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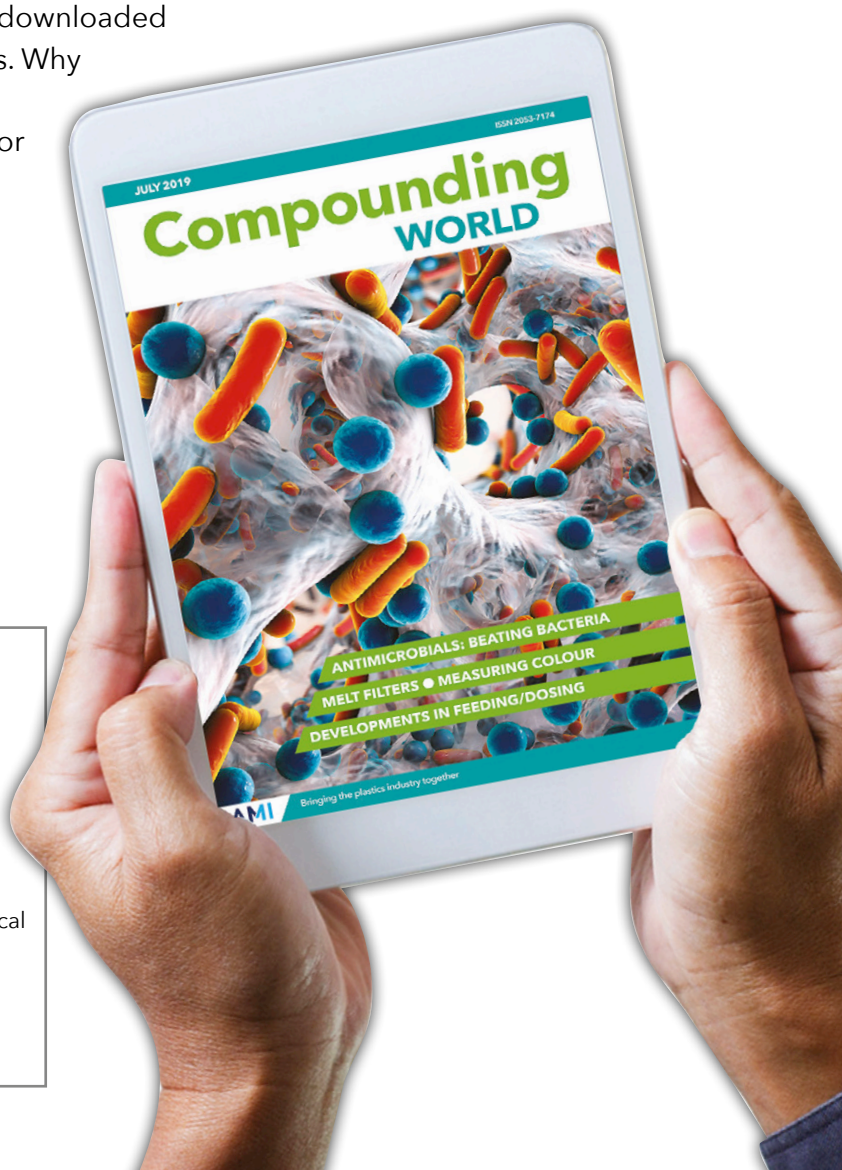

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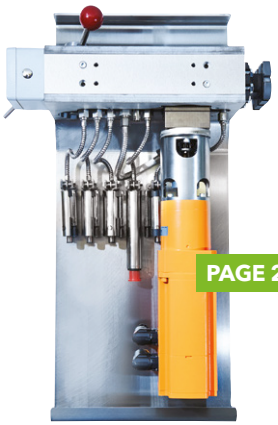
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Akdeniz/Chemson merger to create $500m stabiliser giant

IMAGE: AKDENIZ CHEMSON

Turkish investment fund OYAK is to merge its Akdeniz Kimya and Chemson businesses to create a global market leader in PVC stabilisers with annual sales of around $500m. The new company, which will have a sales presence in more than 100 countries, is named Akdeniz Chemson.

OYAK, which is the largest occupational pension fund in Turkey, said the merged entity will remain active in M&A and will develop new products for different industries and markets, in addition to its existing range. It aims to grow sales to $750m and capacity to 250,000 tonnes/year.

"We will increase our diversity in the industry and product groups as a result of the merger," said Süleyman Savaş Erdem, OYAK's General Manager.

Focus markets will include Europe, Russia, the Turkic republics of Central Asia, North Africa, Middle East, US, China, Brazil and Australia. Akdeniz Chemson will also continue to manufacture many of the raw materials for its calcium, zinc and lead-based stabilisers in its six facilities.

OYAK acquired Austrian-headquartered Chemson in 2013.

› **www.akdenizchemson.com**

Barentz to acquire Maroon

Netherlands-based Barentz International, a global distributor of life science ingredients, is to buy Maroon Group, one of the largest speciality chemical distributors in North America. The deal is expected to close within 2020.

Ohio-headquartered Maroon operates across the US and Canada and turns over around $500m annually. It is active in the life science sector as well as distributing a range of chemicals and additives for use in plastics. Barentz said the acquired business will continue to be run by current CEO Terry Hill and his management team.

Barentz said there is little overlap between the two companies in product and markets and considerable scope for synergies. It said the acquisition was aligned with its strategy "to become a global leader in the life science and broader speciality chemical industries".

› **www.barentz.com**

› **www.maroongroupllc.com**

Milliken's PP clarifier approved

Following testing by Europe's RecyClass PP Technical Committee, Milliken's Millad NX 8000 clarifying agent has been classified as fully compatible with current European industrial recycling processes for PP containers.

RecyClass certifies that Miliken Millad NX 8000 will not have a negative impact on European PP container recycling where the container is made of clear PP, the density of the final packaging is less than 1 g/cm^3, and where the clarifying agent accounts for less than 0.4% of the total weight.

› **www.recyclass.eu**

IMAGE: MILLIKEN

Above: Tests show Milliken's NX8000 clarifier will not compromise PP recycling

SABIC's specialty split is on

SABIC said that its Specialties strategic business unit (SBU) becomes a separate, stand-alone business from 1 November.

The company said the new stand-alone model for the Specialties SBU will bring additional value to customers for its Ultem and Noryl resins and LNP compounds and copolymers. "The task we have as a business is to continue to strengthen our market position and bring added value to our customers," said Ernesto Occhiello, Executive Vice President Specialties at the company.

Anticipated capacity expansions for Ultem and Noryl resins are "progressing", the company said.

› **www.sabic.com**

Delta Tecnic moves ahead with Mexican production

Spanish masterbatch maker and distributor Delta Tecnic is moving ahead with its first overseas production investment at Querétaro in Mexico, despite the global challenges imposed by the Covid-19 pandemic.

The company, which has two production locations and 20 production lines at Barcelona in Spain and a current capacity of around 18,000 tonnes, specialises in colour and additive products for the cable sector (including micro-masterbatch), as well as colour concentrates for PVC. It is investing €4.5m in the Mexican operation, which will cover 3,000m² in its first phase and include two lines, with plans to expand to five.

Delta Tecnic CEO Eric Xirinachs said earlier this month that construction and commissioning of the new plant had inevitably been impacted by the pandemic. "The plant has suffered a delay. The plan was to start this year…now aiming for Q1 2021. We are currently installing the production lines."

IMAGE: DELTA TECNIC

Above: Delta Tecnic CEO Eric Xirinachs sees big opportunities in Mexico

He said the Mexican investment marks an important step for the company, which expects to end this year with sales of around €40m (about 8% down on pre-pandemic forecasts). Some 75% of this is generated by its masterbatch production activities and 80% from outside of Spain.

The new plant will be focused on the automotive cable sector, where Xirinachs said Mexico is an "industrial hub" for the Americas. "We have been in Mexico as an importer for many years and have an important presence," he said. "Our customers, especially in automotive, wanted us to localise our production."

Xirinachs said the company, which has been majority-owned by PE firm Aurica Capital since 2017, currently generates sales of around €3m in Mexico but expects this to rise to €6m once local production begins. Part of this growth is expected to be due to its micro-masterbatch technology, which is said to allow cable producers to reduce colorant cost and increase line speeds.

› **www.deltatecnic.com**

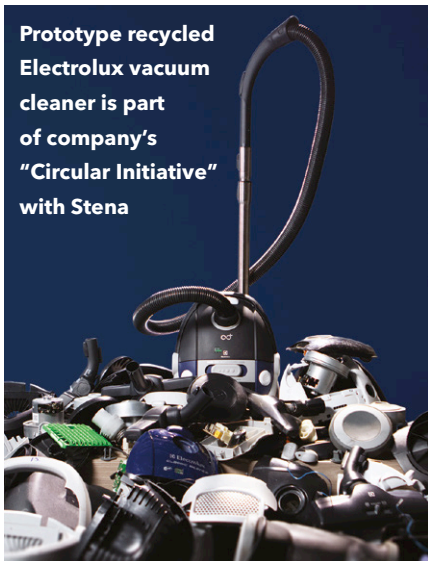
Piovan Group buys Doteco

Piovan Group, a major player in process automation systems for storage, preparation and transport of plastic and powders, has acquired Doteco, an Italian supplier of materials handling technologies for production of plastic films and synthetic fibres.

"With this integration, we could combine Doteco's film dosing technologies with Piovan's feeding and storage automations, becoming a leader in the supply of complete plants in this field and acquiring new customers in a sector that, also in light of the increasingly necessary sanitary and hygiene improvements, is becoming strategic in food packaging," said Filippo Zuppichin, CEO of Piovan.

Doteco turned over €19.7m last year and posted an EBITDA of €3.4m.

› **www.piovangroup.com**



Prototype recycled Electrolux vacuum cleaner is part of company's "Circular Initiative" with Stena

IMAGE: ELECTROLUX

Electrolux joins Stena in circular materials initiative

Electrolux and Stena Recycling have jointly developed a prototype vacuum cleaner made of 100% recycled and reused materials sourced from consumer electronic products such as hairdryers, vacuum cleaners and computers.

It is the first result of Electrolux's 'Circular Initiative' collaboration with Stena. No details were given about the polymers involved in the joint project, other than that they were sourced in the Nordic region.

"We at Electrolux have a strong commitment to reduce our climate impact by 2030 and circularity is a key dimension of this," said Electrolux CEO, Jonas Samuelson, who said the company has pledged to use 50% recycled materials in its products by then.

› **www.electrolux.com**

› **www.stenarecycling.com**

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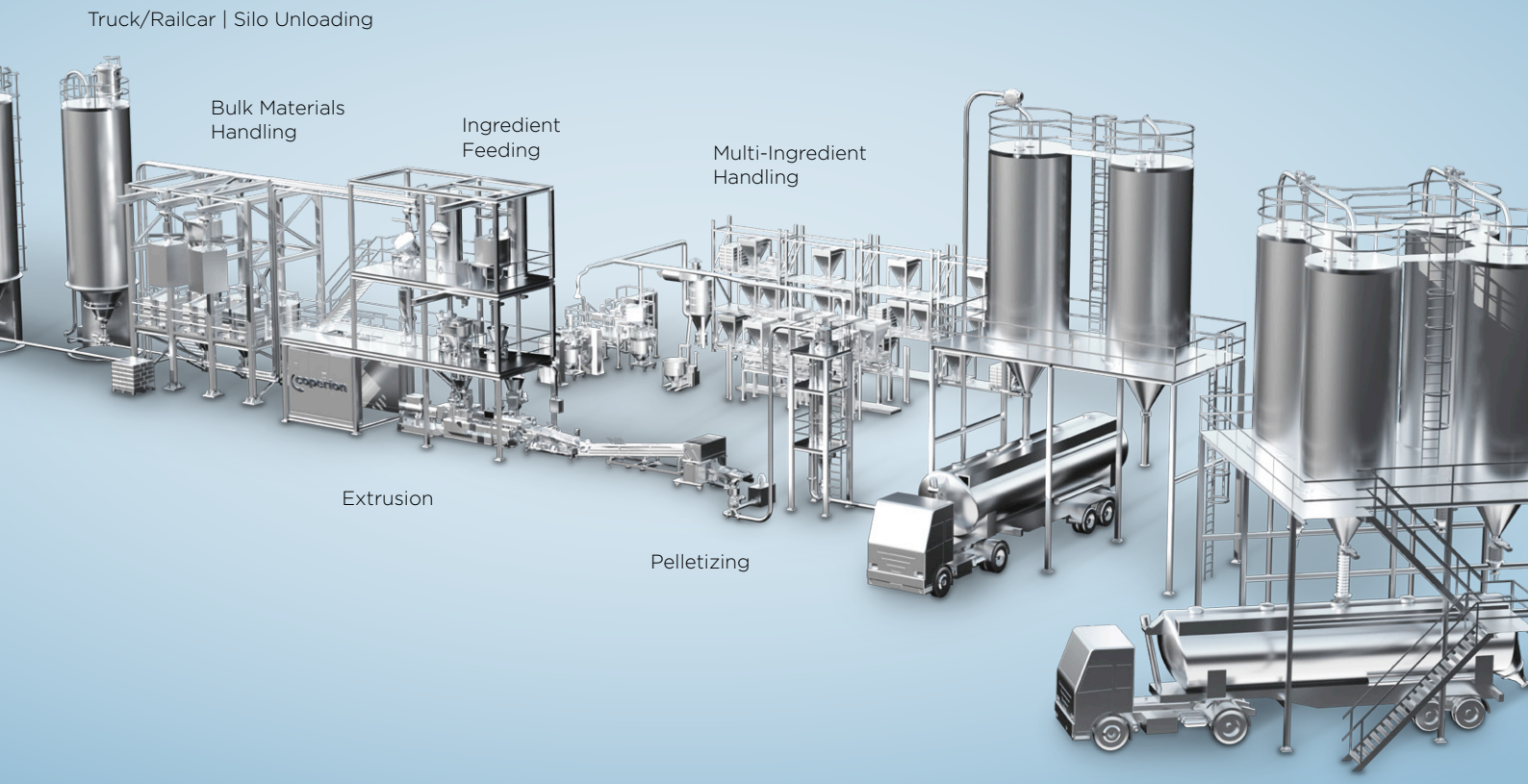

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Röchling launches PLA-based compounds for automotive

German automotive supplier Röchling has launched a family of PLA-based bioplastics that it intends to offer as an alternative to PP, ABS, PA6, PET, PBT and PC for automotive parts.

Three standard grades of the BioBoom compounds are currently available, each of which contains a minimum of 90% sugar cane/beet-based renewable materials and can be further customised to specific applications. The company said they are suitable for interior, engine compartment, and underbody applications.

"We want to support our customers in the development of environmentally friendly vehicles and thus help shape the transformation of the industry towards a sustainable one," said Prof Dr Hanns-Peter Knaebel, Chairman of the Board of Management and CEO of Röchling Automotive.

'We have set ourselves the goal of becoming the leading supplier of bioplastics and recycling materials in the automotive industry by 2035 at the latest," he said.

Roechling has not disclosed the specific composition of the BioBoom materials beyond its use of PLA as the main polymer component in combination with fillers such as talc and glass and natural fibre reinforcements.

The company was granted a **European patent** in 2014, together with compounder Softer (acquired by Celanese in 2016), covering formulations based on PLA and aromatic copolyesters that claimed high impact, scratch and UV resistance and HDT values of more than 140°C.

› **www.roechling.com**

Rowa sets sights on pure black

Germany's Rowa Masterbatch has added a "high-purity" Rowalid PA-B044A RHC Black to its range of PA-based nigrosine masterbatches for the automotive industry.

RHC stands for 'reduced halogen content', which is said to achieve a reduction in electrocorrosion and reduced interaction with other formulation components – the company claims some improvement in mechanical properties after thermal ageing.

According to Rowa, because the new grade prevents corrosion of metals such as copper, it may also find application in E&E applications, including heat exchangers, connector housings and terminal blocks.

