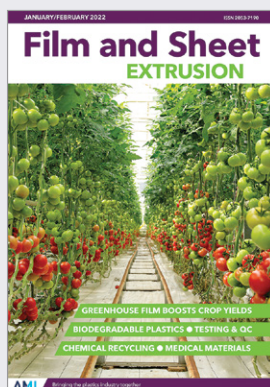
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Pipe and Profile Extrusion January/February 2022

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

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Film and Sheet Extrusion January/February 2022

The first edition of Film and Sheet Extrusion magazine in 2022 explores innovations in the agricultural film industry. It also looks at how enzymes may be used as plastics additives, and reviews developments in bioplastics, quality testing, and medical applications.

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GLOBAL EXHIBITION GUIDE

2022	15-17 March	Swiss Plastics Expo, Lucerne, Switzerland POSTPONED	www.visit.swissplastics-expo.ch/en/
	16-17 March	PlastExpo Nordic, Helsinki, Finland POSTPONED	https://pfsptec.messukeskus.com/
	5-8 April	FIP, Lyon, France	www.f-i-p.com
	25-28 April	Chinaplas, Shanghai, China	www.chinaplasonline.com
	3-5 May	JEC 2022, Paris France	www.jec-world.events
	3-6 May	GreenPlast, Milan, Italy	www.greenplast.org
	16-18 May	PlastAlger, Algiers, Algeria	https://www.plastalger.com/
	18-19 May	PlastExpo Nordic, Helsinki, Finland	https://pfsptec.messukeskus.com/
	25-26 May	Injection Moulding & Design, Detroit, MI, USA	https://injectionmoldingexpo.com/
	10-13 June	IPLAS, Chennai, India	www.iplas.in
	26-30 September	Colombiaplast, Bogota, Colombia	www.colombiaplast.org
	3-7 October	Plastex, Brno, Czech Republic	www.bvv.cz/en/plastex/
2023	19-26 October	K2022, Dusseldorf, Germany	www.k-online.com
	9-10 November	Compounding World Expo USA, Cleveland, USA	www.compoundingworldexpo.com/na/
	17-19 January	Swiss Plastics Expo, Lucerne, Switzerland NEW DATE	https://swissplastics-cluster.ch/
	1-5 February	PlastIndia, New Delhi, India	www.plastindia.org
	14-15 June	Compounding World Expo Europe, Essen, Germany	www.compoundingworldexpo.com/eu/
	5-8 September	Plast 2023, Milan, Italy	www.plastonline.org/en


AMI CONFERENCES

14-16 March	Cables Europe 2022, Cologne, Germany
29-30 March	Chemical Recycling North America, Houston, TX, USA
5-6 April	Polymers in Flooring Europe, Berlin, Germany
26-27 April	Fire Retardants in Plastics 2022, Houston, TX, USA
10-12 May	Masterbatch Europe, Frankfurt, Germany
7-8 June	Compounding World Congress Europe, Cologne, Germany
15-16 June	Chemical Recycling Europe, Cologne, Germany
28-29 June	Polymers in Cables North America, Philadelphia, PA, USA

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

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ENTEK Manufacturing Acquires Adaptive Engineering & Fabrication



ENTEK Manufacturing and Adaptive Engineering & Fabrication (AEF) are excited to announce the acquisition of AEF by ENTEK. Terms of the transaction were not disclosed.

Based in Placentia, CA, AEF is a significant supplier of material handling systems specializing in difficult to handle and convey materials. As a specialist in extrusion and downstream processing equipment, ENTEK has partnered with AEF on many projects, and ENTEK and AEF have worked together as customer and supplier for many years. Combining the companies was a natural next step in the relationship and an opportunity to provide a more streamlined platform for customers.

ENTEK and AEF have each enjoyed recent significant growth. "Together we will be able to leverage our teams to better serve our customers. We will be even better positioned to share resources and deploy systems that will make building a plant or buying equipment solutions from the combined ENTEK AEF teams an even better experience," said Kim Medford, President of ENTEK Manufacturing.

AEF will remain at its current location in Placentia.

As part of the transaction, all of the AEF employees will stay with the company and Rick Buschini and Chuck Nadolski will continue to lead the sales, development, and installation of material handling equipment with the support of the ENTEK engineering and project management teams.