› **www.rowa-group.com**

IMAGE: BENVIC

Above: Benivc has acquired Italian medical component maker Luc & Bel

Benvic buys into medical

PVC compounder Benvic has acquired a majority stake in Italy-based injection moulder Luc & Bel. It is Benvic's seventh European acquisition, including four in Italy, since it was acquired by Investindustrial in 2018.

Luc & Bel makes complex medical components and assemblies under Class 8 cleanroom conditions. It is based near Modena, where Benvic last year acquired Modenplast, which is active in the same sector through compounding of medical PVC formulations and extrusion of tubes and hoses.

"PVC plays a fundamental role in all parts of this sector and we expect to further develop Benvic's medical division, starting with Italy," said CEO Luc Mertens.

Luc & Bel founder and CEO Luca Ferrari will remain at the helm of the company and will retain a minority stake.

› **www.luc-bel.com**

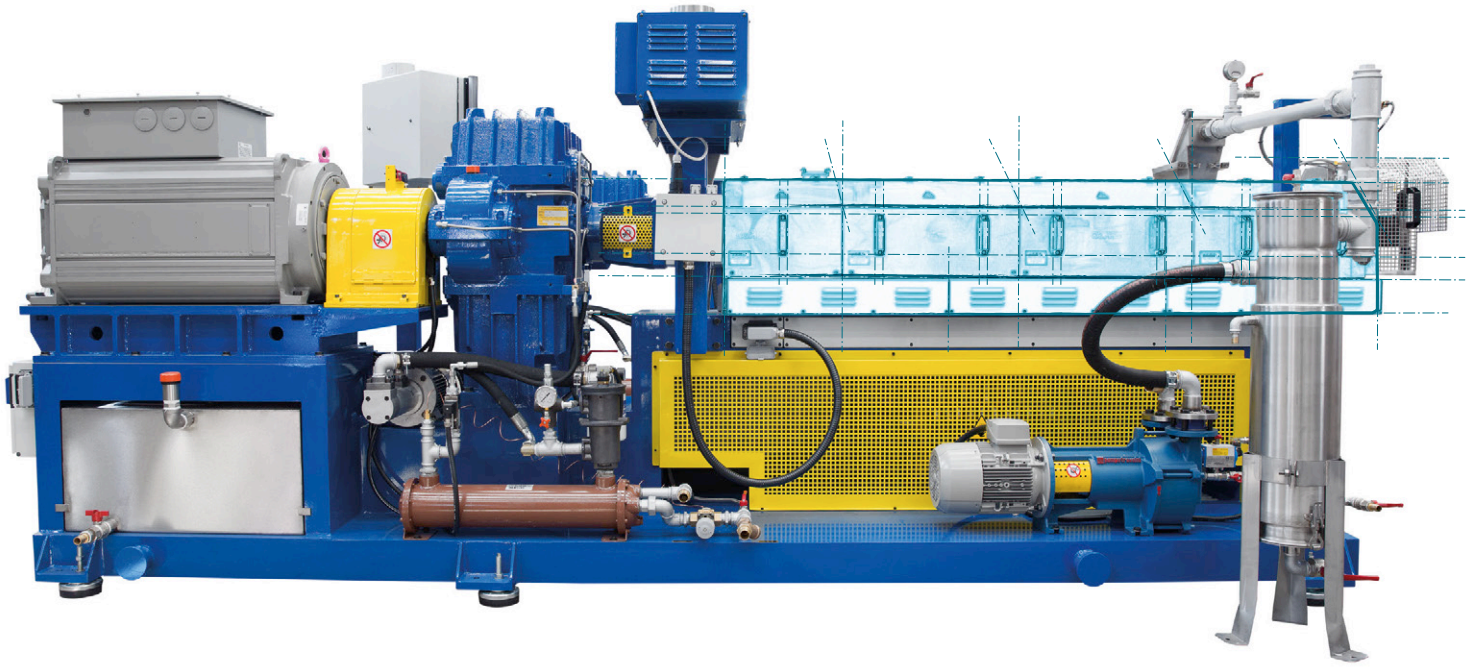
› **www.benvic.com**

Lactips to open new French plant

Lactips, a specialist in production of soluble plastics, has announced plans to build a new facility at Saint-Paul-en-Jarez in France.

The intention is to produce 3,000 tonnes/yr of material on the 12,000m² site, with a longer-term target of 10,000 tonnes/year. The project includes a 2,500 m² production building and 1,000 m² administrative and sales building with a laboratory.

› **www.lactips.com**



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OCSiAl opens graphene nanotube R&D centre

Nanotechnology firm OCSiAl has opened its latest R&D and technical support centre for single wall carbon nanotubes (SWCNTs) in Luxembourg.

The facility covers 350m^2 and will be targeted at development of elastomers and thermoplastic composites enhanced with SWCNTs (which the company refers to as graphene nanotubes). Key focus areas will include lightweight and smart car bodies and energy efficient tyres.

Russia-headquartered OCSiAl has existing R&D facilities in Asia and Eastern Europe. It said the new Luxembourg location "is related to the fact that Europe is at the forefront of developments in material engineering solutions, including the ongoing auto industry revolution."

IMAGE: OCSIAL

Above: OCSiAl's Luxembourg centre will accelerate SWCNT developments

OCSiAl currently has an SWCNT production capacity of around 75 tonnes/yr. It plans to commission a 100 tonnes/yr production unit in Luxembourg in 2023.

› **www.ocsial.com**

Altair buys M-Base Engineering

Altair, a US-based company focused on data analytics and computer-based simulation technologies, has acquired Germany's M-Base Engineering+Software, which supplies material database and information systems, mainly for the plastics sector.

M-Base is the official software supplier to CAMPUS (Computer Aided Material Preselection by Uniform Standard), which is the world's most successful plastic material database. Altair said it will continue to invest in the CAMPUS database in order to ensure consistent, high-quality material data is available to customers to drive accurate simulation results.

M-Base Engineering+ Software also develops its own Material Data Centre plastics information tool, which combines CAMPUS with other databases and tools to support designers and engineers.

› **www.altair.com**

Danimer set to go public

US biodegradable polymers manufacturer Danimer has sealed an agreement with Live Oak, a special purpose acquisition company, that will lead to a $210m investment and see it list on the New York Stock Exchange as Danimer Scientific. Danimer CEO Stephen E. Croskrey will remain at the helm.

Danimer owns a portfolio of core patents it purchased from Procter & Gamble in 2007. Its best-known product is Nodax PHA, a fully biodegradable and renewable plastic derived from canola oil that carries marine degradable certification.

Nodax is currently made on an industrial scale at Danimier's facility at Winchester, Kentucky, and production there is said to be fully sold out, based on signed and pending contracts. The company said it will use the newly secured capital base to increase production tenfold to about 90,000 tonnes/year by 2025.

› **www.danimerscientific.com**

Recycled PS suitable for food contact use

Styrenics Circular Solutions (SCS) says challenge testing carried out at Fraunhofer Institute in Germany has shown that polystyrene mechanically recycled using "supercleaning" technology developed by Gneuss, also of Germany, is suitable for food contact applications. It said it now plans to make a first application for an opinion from the European Food Safety Authority.

SCS, which is a value chain initiative that aims to increase the circularity of styrenic polymers, said the tests simulated worst-case assumptions by adding impurities to post-consumer PS before recycling it. The results, it said, showed that the high efficiency of the mechanical recycling technology for removal of impurities.

› **www.styrenics-circular-solutions.com**

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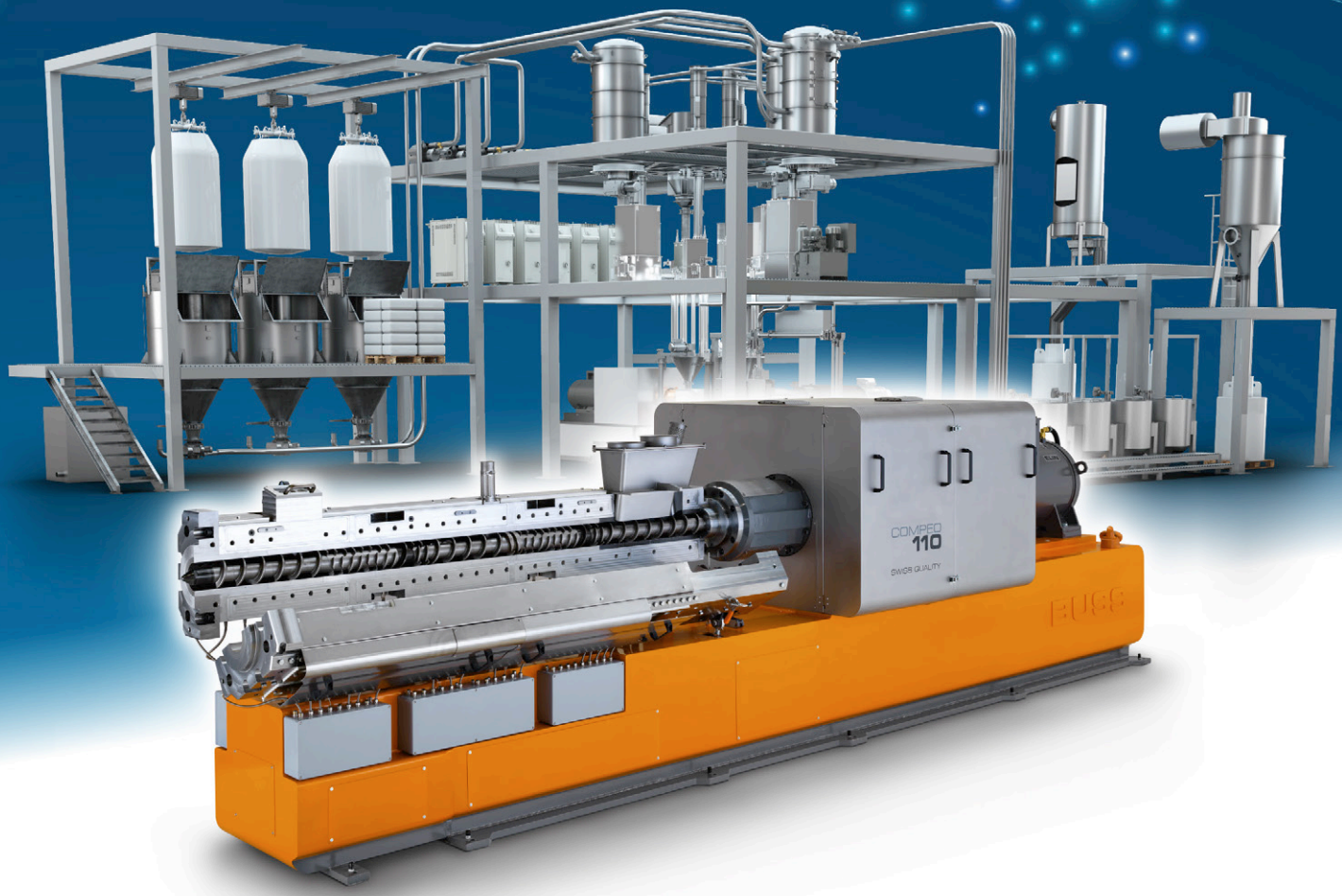

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Mayzo buys Bio Accutech

Mayzo, a US-based manufacturer and distributor of polymer additives and speciality chemicals, has acquired Bio Accutech, a distributor of chemicals for the coatings, inks and plastics markets also based in the US.

Mayzo said the move extends its global supply chain and adds several new optical brighteners, photoinitiators and PVC additives to its portfolio. This includes antioxidants, UV absorbers, optical brighteners, release coatings, polymer enhancers, masterbatches and blends.

Integration of the acquired business has already taken place and all activities are now managed through Mayzo's recently built 5,700 m^2 operations centre at Walterboro in South Carolina.

› **www.mayzo.com**

EU calls for more limits on bisphenol-A content

The European Chemicals Agency (ECHA) has opened a call for evidence following a proposal from Germany to place a restriction on the presence of bisphenol-A (BPA) and alternatives as an additive or unreacted monomer in articles and mixtures at levels or more than 0.02wt%.

BPA is used as a monomer in production of polycarbonate (PC) and epoxy resins. It is classified in the EU as toxic to human reproduction and restrictions already apply in certain end use applications. Germany says it wants to reduce environmental emissions of BPA and is taking the restriction route, rather than authorisation, as the latter does not effectively address imported articles.

PlasticsEurope, which represents PC producers at an EU level, said the German move was unexpected "considering the data already available on the sources of BPA emissions into the environment, and further clarifying research results being on the way."

IMAGE: SHUTTERSTOCK

Proposal from Germany would impose a 0.02wt% limit on BPA

The association said studies shared with the German competent authorities show PC articles account for less than 1% of total BPA emissions to the environment. It said that it would contribute to the process with "the expectation that a restriction proposal shall be based on facts and the most recent scientific insights."

Previous published studies indicate residual BPA content in PC is below the proposal's 0.02wt% limit.

A pilot project carried out by ECHA's Enforcement Forum has found more than 23% of products imported into the EU non-compliant with REACH and CLP Regulations. Inspectors across 16 member states checked around 1,400 products. 17% of the 1,225 checked for restricted substances had amounts above the required limit. Of the 167 products checked for CLP compliance, 64% were found to be non-compliant.

› **www.echa.europa.eu**

Casio connects with Ultramid Advanced

IMAGE: BASF

BASF Ultramid PPA is used in Casio's latest G-Shock smart watch

Casio Computer Company is using BASF's Ultramid Advanced N PPA in its newest digital watch and fitness tracker, the G-Shock GBD-H1000. The material is used in the terminal header, which sits on the terminal block and contributes to power charging and data synchronisation.

The terminal header is about 1.2cm wide with a wall thickness of 0.2 mm and weighs less than 0.1 gram. Block and header are fixed to the motherboard using SMT (surface mount technology), which calls for resistance to heat distortion temperatures of up to 260°C during the production process. Casio and BASF worked with Taiwanese connector maker Aces Electronics on the development.

Ultramid Advanced N is said to combine high heat resistance, good mechanical and dimensional stability, low moisture uptake, high heat deflection temperature, exceptional chemical resistance and good adhesion to the metal terminal block

› **www.ultramid-advanced-n.basf.com**

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IMAGE: TOTAL CORBION

Above: Total Corbion plans to build its second world-scale PLA facility at Grandpuits in France

Total Corbion to build PLA plant in France

Total Corbion PLA, the 50/50 joint venture set up by Total and Corbion to produce polylactic acid (PLA) bioplastic, is to build a second industrial-scale plant at an existing Total refining site at Grandpuits in France.

Due for completion in 2024, the project represents an investment of around €200m and will take capacity for Total Corbion's Luminy brand of PLA resins to 100,000 tonnes/year (the JV currently has a 75,000 tonnes/year facilty in Thailand, which started up two years ago). It will be the first large scale PLA production operation in Europe.

Luminy resins include high heat and standard PLA grades and are used in markets including packaging, consumer goods, fibres and automotive. They are made from renewable resources and can be mechanically or chemically recycled, as well as being compostable and degradable, according to the company.

The investment is part of a €500m 'net zero' strategy for the Grandpuits refinery which also includes production of renewable diesel from used vegetable oils; a chemical recycling plant joint venture with Plastic Energy; and operation of two photovoltaic solar power plants. Total is ending crude oil refining at the site.

Meanwhile, NatureWorks – also a key player in PLA production – has announced multiple technology projects that will increase capacity at its facility at Blair in Nebraska, US, by 10% be the end of 2021. These include enhancements to its lactide monomer purification processes.

Natureworks CEO Rich Altice said the PLA market "continues to rapidly evolve due to the COVID-19 pandemic" and that demand is still growing strongly in many end markets. He said the company continues to pursue potential opportunities for a second manufacturing site outside of the US to serve growing international markets.

› **www.total-corbion.com**
› **www.natureworksllc.com**

IN BRIEF...

Nordmann is expanding its distribution partnership with Spain's **Repol** to cover the full European market. The UBE Group company Repol produces a range of engineering compounds including Dinalon PA6 and PA 66, Dinarex ABS, Dinaxan PC, Dinadur PBT and Dinatron PPS.
www.nordmann.global
www.repol.com

Carbon black producer **Birla Carbon** has extended its joint development agreement with nanotechnology firm **Chasm Advanced Materials** to include commercialisation of novel nanomaterials.
www.birlacarbon.com
www.chasmtek.com

LyondellBasell and **Sasol** are to form a 50/50 joint venture through which LyondellBasell will acquire 50% of Sasol's 1.5m tonne/yr ethane cracker and 900,000 tonne/yr polyethylene plants for a total consideration of $2bn. The JV will operate under the name Louisiana Integrated PolyEthylene JV.
www.lyondellbasell.com
www.sasol.com

M Holland makes first moves in Europe

US-based resin distributor M Holland has announced a partnership agreement with JL Goor Materials, a polymer distribution company headquartered in Dublin, Ireland.

It is the US company's first formal venture in Europe and will allow it to better support global clients and expand the reach of its Mtegrity generic prime resins and compounds to Ireland and the UK.

"Our partnership with JL Goor Materials provides a value-added logistical solution to support our clients who have international business locations or expansion plans," said Josh Blackmore, Global Healthcare Manager at M Holland.

JL Goor Materials Managing Director Gearoid Clarke said: "This partnership and the quality product offering will strengthen our growth plans for the UK, complement business with our existing polyolefin partners in Ireland, and enhance our supply options to existing and new customers. We will also be working with M Holland to grow our medical polymer portfolio."

› **www.mholland.com**
› **www.jlgoor.ie**

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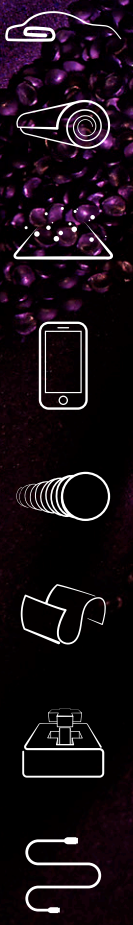

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Green moves in carbon black

IMAGE: SHUTTERSTOCK

Environmental concerns continue to play a major part in carbon black developments. Peter Mapleston finds out how suppliers are responding to green pressures

Environmental issues continue to dominate discussion and developments in carbon black for plastics. Whether producing new blacks from old tyres or reducing levels of polycyclic aromatic hydrocarbon (PAH), major and minor carbon black producers are working hard to grow opportunities for this workhorse product, and in doing so providing masterbatchers and compounders with wider choice in terms of "green" solutions.

Demand for carbon black recovered from old tyres (rCB) in the plastics compound supply chain is certainly growing, says Martin von Wolfersdorff at **Wolfersdorff Consulting** in Berlin in Germany, who closely monitors this market. But supply is still limited. Few companies are currently in commercial production with the types of rCB suitable for plastics (the property requirements for plastics are quite different from those used in rubber compounding). "Inspired by recent announcements by Michelin and BASF, many tyre pyrolysis ventures are aiming to go into business all around the world, but the timeline to market is two years or longer," says von Wolfersdorff.

Recovered carbon black differs from regular carbon black in being a composite of carbon blacks used in the tyre feedstock, inorganic ("ash") content, and organic content from rubber polymers. The ASTM workgroup D36 is currently working on test methods and specifications covering rCB, but there is as yet no universally-agreed definition. Specifications will be required, however, as rCB quality consistency is important and can be a challenge to maintain when tyre feedstocks are not controlled.

Von Wolfersdorff says markets are exerting a strong pull, particularly at tyre producers, which interface directly with consumers. Several have set themselves targets for incorporation of rCB into new tyres and/or have invested in tyre recycling companies. Bridgestone, for example, has invested in **Delta Energy** and is already using rCB in some tyres. Pirelli says it aims for its tyres to have on average 3% rCB content by 2025. And Continental is already at 4% rCB content and wants to be at 10% by 2026.

Michelin is taking a very pro-active approach, having acquired the tyre granulate company **Lehigh Technologies** and invested in Swedish rCB producer **Scandinavian Enviro Systems** (the tyre maker is now the principal shareholder).

Michelin is also involved in the three-year EU-sponsored **BlackCycle** project, which commenced in May and aims to develop an integrated approach to producing and using rCB and pyrolysis oil from old tyres. According to its prospectus, the BlackCycle project "has an upcycling ambition, targeting to create a circular economy of the end-of-life tyre (ELT) into technical

Main image: Whether its sustainable sourcing, process improvement, or emission reduction, both new and established players in carbon black are seeking "greener" solutions

IMAGE: SCANDINAVIAN ENVIRO SYSTEMS

Above: Scandinavian Enviro Systems and Michelin hope to build a pyrolysis plant to produce rCB from tyres

applications…by producing high technical second raw materials (SRMs) from ELTs. The BlackCycle project aims at creating, developing, and optimising a full value chain, from ELT feedstock to SRMs, with no waste of resources in any part of the chain and a specific attention for the environmental impact."

The project's ambition is that by 2029 close to one out of every two end-of-life tyres will go through its new recovery process, "which will be the only virtuous cycle of this magnitude amongst all industrial sectors in the recovery of end-of-life products."

IMAGE: SHUTTERSTOCK

Above: Projects such as the EU-funded BlackCycle aim to developed integrated systems to recover carbon black from scrap car tyres

Investing upstream

In July, Scandinavian Enviro Systems and Michelin prolonged their letter of intent regarding a strategic partnership until the end of October (after this article was written). Initially, the parties expected a final agreement would have been reached by mid-year, but negotiations have been delayed, in part due to the ongoing Covid pandemic. The two companies have agreed, however, that the partnership will include a development agreement to deploy Enviro's pyrolysis technology on a larger scale and a shared project to build a factory to industrialise the technology.

Enviro Sales Manager Fredrik Olofsson says that the company does intend to work on plastics applications for rCB and is carrying out some trials, but for the moment its emphasis is on tyres and other rubber products. "The problem with plastics applications is the high ash content in rCB," he says. Without special processing steps, ash contents in rCB are substantially above what is normally required to produce plastic compounds with good levels of blackness.

Other leading rCB producers include **Black Bear Carbon** in The Netherlands. However, its attempts to bring rCB to market suffered a major set-back in early 2019 when its already-limited production facility was taken out of production by a fire. In November last year, the company announced it was aiming to develop its next tyre carbonisation plant at the Port of Rotterdam. Construction is set to begin next year on the facility, which will decompose granulate from end-of life tires into carbon black, pyrolysis oil and gas.

Pandemic effects

Germany-headquartered **Pyrolyx** was one of the earliest players in the rCB sector and had been making progress until the arrival of the Covid pandemic. The company has one plant at Stegelitz in Germany, which has been operating for several years, and another at Terre Haute in Indiana in the US, which began operation in January. However, it said in March that both would be idled and has given no indication yet as to when they will restart.

Despite the pandemic challenges, US-based **Bolder Industries**, another company converting end-of-life tyres into carbon black and petrochemicals, says 2020 has been a year of growth due to increasing demand for sustainably produced products. Its flagship product, BolderBlack, is aimed squarely as an alternative to petroleum-derived carbon black pigments in plastics and offers the typical virgin carbon attributes critical for thermoplastics products such as UV protection, conductivity, and anti-static properties, according to the company.

BolderBlack is made from 100% post-consumer or post-industrial tyres and scrap rubber. Its lifecycle impact versus virgin carbon black is massive, according to the company, which claims 90% less water consumption, 61% less electricity input, and 97% lower CO_2 emissions. "We recover 98% of the materials from each discarded tyre," says CEO Tony Wibbeler.

Bolder Industries broke ground on a plant expansion earlier this year that will increase capacity by nearly 200%. It will add around 1,580m² to the company's existing footprint at its site at Maryville in the US state of Missouri. Completion is scheduled for Q1 2021.

International market interest in Bolder Industries'

IMAGE: BACK BEAR CARBON

Left: Black Bear Carbon's rCB ambitions were hit by a fire at its Netherlands facility. Plans for a new facility are underway

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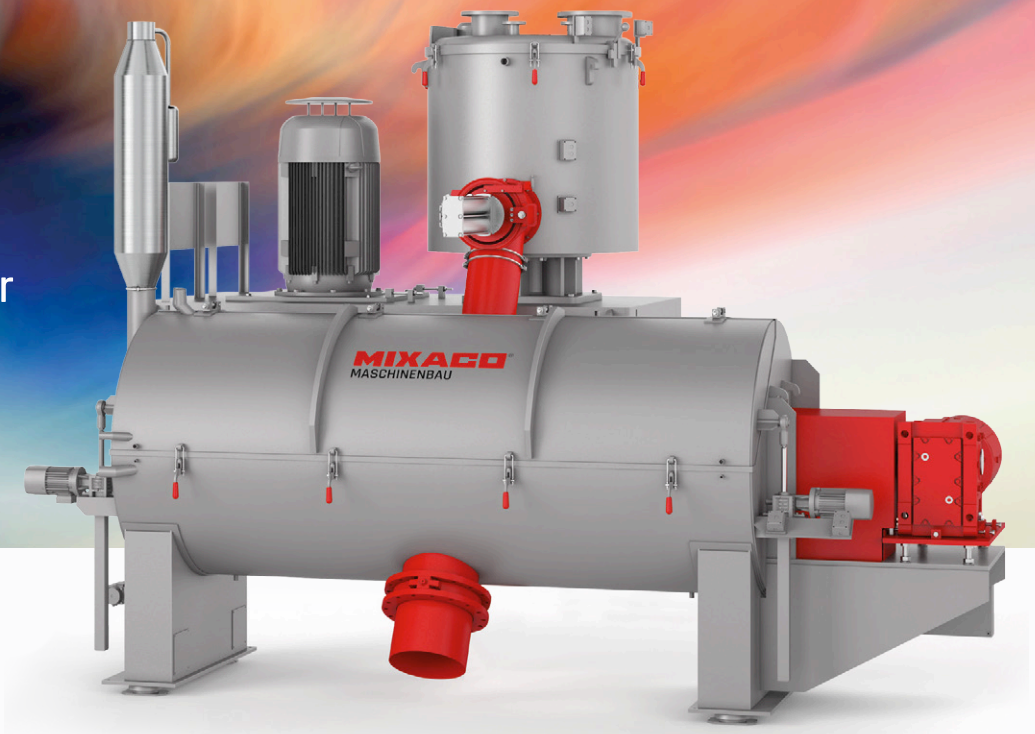







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IMAGE: BOLDER INDUSTRIES

Above: Bolder industries plans to expand rCB capacity at its facility at Maryville in the US by 200%

products is said to stretch well beyond its planned capacity, with interest from as far as Latin America, the Middle East and Europe. The company says its product can be found in more 300 plastic and rubber products, with use split roughly 50/50. It cites existing applications in wearables, indoor and outdoor gear, accessories, instruments, and furniture and says it has more than 100 additional product evaluations underway.

M&A activity

Also looking to be making progress in rCB is Canadian company **Klean Industries**. In 2018, it acquired a shuttered pyrolysis facility at Boardman, in Oregon in the US, that was previously owned by ReKlaim (a joint venture partner of Pyrolyx). It plans to use the facility to prove its own technology on an industrial scale.

Last November, Klean Industries acquired Carbon Resources Recovery (CRR), which is based in Berlin in Germany. According to Wolfersdorff Consulting, CRR operates a series of rotary kilns at Bukowno in Poland, supplying local masterbatch companies with rCB. The company says these are running in 24 hour operation 365 days a year.

Klean says the combination of the two companies makes it a world leading tyre pyrolysis technology company with a combined IP portfolio that is "second to none in the tire pyrolysis recycling sector." It says that CRR already had the largest fully continuous, commercial scale facility operating in Europe. Now branded as part of Klean's technology portfolio, it says that means the company now has plants in operation in Asia, South America and Europe. Klean says it also plans to start up a number of additional facilities in the US.

Traditional carbon black suppliers are also taking a close look at what can be done in the rCB sector. Orion Engineered Carbons, for example, is involved in the EU BlackCycle project.

Masterbatch interest

Some leading supplies of black masterbatch for plastics have already dipped their toes into the rCB waters. **Avient** (formerly PolyOne) has been taking material from Bolder Industries for several months and Ampacet and Modern Dispersions are also among the early adopters: **Ampacet** introduced its Rec-O-Black 216 masterbatch – which uses not only carbon black from recycled rubber products at a level of 40% but also recycled polyethylene for the carrier resin – in 2016; **Modern Dispersions** launched its EcoBlack product the same year. Last year, **Cabot** launched its TechBlak 85 masterbatches, which are made from post-industrial carbon black and recycled polymers. And Brazilian company **Cromex** said it is using rCB from tyre recycler Polimix Ambiental to produce masterbatches in a range of carriers.

Commenting on its introduction of the Rec-O-Black product line, Ampacet Strategic Business Manager François Thibeau says: "The market is very curious about this kind of development as it responds to needs of the circular economy: re-use, repair and recycling…Rec-O-Black provides very good opacity in finished articles. Opacity data may slightly vary upon the nature and quality of the feedstock used to generate the recycled black pigment but overall there is no compromise in terms of quality."

Bolder Industries has also integrated into masterbatch production, according to Wolfersdorff Consulting. "Kylos is a new brand we are working with that was created by a customer. It is a brand dedicated to sustainability and all of its products contain BolderBlack and use recycled resin. Kylos also allows us to provide sustainable masterbatch solutions to plastic compounders and other plastic manufacturers who reach out," says Bolder CEO Tony Wibbeler.

Wibbeler says the Kylos brand has not yet been

IMAGE: AMPACET

Right: The market is "curious" to explore opportunities for circular recycled carbon black products, says Ampacet

IMAGE: MONOLITH MATERIALS

Above: Monolith Materials claims its facility at Hallam in the US produces zero emission carbon black

formally released. "But I'm happy to hear that word is getting out that a fully sustainable masterbatch is available for sale in North America," he says. "Kylos has two manufacturing partners, one in New York State and the other in the Chicago areas and product is shipping. Kylos is fairly focused on a niche so we can still work with other [masterbatch producers]."

Carbon from gas

US-based **Monolith Materials** is taking another novel approach to improving the sustainability of carbon black production. The company says it achieved mechanical completion of its Olive Creek 1 (OC1) facility near Hallam in Nebraska in the US earlier this year. This is claimed to be the first commercial-scale carbon black manufacturing plant to combines natural gas feedstock and electricity through the methane pyrolysis process to manufacture carbon black with zero emissions.

Methane pyrolysis-produced carbon black is said to be "nearly identical" in performance properties to carbon black made from petroleum feedstock. "In some formulations, it will be an easy drop-in. In others we will formulate the carbon black to match the properties," says Monolith CTO Tom Maier.

Right: Cabot says demand for deep black plastics is growing in automotive as a consequence of lightweighting

The OC1 facility is projected to produce approximately 14,000 tonnes/yr and Monolith expects to start delivering carbon black to customers in Q4 of this year. Chris Cornille, Chief Commercial and Supply Chain Officer, says: "No matter who we talk to in the marketplace, 'sustainability' drives every conversation." He says the OC1 plant will only supply a small percentage of the more than 14m tonne global market demand for carbon black but considers it a glimpse into the future of global carbon black manufacturing.

"Over the last year, we've seen a shift in customers asking for clean carbon black alternatives to demanding them," he says. This demand has accelerated Monolith's expansion plans. It recently announced plans to construct a second facility, OC2, which will have a capacity of 180,000 tonnes/yr. The sum of the two capacities will make Olive Creek the largest single carbon black manufacturing facility in the US, according to the company. Construction on OC2, which is in the early design phase at present, is set to begin in Q2 of 2021, with completion expected in 2024.