"Together we will be able to grow our combined company to provide our equipment and engineering services to customers in North America and beyond. Combining with ENTEK's international footprint and knowledge provides us a platform to better serve our current and future customers both domestically and internationally," said Rick Buschini, VP Material Handling Sales.

As ENTEK grows its manufacturing capabilities in its recently opened plant in Henderson, NV, it will build both extrusion and material handling equipment in this location, providing the necessary space and additional resources to support the growth of the combined companies.





An Exciting New Chapter in ENTEK's History

Welcome to the latest issue of **Extrusion Solutions**.



Kim Medford

“

Our investment in this new facility is significant and will result in additional capacity for both our fabrication and wear parts manufacturing.

”

ENTEK Adaptive

For our first issue of 2022, we are excited to announce the news of ENTEK's acquisition of Adaptive Engineering & Fabrication, a leading supplier of material handling systems based in Placentia, California (story on page 1).

ENTEK and AEF have worked together for many years; in fact, we have partnered on numerous projects as customer and supplier. AEF specializes in material handling and downstream processing equipment, and there are many ENTEK complete extrusion systems in the field that include AEF equipment. By combining our companies, we can provide our customers with even better service and a single source for their extrusion and material handling system needs.

Henderson Update

ENTEK continues to execute on growth plans to meet the growing demand for both production equipment and extrusion wear parts with our new 98,000 square foot facility in Henderson, Nevada (see the story on page 4). Since announcing the opening in late 2021, we have been hard at work installing new state of the art machinery and hiring new ENTEK team members including machinists, welders, IT personnel, and both mechanical and controls engineers.

Our investment in this new facility is significant and will result in additional capacity for both our fabrication and wear parts manufacturing. Our aftermarket wear parts are an important part of serving our customers, and our new plant will enable us to produce more parts faster than ever before.

We have numerous job openings available at ENTEK, both in Lebanon, Oregon and Henderson, Nevada; check out our list of positions at <https://entek.com/careers/us/>. If you or someone you know is interested in joining our growing company, please contact us today.

Well-Deserved Promotions

I want to congratulate John Burke, Marvin Kuenzi, and Tim Glover on their recent promotions to Vice President positions at ENTEK (see story on page 3). John, Marvin and Tim are the leaders of ENTEK's Manufacturing, Engineering, and Machining operations and they do an outstanding job leading their teams and are an important part of our business growth.

I am also excited to share that Craig Clayton has been promoted to Regional Sales Manager. Craig joined ENTEK in 2021 from Gala/MAAG, where he worked on many installations that included ENTEK extruders. Craig is a great addition to our growing sales team.

Thank you to all of our customers for your continued support.

I encourage you to contact me anytime at kmedford@entek.com.

Kim Medford
President





Personnel News

ENTEK is pleased to announce the promotions of John Burke, Tim Glover, and Marvin Kuenzl to Vice President roles at the company. Also, we are pleased to announce the promotion of Craig Clayton to the position of Regional Sales Manager.

John Burke

VP of Manufacturing

Rarely will you find John at a desk. His training in the principles of servant leadership has inspired him to be a passionate practitioner of, and advocate for, servant leadership in life. Most days you'll find him out on the shop floor, where he oversees ENTEK's manufacturing. John started at ENTEK in 1999, and his background in manufacturing and production scheduling gave him all the tools he needs to step into his new position as VP of Manufacturing. When he's not keeping things running smoothly at work, John also enjoys creating beautiful designs in metal and wood.



Tim Glover

VP Machining

Tim has made machining and manufacturing his career. 18 years of that has been at ENTEK. Tim leads the machining team, which will soon mean he has a lot more ground to cover once move-in is completed at our new manufacturing facility in Henderson, NV. Since beginning his career in 1982, Tim's primary focus has been on machining and product management. He also believes strongly in the principle that you need to grow people in order to grow a business successfully.



Tim grew up in the area and takes a particular interest in educating young people about the opportunities available in machining, as well as encouraging and mentoring the next generation of machinists.

Craig Clayton

Regional Sales Manager

Craig Clayton has been promoted to the position of Regional Sales Manager. Craig joined ENTEK in 2021 and has been visiting customers and training for this position since he started.