Traditional gains

Traditional carbon black manufacturers are, of course, working on more sustainable solutions for their current product lines. **Cabot** cites the example of its new Black Pearls 1180HD specialty carbon black which addresses calls for reduced CO_2 emission from markets such as automotive. "Vehicle lightweighting and metal replacement is creating a market demand for stronger, more durable plastic materials with deep, dark colour," the company says.

"Due to the difficulty of dispersing traditional high colour carbon blacks, until now it has been difficult for automotive plastic compound manufacturers to deliver high black colour and mechanical strength simultaneously. Black Pearls 1180HD breaks this trade-off, promoting high jetness at low loadings, good dispersibility and mechanical strength preservation. Ultimately, this creates more opportunities for metal replacement and further reduction in wall thickness of existing plastic parts which help to reduce a vehicle's weight," the company says.

Cabot says carbon black users in the electrical and electronic and consumer markets can also benefit from this new grade's combination of favourable product characteristics. "Black Pearls 1180HD is an ideal choice for any application requiring deep, dark colour in combination with mechanical performance," it says.

IMAGE: SHUTTERSTOCK

At Russia's **Omsk Carbon Group**, Ivan Maslenikov, Head of Product Development, Marketing and Strategic Development, says that with global trends towards sustainability and health putting more attention on chemical purity of products intended for contact with people, food and water, the company has been working on innovations to deliver carbon black with significantly reduced PAH (polycyclic aromatic hydrocarbon) content. Two new grades, Omcarb S500FA and Omcarb S600FA, are intended for a broad range of applications, including toys, home appliances and domestic tools, sport equipment, clothing and materials, which may come into direct contact with potable water.

"Producers of pressure pipes for potable water and gas, thin and multilayer films, and fibres demand enhanced dispersibility, good production efficiency and long product service life," Maslenikov says. "For those applications, Omsk Carbon Group specially developed P-type grades Omcarb P72 and Omcarb P108 with outstanding physical and chemical cleanliness, good filter pressure values, low moisture absorption and improved pellet properties." These grades too are said to have very low levels of PAH.

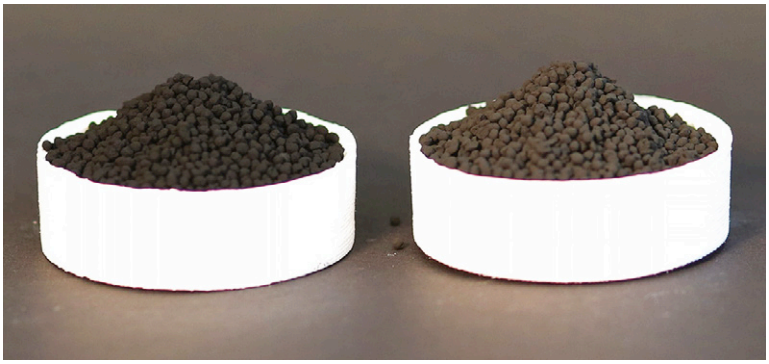

IMAGE: OMSK CARBON GROUP

Above: Omsk Carbon has extended its line of low-PAH carbon blacks with two new grades

Deep blacks are proving increasingly popular in plastics applications due to the association between black depth and quality, according to Birla Carbon. "Plastic formulators are looking for ever-increasing jetness in their finished product," says Fabrizio Rossin, Plastic Sector Head at **Birla Carbon** Italy. "Deep black is becoming more prominent in the automotive industry. Car interiors are showing more jet black components. In consumer electronics, brands are using deep black exteriors to add value to their offerings. Home appliances are also turning a deeper shade of black. Deep black plastics, with a smooth surface finish, are also being used to

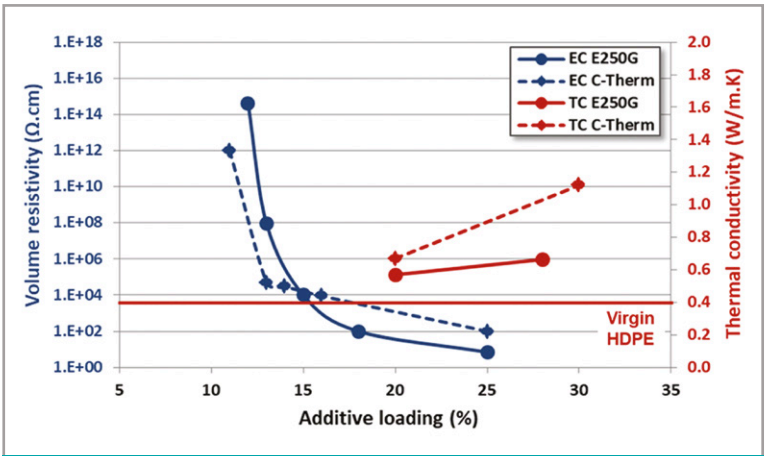

Table 1: Chart showing volume resistivity and through-plane thermal conductivity (Laser Flash on injection moulded samples) of Ensaco 250G and C-Therm carbon blacks as a function of additive loading in HDPE
Source: Imerys Graphite and Carbon

displace black surface coatings."

Rossin points to Birla Carbon's high-colour Raven blacks, which he says are designed for exceptional colour and physical properties. He says they offer high jetness, UV protection and viscosity control. "Raven 2800 Ultra , Raven 2900 Ultra and Raven 3000 Ultra blacks are particularly designed keeping both colour and processability in mind," he says. "Because of their unique combination of surface area and structure, they are easy to disperse and hence provide excellent jetness. Birla Carbon aims to set the bar even higher by launching a new ultra-high (piano) black product for plastics in 2021."

Conductive solutions

Imerys Graphite & Carbon says its Ensaco and specialty Timrex C-Therm carbon solutions are formulated to confer electrical (and thermal) conductivity to polymers. It also points to the impact of megatrends such as metal replacement and light-weighting, which are causing a steady increase in demand for conductive carbon black across multiple markets. "One of the fast growing applications for electrically conductive compounds is EMI shielding, linked mainly to the deployment of 5G technology and vehicle electrification with the adoption of EV and hybrid vehicles, the increased number of sensors and electronic parts on-board vehicles," the company says.

"Thanks to their high conductivity and ease of processing, Ensaco conductive carbon blacks and high aspect ratio Timrex C-Therm are ideal solutions to confer EMI shielding properties to polymers and to achieve high levels of attenuation in combination with other conductive additives such as metal fibres," it says. "Ensaco is a cutting-edge conductive carbon black, with a winning combination of high purity, high structure and low surface area, which guarantees low moisture pick-up as well as easy dispersion. This unique set of properties enables reaching high levels of conductivity at low loadings and is a key benefit for compound mechanical and flow properties. The high level of graphiticity of Ensaco also makes it a suitable additive to bring thermal conductivity to polymers, especially in applications where high through-plane thermal conductivity is required."

Advances in hybrid (HV) and fully electric vehicle (EV) technology have increased demand for thermoplastic conductive compounds for shielding against electrostatic discharge and electromagnetic interference (RFI/EMI). Both functions are enabled by conductive fillers. **Orion Engineered Carbons** says it has been focusing on the nature of carbon black conductivity, conductive black application in these applications, and in applications development.

"Consumers and our customers require us to move forward with sustainability initiatives," says Greg Zartman, Orion Marketing Manager, Polymers, Americas. "This work in conductive plastics, on-going efforts to reduce tyre roll resistance, and participation in the BlackCycle

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project are important components of Orion's sustainability efforts." He says that while most all carbon blacks impart conductivity in plastics, a key requirement for HV and EV applications is to enable conductivity while retaining good compound mechanical properties. "Meeting this requires sound carbon black selection and application development."

Beyond percolation

Higher black dosage enables lower resistivity, but adversely affects compound mechanical properties. In addition, formulators have to deal with the issue of percolation. The graph shows how conductivity in a compound can change with carbon black loading. The percolation curve shown in Figure 1 is typical for conductive carbon blacks. It shows that to achieve stable compound resistivity it is prudent to dose the conductive carbon black to the flat part of the curve beyond the critical area where small changes in loading can have disproportionate effects on conductivity.

Although other properties affect compound resistivity, carbon black surface area, structure, and porosity drive resistivity at the target carbon black dosage (see Table 1).

"Many conductive black compounders prefer super-conductive blacks, such as Printex XE2, because of the low resistivity it imparts at low dosage," says Vasanthakumar Narayanan, Orion Technical Market Manager, Polymers, Americas. "We work with customers to ensure conductivity and mechanical properties are in balance."

Within the HV and EV applications (and in future autonomous vehicles), the density of electronic components and potential EMI and RFI interference has created strong demand for conductive thermoplastics. To give some idea of the scale of this issue, he says humans can perceive a 3000V static discharge while electronic vehicle components can be damaged by a 100V discharge. "For these electrostatic discharge applications, Orion's Printex Kappa 70, compounded at 15-20% by weight in polypropylene, will provide desirable balance of low resistivity and mechanical property retention,"

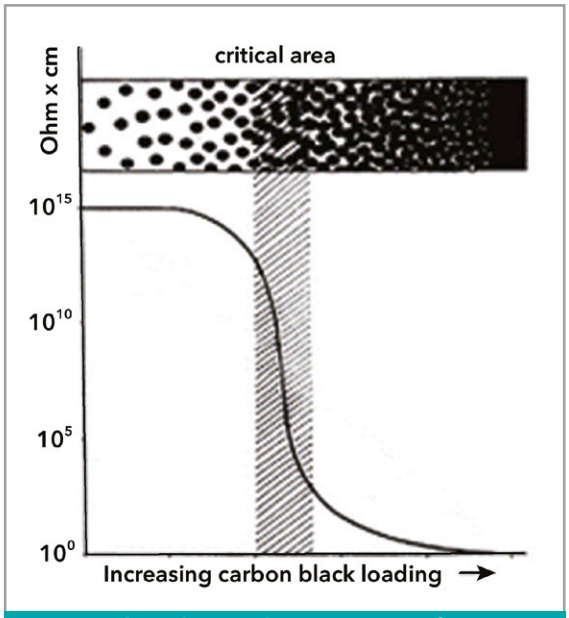

Figure 1: Chart showing how resistivity of a conductive polymer compound drops rapidly around the percolation point, demonstrating the need for accurate dosing control
Source: Orion Engineered Carbons

Narayan says. "EMI/RFI applications require much lower resistivity, so Printex XE2 is more preferred, at 8-10% in the polymer."

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Table 2: Carbon black surface area and Oil Absorption Number (OAN) versus MFR and resistivity for various carbon black grades

Sample – 14%	Printex Kappa 70	Y200 acetylene black	HiBlack 40B2	Printex XE2 (at 10%)
Resistivity (ohm-cm)	990	$2.16x10^{6}$	$1.0x10^{15}$	<100
MFR (g/10 min)	31	29.6	34.6	4.0
Surface area (m^2/g)	250	68	112	1000
OAN (mL/100 g)	170	283	150	420

Source: Orion Engineered Carbon

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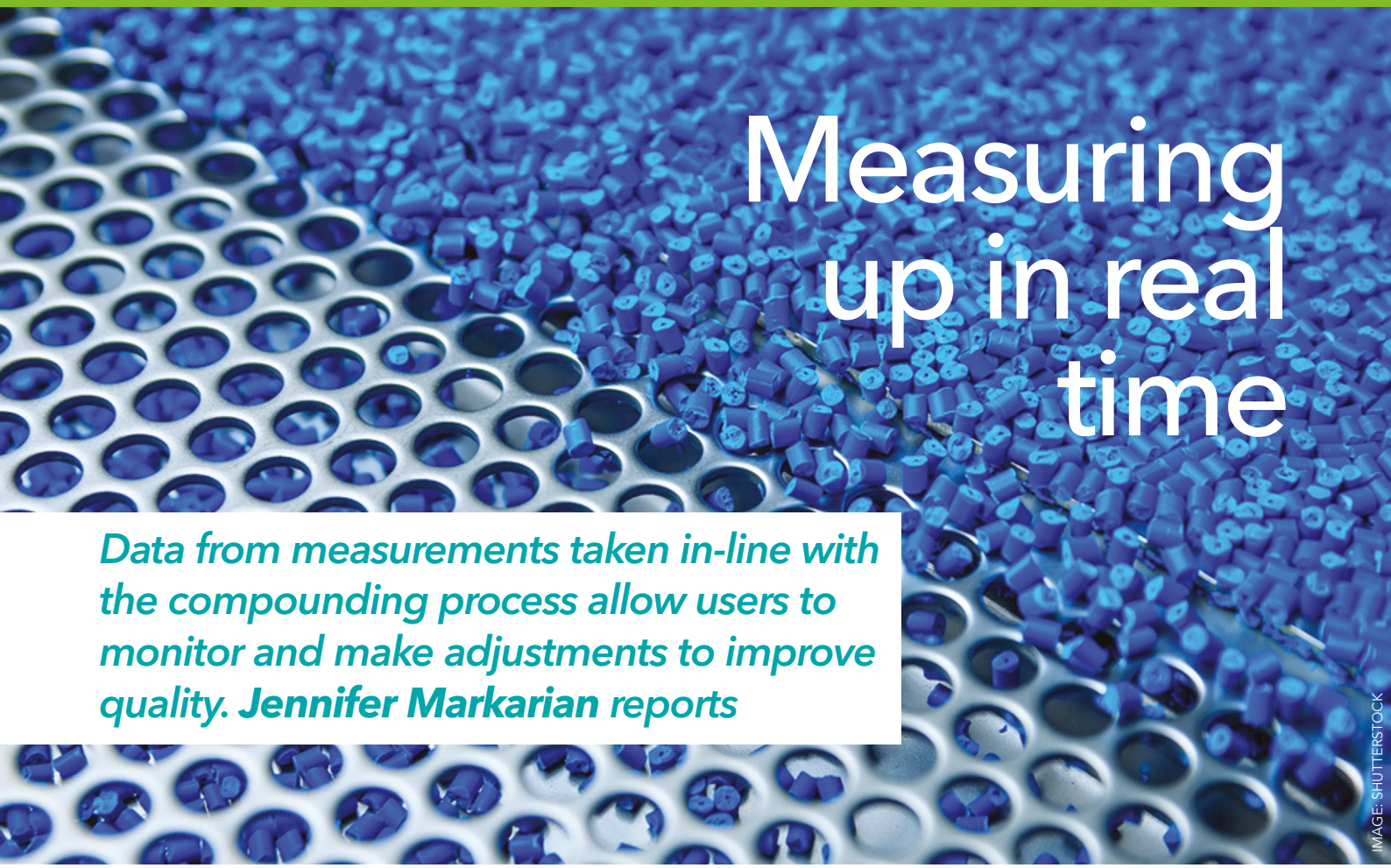

Measuring up in real time

Data from measurements taken in-line with the compounding process allow users to monitor and make adjustments to improve quality. Jennifer Markarian reports

IMAGE: SHUTTERSTOCK

Main image: in-line measurement technology promises to help plastics compounders improve product quality and reduce material wastage

The traditional approach to process control relies on monitoring of equipment parameters – such as temperature, pressure, or feeder rate – to ensure that production is running as expected. Off-line laboratory testing is then used to ensure compound and masterbatch product quality has been met. By the time that quality determination has been made a lot of product may have been produced. In-line analysis during processing provides an alternative that allows "real time" process adjustments to be made to improve product quality and reduce or eliminate out-of-specification product.

"The ongoing automation of traditional manufacturing requires the use of smart technology that can measure, analyse and diagnose issues without the need for human intervention," says Jaime A Gómez, President and CEO of US-based **Equitech**, which offers in-line colour measurement solutions. He says that the pandemic has driven an increase in automation this year as many companies have had to restrict access to their facilities and looked for ways to reduce employee interaction.

Equitech's colour measurement solution uses optical fibre probes connected to a spectrophotometer. A sapphire-tipped probe is inserted into the melt through a die adapter, allowing the melt to be illuminated and the light reflected to the spectrophotometer, where it is measured and output as colour values (L*, a*,b*, C*, h). The probes allow measurement in reflectance mode for opaque materials and transmission mode for transparent materials. The company says that measurement intervals as short as one to two seconds are possible, but adds that 10 to 60 second intervals are recommended for continuous process monitoring.

Gómez says the L* measurement feedback can be used to provide immediate adjustment of the colorant feeder to maintain the final product in specification throughout the product run. "With a more sophisticated pigment library, closed loop on a* and b* can also be achieved," he says.

He explains that laboratory and in-line colour instruments will produce numerically different results because of differences in the instruments and in the measurement environment. He says that a best practice for harmonising these numbers is straight-forward. "We use the offline (laboratory) measurement values to adjust our in-line measurements by making an offset that matches the laboratory. In this way, when the offline measurement is done (every two or three hours) we use it to adjust our in-line measurement and eliminate any drift in in-line data."

Equitech reports a growing trend to use real-time data for more comprehensive analysis of the

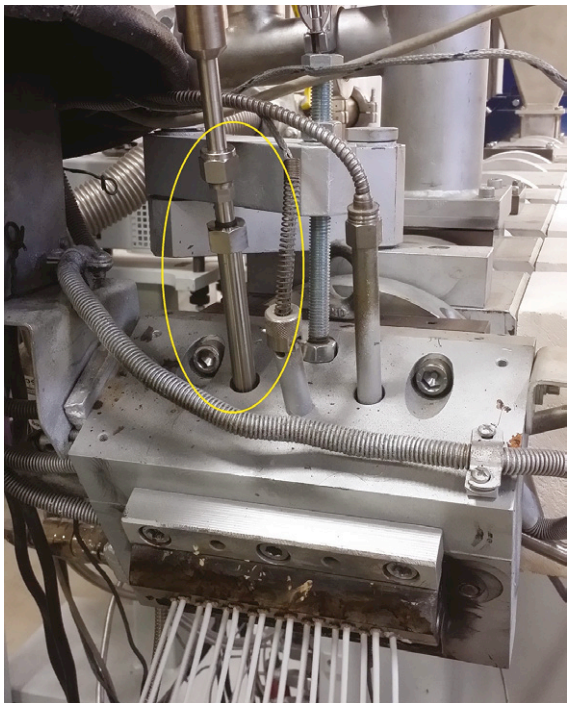

IMAGE: KRAUSSMAFFEI

Right: An in-line colour measurement probe from ColVisTec installed on a KraussMaffei compounding line processing PP

process, although Gomez says this is a significant change for the industry. "[Processors] have been operating in the traditional way – run production, send sample to the laboratory, do analysis, send results to production, adjust process, repeat – for decades," he says. "The availability of new technologies makes it possible to create very efficient plants that make instant adjustments, generate a comprehensive analysis of the process and don't mask costs. A change in paradigm indeed, but to achieve it, companies need to change their mindset and invest in capital and personnel assets."

Material savings

The main benefits of making such changes are savings, particularly in the use of often expensive raw materials. Pigment quality variations are normal as well as variations in their feeding, resulting in too high or too low of a concentration, Gómez explains. Real-time measurements, however, allow immediate adjustments to keep a product within specification. "In addition to raw materials, think of all the other processing costs associated with a bad run: energy, labour, utilities, operating losses, machine wear and tear, downtime, shipping, packaging and handling losses," he says.

Germany-based **ColVisTec** also offers an in-line colour measurement system. Its InSpectro X system also combines a spectrophotometer with optical fibre probes that are inserted in the extruder. It assesses process and product stability in the extrusion process through detection of changes that take place in the polymer melt, according to Fuat Eker, Director of Sales, Marketing and Customization at the company.

In the InSpectro X system, the in-line UV-VIS spectrometer measures optical changes in the ultraviolet and visible (UV-VIS) wavelength (220 to 820 nm) spectral range. "By directly observing variations in the spectrum emitted from the polymer melt, we pick up any change in the process from the polymer itself. Such trends include colour changes, yellowing, degradation, transparency, dosage fluctuations, segregation of premixes, drift and colour/recipe changes. These are effects caused, for example, by change in process parameters such as temperature, pressure, speed, throughput, residence time and material feed," says Eker.

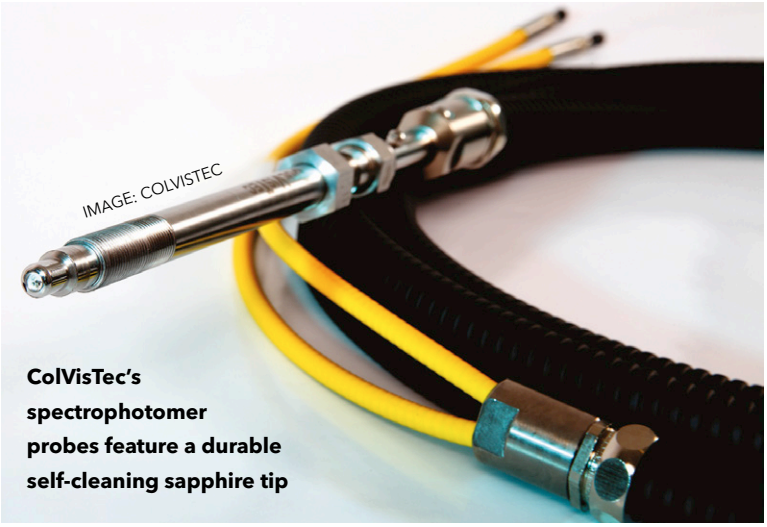

IMAGE: COLVISTEC

ColVisTec's spectrophotomer probes feature a durable self-cleaning sapphire tip

The UV-VIS in-line measurement technology was demonstrated at the K2019 trade fair in Germany on machines of three different extruder manufacturers that partner with ColVisTec: Entex (which makes planetary roller extruders), Leistritz, and KraussMaffei. The latter demonstrated the equipment as part of a liquid colour compounding process and was covered in the July edition of *Compounding World*.

Combined spectroscopy

For 2020, ColVisTec has added near infrared (NIR) and Raman spectroscopy and introduced its GiANT "3 in 1" spectroscopy platform. It also offers a "2 in 1" optical fibre probe that bundles UV-VIS and NIR fibres in one device that measures and displays information in the spectral range of UV-VIS and NIR (1,000 to 2,300 nm) at the same position in the process and at the same time. "This opens up new and extended possibilities for process monitoring in the extrusion and processing of polymers," says Eker. For example, he says NIR can be used to measure the residual water content in various polymer applications, while Raman spectroscopy can be utilised for monitoring of chemical reactions during the extrusion process. ❯

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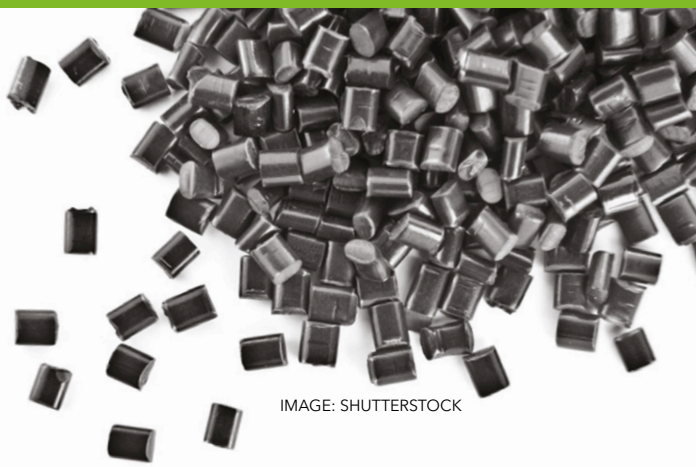

IMAGE: SHUTTERSTOCK

Right: Masterbatches can present challenges for in-line spectroscopy measurement systems due to their high optical density

In-line measurement presents various challenges, including finding a location to install the sapphire-tipped probe into the extruder where it will not interfere with production but where it can measure as intended. Typical probe locations are near the output area of the extruder (in the die, in an adapter piece, before or after a melt pump, or before the underwater pelletising system), Eker says.

"The self-cleaning property of the sapphire window combined with the material flow prevents the lens becoming coated, which is a problem often encountered if not dealt with using the right design principles," says Eker, who explains that sufficient shear from the material flow is needed in order to clean the lens, prevent material from coating it, and present the melt for real-time measurement in front of the window. "The sapphire tip has to penetrate into the polymer melt to achieve this cleaning effect, while avoiding moving machine parts such as screw elements at the installation location of the probe. These safeguards ensure there are no hindrances to the measurement of opaque or transparent polymers," says Eker.

For opaque polymer melts, ColVistec employs a probe designed for reflection measurement in which six optical fibres illuminate the melt while a central single fibre directs the light reflected from the polymer melt to the spectrophotometer for analysis. For transparent or clear polymer melts, two directly opposite and aligned probes are used; one sending the light into the molten polymer and the opposite probe detecting and transmitting it to the spectrophotometer. All ColVisTec probes for extruder applications are designed for a maximum of 250 bar pressure and 400°C melt temperature.

Masterbatch challenges

Masterbatches, which are optically dense, present a special challenge for in-line measurement systems. ColVisTec says it is currently working on an in-line solution that will allow real-time monitoring of product quality in masterbatch production. He says that, at the present time, such dense products have to be diluted in the laboratory to reduce the optical density to be measured.

Eker says that polymer melts containing glass fibre or glass microspheres are also a challenge to measure because they scatter light. In addition, he says these abrasive components will eventually scratch the sapphire lens. For such products, it is recommended that the polymer is measured before the glass additive is introduced.

The goal of in-line measurement is to monitor the process in real-time to allow problems to be rectified

Rapid metal separation cuts plant risk

Germany-based Sesotec has developed the Rapid Pro-Sense 6 metal separator to offer high detection accuracy to prevent even small metallic contaminants from entering the compounding extruder, where they can cause machine damage and unplanned downtime as well as potential quality problems in the end product.

Sesotec says compounders processing recycled materials face a higher risk of metallic contamination. However, the company adds that machine wear and other external sources can also present problems and recommends compounders take a holistic approach to preventing metal contamination in the final product, including preventive maintenance, inspection of incoming materials, and metal separators at critical points in the processing line, such as after sieving and before bag filling.

IMAGE: SECOTEC

Sesotec says the Rapid Pro-Sense 6 metal separator is suited to compounding applications

The Rapid Pro-Sense 6 can detect and remove both ferrous and non-ferrous metal particles in powder or granulated raw materials using high-resolution frequency technology, which the company says is more accurate than magnetic systems. It is suitable for connection to IoT and systems and is equipped with a logbook functiona so compounders can use data to identify the source of contaminants.

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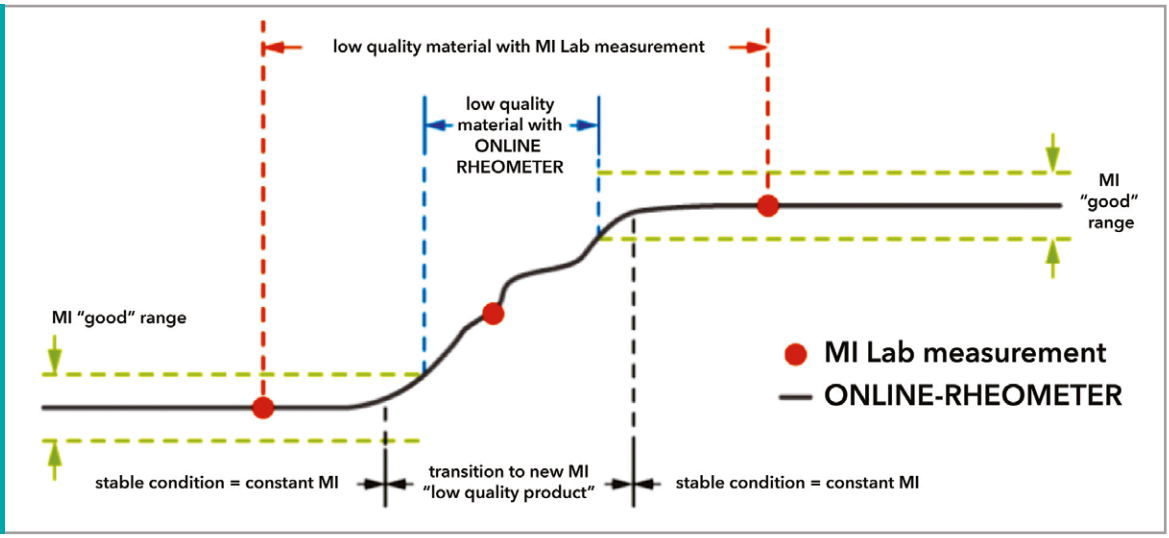


Figure 1: Measuring melt index with an in-line rheometer gives real-time melt index data that can show precisely when material is outside of specification limits. This can be used for more speedy product changeovers

Source: Goettfert

as quickly as possible. "Deviation in process stability is displayed instantly, making drift or fluctuations in the process immediately apparent. Compared to lab-based testing, in-line measurement offers a range of advantages both in terms of response time and a wealth of information that cannot be gained by a few lab measurements covering a total production run," says Eker. He adds that laboratory tests performed on solid samples taken at a specific time can also be correlated to data from in-line measurements if they are accurately time stamped.

In-line real-time measurement forms a critical component of the "Industry 4.0" concept of process control enabled by digitisation and data analysis. "The more ambitious manufacturers in the polymer industry are already adopting this new manufacturing philosophy with very good results in terms of costs as well as increased quality and supply reliability," says Eker. He says that in-line measurement has been demonstrated to be especially helpful in compounding and processing of recycled material, where the stability and possible range of input materials is particularly challenging.

"The recycling companies are confronted with a mass of materials in different qualities and with different additive contents. From this they are then supposed to produce high-quality products competing against pure polymers – an extremely challenging task," Eker says. "In-line process measurement helps the recyclers maintain process stability, weed out finished product that has been polluted by unwanted raw materials, and confirm to the customer that the product delivered matches the quality specified in the customer's order. Our in-line technology has been successfully used in recycling for over five years and has shown its value in delivering top output quality in this difficult environment."

ColVisTec argues that recyclers get significant returns when they adopt in-line testing and other technologies. Eker says that, in order to be able to deliver what future markets requires, the plastics recycling sector has no choice but to adopt these better process and product monitoring technologies.

In-line rheology

The benefits of process and product monitoring also apply to in-line rheology testing. Melt index (MFI) is a widely-used quality control test because it correlates directly to polymer properties. In-line melt-flow measurement promises real-time quality control of the melt in the extruder under processing conditions.

Various types of in-line melt-flow measurement systems are available, says Tim Haake, General Manager of **Goettfert**. Some take a continuous bypass stream, measure it, and discharge the sample as a waste stream, but he says that the more sophisticated (and also more expensive) approach is use a return melt rheometer that directs the sample stream back to the extruder. This avoids material loss and the need to handle a waste stream.

Haake says that care must be taken in setting up an in-line rheometer if it is to correlate melt index results with those from laboratory equipment. "One needs to find the right setup for die size, pump speed and pressures," he explains. "Sometimes it is possible to work with a single drive and single capillary to cover the required range of measurements. If you run a high melt and the pump is also running fast, the results are often quickly available. However, emulating the forces seen in a melt indexer with a low melt will result in slowly running pumps, with a response time too slow for users trying to optimise their process."

One solution is to use a rheometer with an extra pump designed solely to speed up the flow through the bypass. This gives a fast, reliably

correlated and accurate MFR result, says Haake. Goettfert also offers the option to run two different dies in parallel, which allows an even greater measuring range to cover a wider range of MFRs.

Left: Leistritz developed its elongational rheometer in conjunction with the Johannes Kepler University in Austria

Fast feedback

Haake says it is common for compounders to run a variety of products and, especially with larger extruders, quick feedback is needed to minimise off-spec material production. In-line rheometry is particularly useful in optimising product changeovers and this is shown in Figure 1, where the technology is used to determine when the product is in-spec.