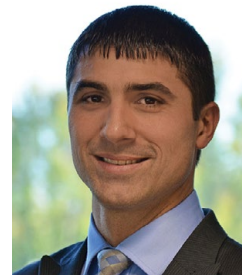
A native of South Africa, Craig worked there in sales and management positions for a financial services firm and a large vehicle manufacturer before emigrating to the USA in 2016. He joined Gala/MAAG in a technical service role, responsible for numerous activities including starting up new systems, operator and maintenance training, troubleshooting and preventative maintenance. He also assisted in establishing the company's first virtual system start-ups in India and South Korea during the early days of the COVID global pandemic.

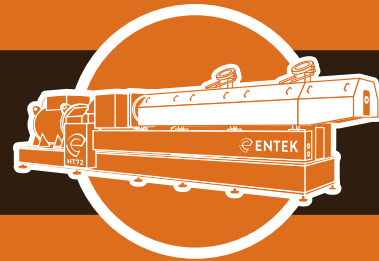
Craig said, "I am beyond excited about the future of ENTEK and the opportunities and challenges that lie ahead. I look forward to being a part of the growth of our company, and also contributing to the growth of our customers and partners."

Marvin Kuenzi

VP of Engineering

Growing up in an Oregon farming community, Marvin has always relied on his aptitude for hard work, creative problem solving, and mechanical abilities to keep things running. As an integral part of the equipment manufacturing division since joining ENTEK in 2007 as a Design Engineer, Marvin has exercised these aptitudes daily to help both ENTEK separator factories and our third party equipment customers to design, build, and commission highly technical production facilities. His involvement in multiple projects through the years, including critical work on the capacity expansion for ENTEK's US separator division in 2014, led to his promotion to Engineering Manager in 2018. In 2022, Marvin was once again promoted to VP of Engineering as he continues to lead both people and projects for ENTEK globally, including our recent Asia expansions and US turnkey factory development for our third party customers. Marvin attended Oregon Institute of Technology, where he majored in mechanical engineering technology.





Henderson Update

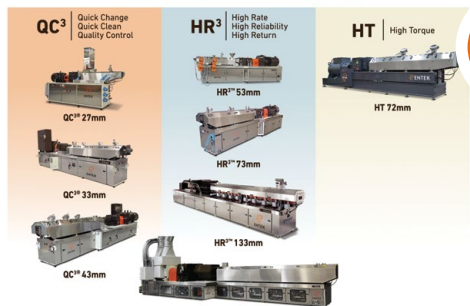
The new Henderson facility is starting to fill up as the new manufacturing equipment arrives. Several pieces are now in place and are at various stages in the commissioning process. This process of equipment being brought on line as soon as each piece is delivered will continue until the last piece arrives at the end of July. This is great news as we expect to be test cutting parts by March 1st.

To date we have hired a full shift of machinists, a machine shop manager, engineers and IT staff to work in Henderson. All of the employees hired have been trained at our headquarters in Lebanon, OR, so that they have the opportunity to learn ENTEK's processes while waiting for the machinery to become production ready.

Watch for more updates on the Henderson facility in the future.



ENTEK Co-rotating Twin-Screw Extruder Throughput Rates* (lbs/hr)



Products & Processes	QC ³ 27mm	QC ³ 33mm	QC ³ 43mm	HR ³ 53mm	HR ³ 73mm	HR ³ 103mm	HR ³ 133mm	HT 72mm
Max Screw Speed (rpm)	1200	1400	1200	1200	900	600	600	1200
Max Power (bhp)	40	100	200	300	400	1400	2000	1300
HDPE, LDPE, PP compounding	100 - 250	300 - 700	500 - 1,400	800 - 2,000	2,200 - 5,400	3,700 - 9,500	4,700 - 17,000	2,800 - 10,800
Maximum rate capability (gph)								
PS, SAN, ABS compounding	150 - 250	400 - 600	800 - 1,200	1,200 - 1,800	3,400 - 4,700	5,800 - 9,500	10,300 - 17,000	4,300 - 9,400
Maximum rate capability (gph)								
PC, PA6, 6/6, 6/10, 6/12, 11, 12 compounding	100 - 200	250 - 550	450 - 1,100	700 - 1,400	1,800 - 4,300	2,800 - 7,500	5,000 - 13,500	2,300 - 8,600
Maximum rate capability (gph)								
Fiber Filled (organic) Chlorine, WPC compounding	50 - 150	200 - 500	350 - 1,000	500 - 1,400	1,000 - 2,500	2,500 - 5,000	4,000 - 12,000	1,500 - 3,000
Maximum rate capability								



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NEW!