Goettfert offers three types of in-line rheometer: bypass, sidestream with return, and its Realtime Rheometer with independent control of the flow. It can also provide additional means for quasi-continuous measurements of rheological data, including shear viscosity, melt index, intrinsic viscosity, or elongation. Haake says the most recent development is a Class 1 Div 2 explosion proof version of its in-line system.

Leistritz has offered its elongational rheometer, which can be used as a standalone measurement device or as part of an in-line process control system, for around three years. Developed in conjunction with the Johannes Kepler University in Austria, the compounding extrusion machinery maker says the system differs from other in-line rheometers in using a slit die system rather than the traditional capillary. It says this means that the device can be used with materials ranging from high viscosity pipe grades to low viscosity fibre or injection moulding grades. It can also handle glass reinforced grades, which the company says is not possible with capillary types.

In an in-line configuration, a small amount of melt is diverted from the compounding extruder into the rheometer via a bypass channel. The die itself features a patented hyperbolic narrowing that

Right: Collin has launched a range of pellet inspection systems for small scale production lines

creates constant elongational flow (Leistritz claims a first for this in an in-line elongational rheometer). Melt delivery to the die is controlled by an internal gear pump, so is independent of the compounding extrusion process conditions, and the measured material is transferred back into the process.

The rheometer provides online measurement of shear viscosity (a measure of fluid flow between melt layers) covering shear rates from 10 to 10,000 s^{-1} and elongational viscosity (a measure of the resistance to stretching) covering elongation rates from 5 to 75 s^{-1}. Elongational viscosity is particularly sensitive to fibre length variation, which makes the system useful in analysis and control of reinforced compounds or formulations containing highly anisotropic fillers (such as nanocomposites).

Leistritz says the rheometer can be used to quickly obtain viscosity curves through targeted variation of shear and elongational rates. It can also determine melt flow index, IV value and melt density, making it useful for product and process quality control as well as for monitoring reactive compounding processes.

Pellet inspection

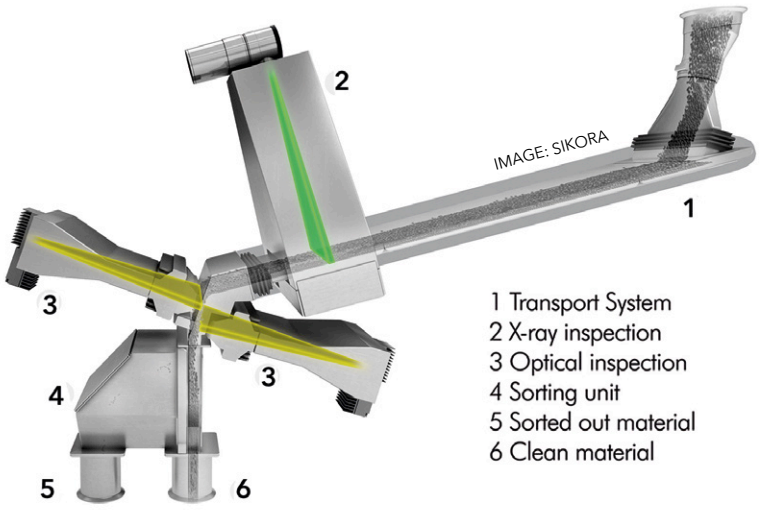
Germany-based **Collin Lab & Pilot Solutions** has introduced three new systems for quality measurement of polymer granules and powders. They can be used as stand-alone devices or combined into an all-in-one system. The PGSS (Powder Granulates Shape & Size) Analyzer is a CMOS camera-based system that quantifies the shape and size of each granule. The PGC (Powder Granulate Contamination) Analyzer uses CMOS camera and LED strobe technology can detect contaminants and impurities. The CMS (Colour Measuring System) measures colour using a spectrometer. The devices can run at up to 25 kg/h for granulated material and up 2 kg/h of powder material.

Collin says the new devices can be used for quality control of both incoming materials and finished goods. According to the company, they can also be used – alone or in combination –for measurement of production quality through a bypass line that takes a sample from the process and delivers it to the testing equipment. All test data is recorded for analysis.

The latest version of **Sikora**'s pellet inspection systems also offer in-line measurement capabilities. The Purity Scanner Advanced systems combines X-ray and optical technologies to provide 100% pellet inspection at throughput rates up to 1,000 kg/h. The system can handle transparent and opaque materials and can detect metallic and non-metallic contamination on the surface or inside each pellet, isolating any problematic granules from the production flow. According to the Germany-based company, its X-ray technology can detect contaminants down to 50 by 50 by 50 microns; optical systems can detect to 50 by 50 microns.

Israel-based **Inspec.Tech** also offers an in-line pellet inspection system, which it claims is affordable and compact. In its basic version, the RMI system uses a single area scan camera to monitor a stream of falling pellets at throughput rates of up to 1,000 kg/hr. Defects such as pellet dimensions and tails can be detected using the basic system while a colour camera upgrade allows colour variation to be monitored. A variety of air blast options are available for isolation of defective pellets.

Below: Schematic showing key components in Sikora's in-line Purity Scanner pellet inspection system



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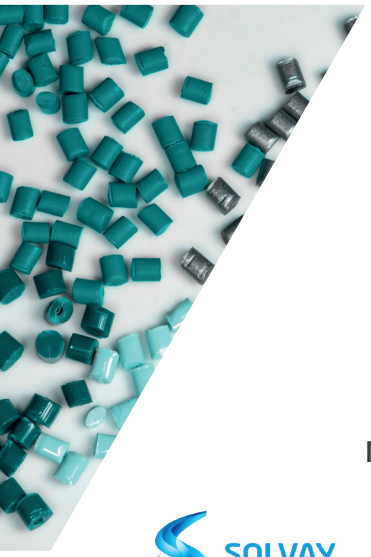

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Feeding with efficiency

Feeding technology and equipment plays an important role in efficient compounding. Peter Mapleston takes a look at some of the latest developments

IMAGE: PIOVAN GROUP

Main image: Penta's Codomix system is designed to dose, mix and convey powder materials to the compounding plant

Feeders are essential components in any compounding plant, ensuring materials are introduced to the compounding extruder reliably and consistently. Suppliers continue to optimise the performance of their designs and the past few months have seen a number of new and often novel additions to the feeding equipment options for compounding plant and other continuously-running equipment. This article provides a run-through of some of the latest developments.

German equipment maker **Brabender Technologie** says it has focused its attention mainly on increased flexibility and safety with its recent developments in bulk materials and liquids feeding, weighing, discharging and flow measurement products. The company says servo motors are set to become standard for feeders, pointing out that they provide a wider speed range compared to standard AC motors, while still maintaining torque. They also show almost no speed fluctuation in situations where high torque is required. "The servo drive eliminates the need for a second pair of screw and tube, thereby reducing changeover downtime of the system," says the company.

IMAGE: BRABENDER TECHNOLOGIE

Left: Brabender says clear PETG outlets will be available on all models through 2021

Brabender has also addressed the flexible connections in its material delivery systems. Manufactured from highly durable, tear-resistant liquid silicone rubber (LSR), it says these are essential in sealing upstream and downstream processes and are especially important where hazardous ingredients are being used, as the connections are relied upon to prevent any potentially harmful toxic dust escaping from the system. "This new design provides highly flexible characteristics essential for ultra-low feed rates below 50g/h," says the company.

The company says it has also developed a new shaft sealing system for use wherever screw or agitator shafts are required. It has added a purge system to its radial shaft seal that incorporates an inner pressurized chamber to ensure that, in the rare event of a seal leak, dust remains in the chamber. The shaft seals act as a barrier in both directions, protecting the motor on one side and the ingredients on the other. Another new addition is a clear vertical outlet. Moulded in PETG, which

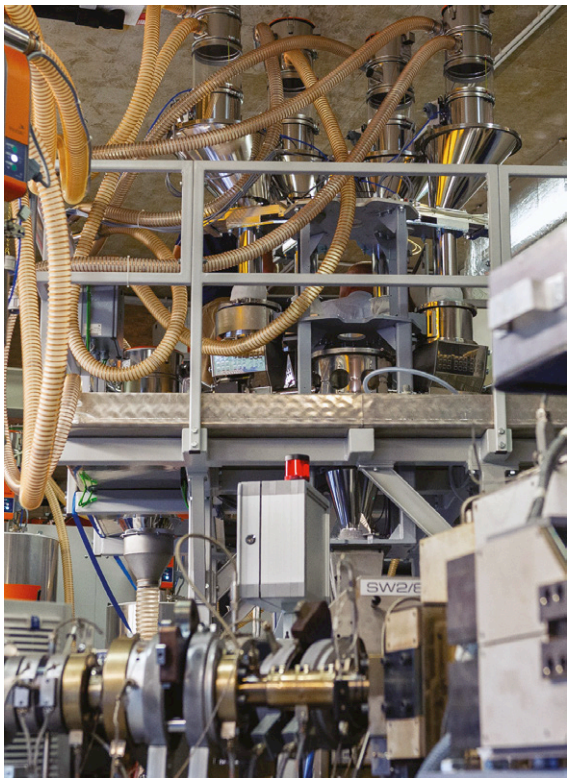

IMAGE: MOTAN COLORTRONIC

Right: A Motan Colortronic Spectroplus system installed on a mezzanine over an extrusion line

remains dimensionally stable up to 90°C, it will be available for all models and sizes by 2021.

Compounding options

Germany-based **Motan-Colortronic** says it has developed its Spectroplus dosing and mixing unit specifically to meet the requirements of the extrusion and compounding sector. The unit, which the company describes as "one of the most flexible overall systems in the Motan product world", can handle virgin granulate, regrind, powder, liquids and flakes. It says it can be adapted to take on the most diverse dosing requirements.

The synchronous dosing and mixing unit can be supplied in either gravimetric or volumetric versions, or a combination of both, and can be configured for both starve-fed and flood-fed applications. Up to eight dosing modules can be mounted on the frame, each of which can be easily removed and installed without tools. Exchangeable dosing modules and an easy-to-clean dosing hopper keep downtimes for material changeovers to a minimum, the company says.

The Spectroplus design is highly compact. Simple individual adapters allow the unit to be mounted directly on the machine feeder of the extruder or on a customer-specific mezzanine. Compared with earlier products, the overall height is much lower although throughputs are the same.

The unit also uses a new load cell arrangement. "This consists of a combination of high-quality strain gauge load cells and a digital electronic transducer of the latest generation," says the company. Benefits of the new system are said to include ease-of-assembly and calibration, long-lasting and low-maintenance operation, trouble-free signal transmission, and minimal susceptibility to external interference.

Spectroplus dosing and mixing models also come with a completely new control system – Spectronet – which can control not only Motan dosing modules but also units from third parties. It is also said to support a broader scope of application.

IMAGE: MOTAN COLORTRONIC

Right: Motan Colortronic's modular Spectroplus dosing and mixing unit configured with four dosing modules and an additional liquid doser

Precision dosing

Italy's **Piovan Group** describes its Quantum gravimetric blender series as one of its top innovations in terms of materials handling, dosing, and mixing. "The ability of precisely dosing multiple ingredients, such as virgin and recycled resins, along with masterbatch and additives in a one-shot homogeneously pre-blended component is an important step ahead," the equipment maker says. "The same applies to the continuous premix of the powders, such as fillers and pigments."

Piovan's Penta subsidiary – which designs, manufactures, and installs automation systems for processing raw materials in powder form – recently introduced its Codomix technology. This simultaneously doses, mixes, and conveys powders to feed compounders and other continuously-running processing machinery in a loss-in-weight operation mode. It can also feed batch processing machines a premixed recipe. Penta says its localised, dedicated control of the dosing and premixing phases allows a much more efficient and stable compounding process to be maintained. The Codomix mixing technology is also claimed to provide a deeper and intensive premix of ingredients, which results in improved dispersion into the molten resin.

Continuous solutions

Azodos is a family of continuous dosing units for powdered products from German systems maker **Azo** that can be expanded and adapted to meet a wide range of

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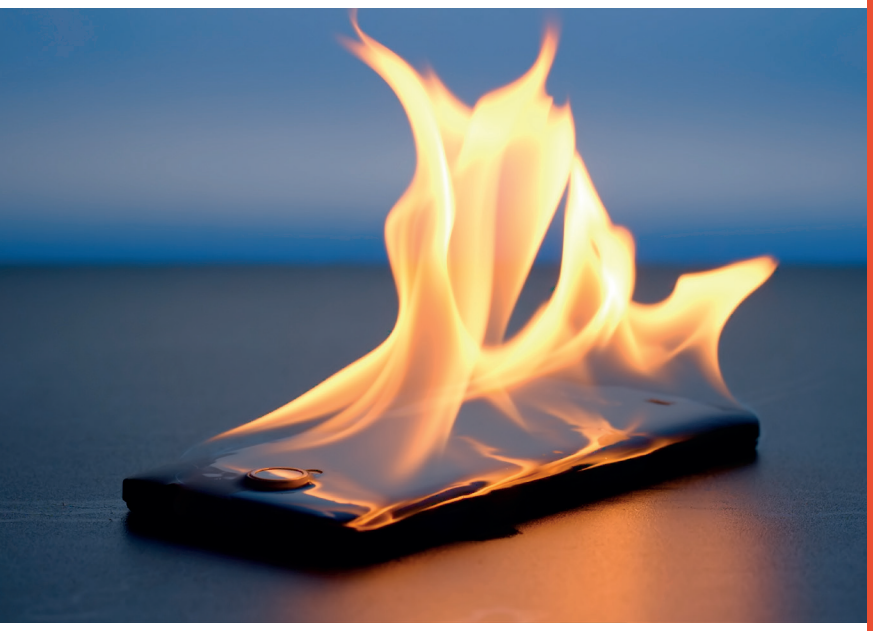

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requirements. Azodos type P DV models are intended for volumetric metering of powdered products, providing a constant mass in coarse or fine flow operation. The basic machine consists of a housing containing one or two dosing screws (depending on the model), driven by frequency-controlled gear motors. An upstream discharge agitator ensures the screws are evenly filled from surge bins, which are also available in various sizes.

This basic machine can be expanded with a platform load cell or a three-point weighing frame to form an Azodos type P DW dosing system. When used as loss-in-weight scales, flexible connections at the supply hopper inlet and screw outlet decouple the system to prevent force shunts. The Azodos P DW can also be combined with an AzoCont dosing control to create a loss-in-weight feeder, which continuously regulates mass flow in terms of target and actual throughput. Up to 10 dosing stations can be controlled from a central AzoCont controller.

AZO recently delivered two challenging materials handling and mixing projects for US company BioLogiQ, which produces plastics from renewable resources such as starch generated as an excess product during potato processing. These thermoplastic starch (TPS) polymers are sold under the NuPlastiQ BioPolymers name and are designed to be blended with either conventional plastics or other bio-based resins.

Explaining the project at last year's k trade show in Germany, Azo said first discussions with BioLogiQ to design a processing solution for the natural based starch materials began in 2016.

"Together with technical expertise out of Germany, a short phase of brainstorming and system design led to a highly functional solution," says Justin Sanders, BioLogiQ Plant Manager. First trials were carried out at the Azo test centre in Osterburken in Germany, with BioLogiQ subsequently carrying out further tests in its existing production operation in Blackfoot, Idaho.

The next step was to adapt and scale up the provisional test results to the layout of the two production plants, one in the US and a second in China. Azo carried out additional tests during the project phase as and when necessary.

Azo said the handling and processing of the starches presents special challenges due to the fluctuating properties of the sticky materials, critical dust explosion data, and some special features required for processing the wet compound. One of the core components of the system is the company's AzoMixomat technology, which combines transporting, dosing, weighing, and mixing in a single unit.