ENTEK Co-Rotating Twin Screw Extruder Specs

We have published an all-new spec sheet with updated data on our entire line of co-rotating twin-screw extruders. The sheet features throughput rates in lbs/hr for our QC³, HR³, and HT extruder lines. Contact us today for your copy!





Now Streaming



Stream Our Latest Webinars!

In 2021, our technical staff produced two webinars through *Plastics Technology* magazine. Click below to learn more and watch these presentations!



Dean Elliott
Technical Processing Manager



Ryley Jones
Mechanical Engineering Supervisor



Dean Elliott
Technical Processing Manager

The Future of Compounding is Now

Presented by Dean Elliott, *ENTEK Technical Processing Manager*, and Ryley Jones, *ENTEK Mechanical Engineering Supervisor*

Link to webinar: www.ptonline.com/events/details/the-future-of-compounding-is-now

How a compounding extruder achieves industry leading output rates for both torque – and volume-limiting compounds.

Compounders in the commodity and masterbatch markets typically run medium-to-large batch production sizes, and high production rates are particularly critical for them, which they typically run on a 24/7/365 basis. Learn how a newly developed compounder with the highest free volume at 18 Nm/cm³ torque density of any co-rotating twin screw extruder on the market is suited for these and any other torque- or power-limited applications. Other design features of this machine include ease of maintenance, machine health status tracking and an operational friendly interface. This extruder meets the needs of a fast-paced manufacturing environment where management can observe the OEE (overall equipment effectiveness) at a glance.



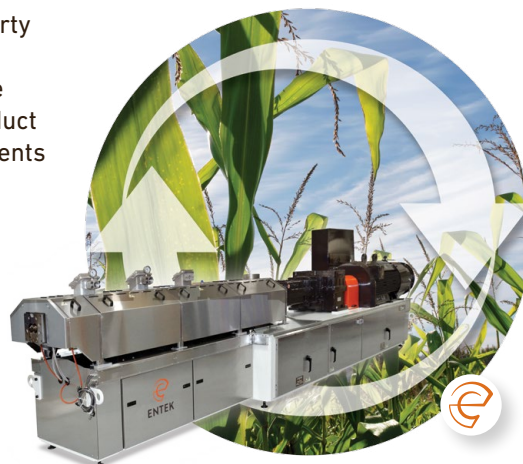
Biopolymer Compounding Done Right

Presented by Dean Elliott, *ENTEK Technical Processing Manager*

Link to webinar: www.bigmarker.com/gardner-business-media-inc-w1/Biopolymer-Compounding-Done-Right?utm_bmcr_source=web

There is a huge push from governments and consumers to use biodegradable polymers; most of their attention is focused on eliminating single-use, petroleum-based polymers.

Biopolymers often do not meet required product property requirements in their pure form. Additives, fillers, and sometimes a portion of petroleum-based polymers are compounded into a biopolymer matrix to enhance product properties in order to meet product property requirements and/or reduce cost. Biopolymer compounds typically include a compounding step more than likely performed on a co-rotating twin-screw extruder (TSE). This presentation discusses preferential configurations of a co-rotating TSE and provides operator processing tips to achieve the highest possible output rates while achieving mix quality without over-shearing the materials.





We Are ENTEK



Upcoming Events

ENTEK will be exhibiting at the following events in 2022. If you plan on attending any of these shows, please stop by to see us!

Plastics Recycling Conference
Washington, DC
March 7-9, 2022



Plastimagen
Mexico City,
March 8-11, 2022



PT XPO
Rosemont, IL
March 29-31, 2022



PT Extrusion Conference
Chicago, IL
October 2022



Compounding World Expo
Cleveland, OH
November 9-10, 2022



Women Breaking the Mold
Nashville, TN
November 14-15, 2022



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RAISING EXPECTATIONS. KEEPING THEM THERE.

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