Flexible feeding

The K2019 show also saw **Schenck Process** reveal the latest addition to its Simplex Flat Bottom (FB) feeder family – the Simplex FB 650. This is designed for feeding plastic flakes, cellulose, hemp, glass or carbon fibres and other virgin or recycled materials for compounding applications (and also film lines). The high capacity stainless steel feeder includes a bottom-driven vertical agitator and auxiliary agitator feeder and is designed specifically for handling hard-to-feed

Feeder upgrade for fluffy materials

Leistritz does not offer feeding equipment as a stand-alone product line but it does build units for inclusion on its own compounding extrusion lines. At Leistritz Extrusion's US operation in New Jersey, President/ General Manager Charlie Martin says it recently installed a crammer assist device to help get fluffy materials (low bulk density flakes, fibres, and the like) into a ZSE-MAXX twin screw extruder.

A typical fluffy material feed system is configured with a custom refill bin integrated with a weigh belt with rotary valve discharge; and a weigh belt feeder complete with AC motor/ drive, Martin says. The crammer assist device uses a screw auger that mates with the ZSE-MAXX feed throat to densify and push low bulk density materials into the feed. It includes a single screw auger with agitator assist arms in hardened steel; a stainless steel conical hopper with internal stator bars; and a latched lid with provision for multiple feed streams.

› **https://extruders.leistritz.com/en**

Leistritz has added a crammer-assist feeder to this compounder in its US laboratory

IMAGE: LEISTRITZ

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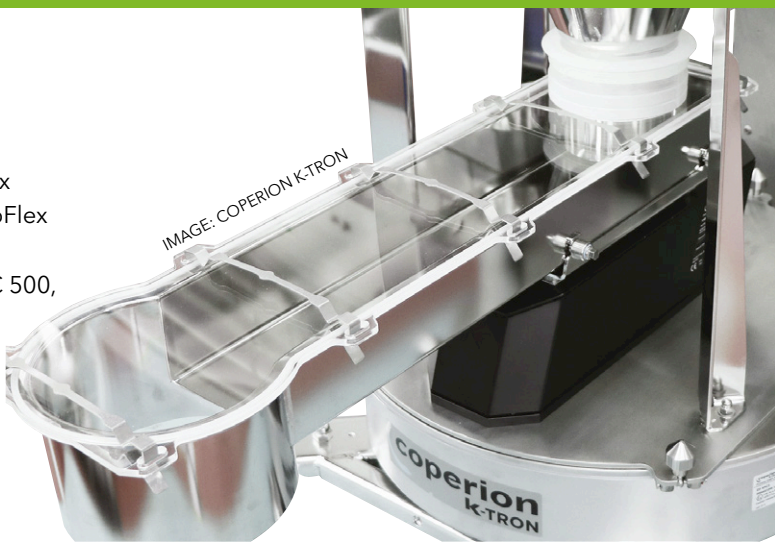

IMAGE: COPERION K-TRON

Right: The Coperion K-Tron Vibratory Feeder uses a new drive design that offers improved feeding performance

materials with light and fluffy characteristics.

Schenck Process also introduced the ProFlex C100 at the show, the latest addition to the ProFlex C family designed to enable low feed rates for masterbatch applications. It joins the ProFlex C 500, 3000 and 6000 units, which were launched a couple of years ago. The new model is equipped with an integrated gearbox for turndown ratios of up to 1:120. It allows up to five feeders to be grouped around the inlet of a lab or small size extruder.

The ProFlex C feeding system is used for continuous feeding of bulk materials such as powder, granulates, pellets or fibres. Optimised design, flexible hopper walls and a multitude of installation options make the ProFlex C a good solution for the compounding and masterbatch industries, according to Schenck. Features such as a quick-change hopper option enable fast and clean changeover without having to disassemble the feed screw while the asymmetric design prevents bridging and plugging of sticky materials.

Feeding tools for solid bulk materials come in various shapes and sizes, with the screw feeder the most popular. However, **Coperion K-Tron** says requests from the market for faster product changes, shorter cleaning times and reduced maintenance prompted it to investigate alterative solutions. "It was determined that vibratory feeders could be the ideal solution," the company says.

IMAGE: COPERION K-TRON

Above: Coperion K-Tron's KCM-III controller features a user-friendly interface with context-sensitive help

Until now, vibratory feeders have been seldom used as accuracy has not always been great and they tended to transfer vibrations to the environment. In addition, tray length was also limited. Using simulation technology and high-speed camera observation, the company's researchers concluded that shock absorber design lay at the root of all three issues. Traditional rubber shock absorbers created a rotational movement of the drive, causing turbulence in the flow of the bulk material on the feeding tray.

Alternative vibes

The company has developed an alternative flexible pendulum absorber design, which keeps the movement of the drive parallel to the desired direction of motion and eliminates rotational forces. As a result, it says material flow is consistent along the entire length of the tray with minimal pulsing, significantly improving feeding accuracy.

The vibratory feeder is used with the company's latest KCM-III feeder controller, which measures acceleration, displacement, load, current and temperature up to 25,000 times per second and then adjusts the drive signal to maintain clean sinusoidal displacement for optimal mass flow. This combination is said to make the new vibratory feeder more accurate than a screw feeder. The mechanical package is modular in design, accommodates custom tray configurations and lengths, and features an extended feed rate range of 1:500. A special quick-release clamp mechanism on the feeder tray allows for quick product changeover.

Coperion K-Tron points out an additional positive benefit in that power consumption of the vibratory feeder is 20 times lower than that of a screw feeder. And, unlike a screw feeder, there are no rotating parts, which makes cleaning easier and cuts maintenance requirements.

The KCM III feeder controller features an improved user interface and includes a number of new functions. The unit, which features a stainless steel housing and 5-inch LCD screen, includes built-in Ethernet capability (wired or wireless) and can be accessed remotely via a web page. Control modules equipped with an optional Wi-Fi gateway can create their own local network, with the Wi-Fi access point allowing an operator using a mobile device to access any module on the network to remotely control dispensing, check status or view files.

"The new feeder controller is equipped with all the technical prerequisites to expand Industry 4.0 functions such as preventive maintenance, electronic service options, Overall Equipment Effectiveness (OEE), outlier detection, machine optimisation and much more," says Coperion. A more powerful CPU, extended memory and optimised control algorithms ensure faster communication with the feeder drive, weighing system and peripherals and, when used in combination with the latest generation of the

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Ampacet buys into feeding systems

Masterbatch producer Ampacet acquired Liad Weighing and Control Systems in February this year. Based in Israel, Liad initially developed a single-component gravimetric feeder technology for injection moulding machines and claims to now offer a full range of feeders, blenders, and real-time quality control solutions to the plastics industry.

In North America, Liad products will be distributed by CISystems Color Integration, a new business unit that Ampacet has created to improve the way manufacturers use colour in their processes. "Ampacet is entering into a new era of delivering holistic solutions to our customers and preparing the stage to enter into new markets with a different value proposition," says Alvaro Mendoza, Ampacet President and CEO.

One of Liad's innovations is BlendSave, which it describes as an advanced, patented multi-weighing channel batch blender. It comprises up to 14 weighing chambers fed directly from silos or containers, and can simultaneously, accurately, and consistently weigh raw materials, combining them as a batch according to pre-determined recipes to pre-determined processing machines.

IMAGE: AMPACET

Left: Ampacet says the Liad BlendSave system is suitable for compounding operations

"BlendSave can optimise the flow of raw materials whilst offering unparalleled consistency and high throughput," the company says.

The main target market for BlendSave is injection moulding operations, but it may also be sold to compounders serving markets such as automotive (but not to masterbatch manufacturers). "We are open to working with a true compounder, blending different resins and additives together to make performance compounds," says Douglas A Brownfield, Commercial Director at CISystems.

› **www.ampacet.com**

Below: Maguire's NVRBE vacuum pump is said to be easy to install in mini systems

IMAGE: MAGUIRE PRODUCTS

company's SFT load cells, the KCM-III also offers a significantly higher weighing resolution of 8,000,000:1 in 20ms. This allows it to react extremely quickly to changes in the system.

Combined control

The KCM-III combines the motor drive and control modules of a feeder and its ancillary components into one unit and is generally mounted directly at the feeder. Built-in software covers a variety of application types for both batch and continuous applications, including loss-in-weight feeders, weigh belt feeders, and smart flow meters. For traceability purposes, the KCM-III automatically stores up to seven days of log and event files, as well as trace and process data. Extended traceability is available as part of an optional software bundle.

The NVRBE is a new vacuum pump from **Maguire Products**, which it says is easy to install, operate, and maintain and can simplifying conveying of raw materials from storage to blenders, dryers, or machine hoppers. Multiple pump units can be configured in "mini-central" systems using Maguire's compact LowPro receivers mounted on multiple blenders.

Notable features cited by the company include: Clear-Vu dust collection bin to allow the operator to easily see when cleaning is required; a filter safety switch that initiates an alarm and stops the blower if the filter becomes clogged; a pressure differential switch that acts as a clogged filter sensor; a temperature safety switch; and an air bypass valve, which prolongs pump life and minimises power usage by allowing the blower to keep running when no vacuum is called for.

"The automatic features of the NVRBE vacuum pump and its simplicity of use make it especially compatible with Maguire's LowPro receivers," says Frank Kavanagh, Vice President of Sales and Marketing at the company. "LowPro receivers are autonomously controlled, making them suitable for deployment in automated mini-central systems for conveying to multiple blenders."

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Mastering the mix

IMAGE: COPERION

Batch and continuous mixers have an important role to play in production of plastics blends, compounds, and masterbatches. Mark Holmes reports on some of latest developments

Whether for PVC dry blends or highly loaded pigment masterbatches, certain polymer compounding operations require specialised mixing techniques. These can be either batch or continuous solutions and may be designed to operate as stand-alone activities or to integrate seamlessly into a compounding operation. In all cases, mixing equipment developers are working to provide more effective mixing with improved plant utilisation and, since the emergence of the Covid pandemic, improved remote access and monitoring.

Batch mixers are widely used in the PVC industry but are extending their scope of application into a broader variety of plastics compounds, according to **MTI Mischtechnik International** General Manager Ulrich Schär. "The company's core business is the production of heating/cooling mixer combinations, which are typically used for dry blending of rigid and soft PVC, as well as for natural fibre compounds including wood, cellulose, hemp and rice husks, for example. We also see a trend for mixers in the development of bioplastic applications and the use of other bio raw materials, such as starch. However, price is currently limiting the number of applications."

Improved operational efficiency ranks highly in most users' list of demands. In addition to development and design of new and more effective mixer types and applications, MTI sees remote access solutions for mixing becoming essential – a requirement accelerated due to restrictions resulting from the ongoing coronavirus pandemic. "Modern mixing plants can only work efficiently and with maximum availability if they are commissioned by experts and, in the event of a malfunction, faults are rectified within the shortest possible time," says Schär. "In these Covid times, with significant travel restrictions and visiting bans, remote access to the machine is of vital importance."

MTI says it has been implementing remote access on its machines for some years and adds that all of its equipment is provided with modems to aid identification of operational issues. "A large number of system issues are caused by electrical components, software errors or simply incorrect operation. While the 'technician on site' is irreplaceable in the event of mechanical problems, controls and their components, as well as electrical drives with speed regulation, can now be checked and reset remotely, if necessary," he says. ›

Main image: Mixing equipment lies at the heart of many plastics compounding operations and holds the key to efficient production

IMAGE: MTI MISCHTECHNIK INTERNATIONAL

Right: MTI Flex-line Heating/ Cooling Mixer Combination MTI Flex-line offers high mix quality for dry blending and compounding

"Remote access not only makes it easy to detect faulty components, but updates for software-supported parts and PLC controls can also be uploaded without the need for manual intervention by a technician. By being able to access the HMI at the plant directly, the local operator can also be instructed and trained on the system as well," Schär says.

MTI uses GS- and WAN-based modules to establish a secure connection to its own server via a VPN tunnel to ensure that safety of data transmission is not compromised. However, data security is not the only challenge to consider, especially where remote access goes beyond troubleshooting. Commissioning via remote access, which is especially necessary due to Covid restrictions, poses special challenges for both operator and supplier and is only possible if strict safety requirements are met and well-trained personnel are involved on the user's side.

Remote intervention

"Remote access cannot replace one's own eyes and ears on site at the machine, so communication during the process is of particular importance," says Schär. "Video-supported tools, such as Microsoft Teams or Skype, are valuable additional instruments here."

Schär says the first mixing plants have already been commissioned by the company in some high-risk Covid areas. "During implementation it soon became apparent that this type of service requires much more intensive preparation. The operator on site usually does not have the specialist knowledge required and must be introduced to the subject with illustrated documentation and then guided through the process. The additional time required for the supervision and implementation of commissioning via remote access must be taken into account – in particular by the provision of trained personnel by the supplier. MTI has recognised this and is strengthening this area accordingly for future orders."

IMAGE: MTI MISCHTECHNIK INTERNATIONAL

Above: The Aspiration Vent tec 2.0 filtration system offers optimal dry blend quality and dehumidifying performance

The range of mixing solutions available from MTI includes Vertical High-Speed Mixer Universal friction mixers, which are suitable for free-flowing raw materials with or without the addition of liquids and offer heating, temperature control, reaction, melting, coating, agglomeration and dispersion under pressure and vacuum if required. The MTI Unitec Vertical Universal Mixer line is said to offer high energy efficiency together with maximum productivity and mixing quality, and fast formulae changeover. The company's Horizontal Mixer provides a proven solution for mixing, dispersing, granulating, coating, heating/cooling and drying of products for virtually all applications.

MTI's Flex-Line Heating/Cooling Mixer Combination provides high mix quality and is said to be well suited to more demanding tasks such as dry blending and compounding, for example. The Eco-Line Heating/Cooling Mixer Combination MTI Eco-line offers a standardised heating/cooling mixer combination and is said to provide good throughput rates at a cost-effective price and operating cost. The MTI Laboratory Mixer is a universal solution device for trial mixtures and small-scale production runs.

Designed for efficient and flexible batch mixing, the company's MTI C tec^{PRO} device can be used with vessels of various sizes up to 600 litres. And the MTI Aspiration Vent tec 2.0 aspiration and filtration system is said to be widely used in hot mixing processes for PVC production and processing of natural fibre compounds, such as WPC and PPC.

IMAGE: ZEPPELIN SYSTEMS

Left: The CMQ Container Mixer from Zeppelin Systems is said to slash cleandown times

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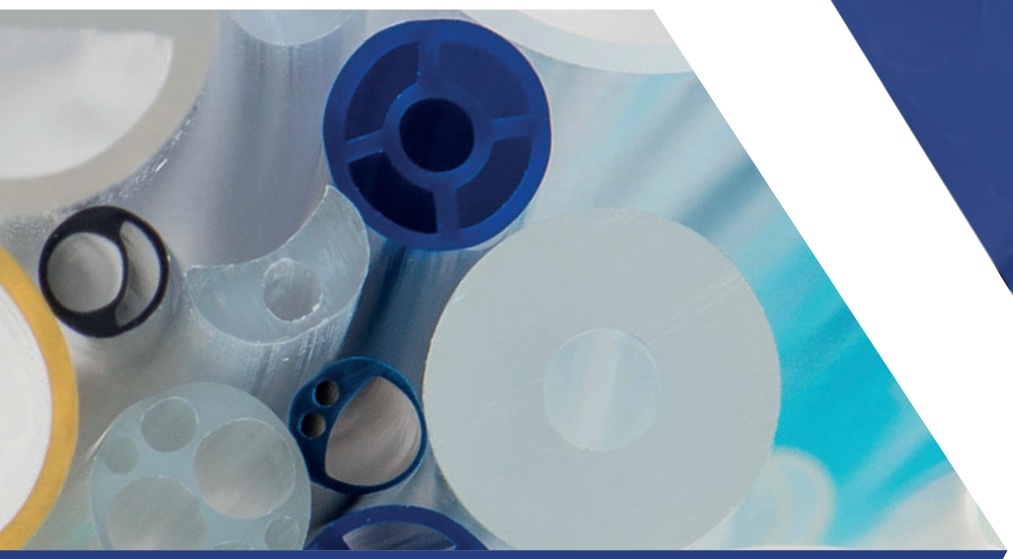

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IMAGE: ZEPPELIN SYSTEMS

Left: Zeppelin System's FM-T High Intensity Mixer features a split mixing bowl to aid cleaning

Custom solutions

According to **Zeppelin Systems**, the current Covid-19 situation has resulted in a number of projects being placed on hold but general demand for mixing systems in the compounding sector has been growing. The German company reports a particularly high level of interest in complex custom-made systems that can be delivered on short lead times. "A wide variety of operations within compounding require mixing solutions," says Karl-Hendrik Schluckebier, Product Manager Mixing & Treatment Components at the company. "These include chemical modification, dispersion of pigments and mineral powders, compounding, drying, coating, stabilisation, homogenisation, pelletising and agglomeration. Such processes are needed for PVC compounds for pipes, profiles, films, sheets and cables, as well colour and additive masterbatches, pigment concentrates and technical compounds, for example."

Schluckebier identifies a number of factors influencing mixer developments for compounding, including automation, machine availability, optimised material flow, reducing cleaning times, and environmental and sustainability issues. He also says that the pandemic has meant remote access has grown in importance and, as a consequence, predicts future development in mixing systems will include predictive maintenance, use of smart components, and support for cloud computing.

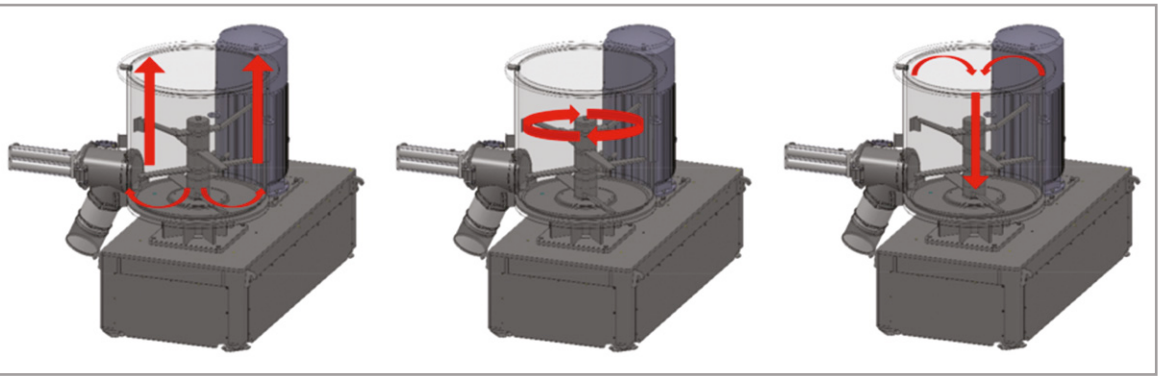
Zeppelin Systems offers two mixers that are engineered specifically for the mixing needs of the compounding sector – the Container Mixer CMQ (EP 3 342 480 B1) and the High Intensity Mixer FM – T. The company says the CMQ Container Mixer incorporates an innovative mixing principle that can cut up to 80% from normal cleaning time. This is achieved through the use of a flat easy-to-wipe mixing head and mixing tool with a high bottom and wall clearance that prevents material build-up.

The company says good mixing is achieved with the wing-profile tool, which due to its low weight makes disassembly for cleaning quicker cleaning. It is also said to ensure a good material vortex, high lifting force, and fast and effective homogenisation is achieved, which results in optimal dispersion characteristics and final colour strength. The machine frame design has no sharp edges, which helps keep the plant clean, while the venting system and container seal guarantees a dust-free working environment.

The FM-T High Intensity Mixer is described as a quick-to-clean flexible stationary. Its design incorporates a two-piece completely jacketed divided mixing bowl configured with a hydraulic unit for lifting the upper bowl part and for lifting and turning the lid. Good access to the inside of the mixer is said to allow easy cleaning and maintenance, without the need for confined space permits (with the US OSHA framework).

Germany-based **Mixaco** manufactures a wide range of container mixers, following the principle that the sooner the mix is removed from the mixer the quicker the machine is back in operation. The most recent addition to its product line-up is the Container Mixer i4, a highly flexible system that can accommodate a range of container sizes and features a flat mixing head to ensure very fast product cleandowns.

›



Schematic representations from Mixaco show the vertical, radial, and horizontal vectors that combine to create the vortex in a container mixer
Source: Mixaco

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Coperion's Mix-A-Lot bulk mixer offers high-speed and cost-efficient homogenisation

Inside the vortex

The company says producing a quality PVC dry blend at speed requires the creation of an optimal vortex in the mixer. In hot mixers the vortex describes the flow of the material as it moves inside the mixing bowl, the company says, and is determined by the different movements (combined vectors) achieved by the design of mixing tool and vessel. The bottom blade creates a mainly vertical upwards movement and pushes the material to the sides while the middle tool creates a radial force. The velocity of the blades creates a centrifugal force (radial vector) and the material gets pressed to the side walls of the bowl, forming a vacuum in the centre. As a result, material is dragged to the shaft (horizontal vector) and pulled down (vertical vector). These three vectors create the vortex, which can be further optimised by the bowl design and turbulence created by the mixing tools.

Mixaco says the vortex is affected by many factors during the mixing process. One is the tip speed of the mixing tool. The ideal tip speed depends on the raw materials, blade and vessel design. If it is too low (less than 20 m/s) no vacuum is created in the centre of the bowl resulting in no horizontal movement of material. The mixer may also start vibrating badly. If the tip speed is too high (more than 35-40 m/s) the material is pushed up and to the side walls, creating a huge vacuum in the centre. The result is no top-down movement of material and a high radial motion –referred to as doughnut-mixing. The quality of the blend suffers significantly.

The filling level of the heating mixer is also an important parameter in creating the optimal vortex. In general, a heating mixer is designed to work with a certain amount of material inside (Mixaco's recommended volume is 85% and vessels, tools and motors are engineered based on this). With too low a filling level the mixer cannot create much downforce and the blend is pushed upwards and remains at the top of the vessel. The result is that the tools are moving but not in contact with material, so the mixing effect is much less. However, the vortex needs some space to expand (free volume) as the PVC particles heat up and increase in volume. If the mixer is overfilled, the vortex will not move efficiently and there is a risk of blowing the filter or lid connections.

Finally, the company says the vortex is affected by changing blade design or enhancing blade configuration. If the blend used is light or has a wide spread of bulk densities, it may be helpful to change blade configuration. Light materials – or highly fluidised blends – tend to stay at the top of the mixer and do not homogenise well. In this case, lowering the blades can provide more space for the materials to collapse in to the centre of the bowl to create a better vortex.

High speed, gentle and cost efficient homogenisation were prime design requirements for the Mix-A-Lot bulk material mixer from **Coperion**. "As an optional addition to compounding plants made by Coperion, the unit ensures particularly efficient, high-speed and gentle homogenisation of the fed material," says Jürgen Rumschick, Project and Sales Engineer at Coperion.

The Mix-A-Lot design is available in four sizes for throughput rates of up to 5 tonnes/h (an ATEX version is available). Rumschik says the unit provides very good mixing performance and short mixing cycles, which he attributes to its optimised mixing rotor design. "Its low circumferential velocities and optimum design of the gap to the housing permit gentle handling, without particle destruction or heating of the product. The large inspection door on the front of the Mix-A-Lot provides easy access to the entire process chamber. An additional opening at the discharge flap also facilitates inspection and cleaning of this section," he says.

Simplified feeding

Coperion says using the Mix-A-Lot to premix ingredients prior to introduction to the compounding extruder can provide the opportunity to reduce capital investment and plant maintenance costs. "Up to now it has generally been standard practice to feed each individual component to the extruder through a separate differential loss-in-weight feeder with a buffer hopper. However, using this technique, the Mix-A-Lot first produces the specific pellet mixture, for which one single loss-in-weight feeder is then sufficient," he says. ›

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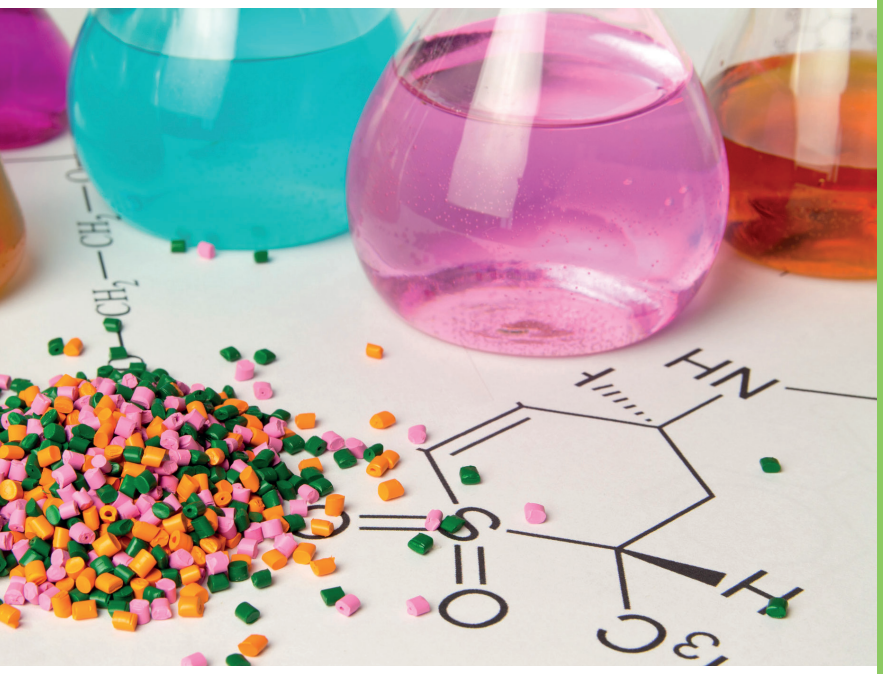

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"The weighing function of the mixer ensures accurate recording of the weight of each component fed in, to guarantee correct dosing according to the recipe. As the Mix-A-Lot is of vacuum and pressure-resistant design, direct pneumatic feeding is possible without the need for a separate reception bin for pneumatic conveying. This simplified plant concept allows the reduction of investment and maintenance costs compared to conventional systems," according to Rumschik. He says cleaning during changes of product is also greatly reduced and much less space is required above the extruder.

Coperion says a Mix-A-Lot 400 (useable volume of 400 litres) has now also been installed in its test centre in Weingarten/Niederbiegen in Germany and is available for tests on an industrial scale. It has a throughput of up to 1.5 tonnes/h and has been equipped with a special mixing tool, which permits individual adjustment to optimise the mixer to the requirements of the application. For example, the gap to the housing and inclination and geometry of the paddles can be varied. The mixer is fed by two conveying lines through vacuum conveying from a big bag emptying station, container emptying station or suction nozzle.

The Ploughshare laboratory mixer type L1 is the smallest contained mixing machine from Germany-based **Lödige Process Technology**, offering a drum volume of only one litre. According to the company, the machine was developed in response to an enquiry from an existing customer for a solution for handling challenging dry mixtures in its development laboratory. The powdered substances to be handled were sensitive, expensive or hazardous, meaning the solution had to contain the mixing process in a gas-tight container, referred to as a 'glovebox'.

The compact L1 Ploughshare laboratory mixer is a special addition to the L series, which is Lödige's laboratory range for small batches. These machines are designed for development and small batch production and are available in several sizes with drum volumes generally ranging from 5-50 litres. The company says that, like other Ploughshare batch mixers, the mixers use the established Lödige mixing process, which involves generation of a fluidised bed.

The Ploughshare L1 is the smallest contained laboratory mixer from Lödige Process Technology

IMAGE: LÖDIGE PROCESS TECHNOLOGY

Updating equipment

US-based **B&P Littleford** reports significant market activity for both batch and continuous mixing systems at the current time, with many companies considering updating equipment. The company – which supplies a number of products for the plastics and PVC markets including the TriVolution Compounder, Continuous Kneader, Twin Screw Compounder, Vertical High Intensity Mixer, and Littleford Plow mixer – says that it also sees a switch from batch to continuous production. Another current trend is a growing interest in processing temperature-sensitive materials produced from bio-renewable sources.

According to the company, the versatility of the TriVolution and Plow mixer lends these machines to speciality applications. The Littleford Plow can operate as both a continuous or batch mixer, as well as at atmosphere, under deep vacuum and as a pressure vessel. The TriVolution kneader was originally designed for continuous compounding of PVC. However, with modifications, it can be adapted to process low and high viscous liquids.

The company says it is adapting its product

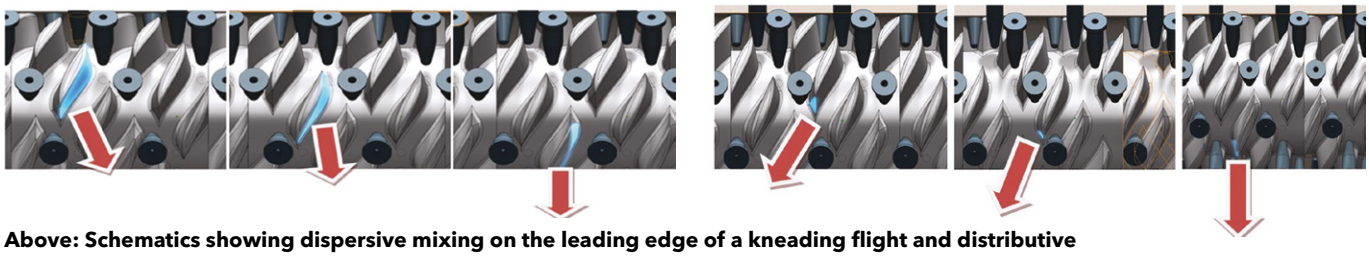

IMAGE: B&P LITTLEFORD

Above: Schematics showing dispersive mixing on the leading edge of a kneading flight and distributive mixing as the material is split on the kneading flight tip in B&P Littleford's TriVolution kneader

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offering in line with current restrictions and protocols. "With many countries still having travel restrictions and companies limiting travel, we are focused on increasing our virtual presence. For example, this includes online training for customers looking to learn about new equipment, how to adapt current machinery to a new polymer or filler material, maintenance and operational training," says Alan Malott, Global Product Manager, Continuous Mixing Systems.

"While we will still continue running trials on our pilot equipment and hosting customers during these trials, we have also begun to live-stream and record tests for customers while running their processes," he says.

The TriVolution Compounder is a development of the company's CK-Series single stroke continuous kneader extruder. That consists of a single shaft comprised of segmented 3-flighted mixing elements and conveying elements that strokes forward and back once for each 360° rotation. The inside of the barrel is lined with three rows of pins in a 3-flighted system mixing.

"The shaft on the TriVolution strokes forward and back three times per each full revolution of the shaft," Malott says. "This allows us to increase the rows of pins in the barrel from three to twelve. Mixing elements have also been improved, moving from the 3-flighted system to elements with 8, 12, 16 and 24-flights." Elements with 8-flights are more effective at conveying material, meaning that conventional conveying elements are not required after the main feed port, and there is no need to move pins when switching mixing elements, he adds. The machine is also fully wiping, so there are no dead spots for material.

"These design modifications allow the TriVolution to operate at a lower rpm than the single stroke system. The B&P Single Stroke Kneader operating at 800rpm would be a comparable size to the TriVolution operating at only 200rpm," Malott says.

"Through many trials on our pilot systems, a CK-60 continuous kneader and our 60-mm TriVolution, we have found that we are able to reach much higher fill levels of up to 90% and at higher throughput rates. It has also expanded the types of polymer systems we are able to work with. Historically, the kneader has been limited in the range of polymers it is able to process. Typical systems are used for PVC or other low melt temperature materials. The TriVolution has easily processed these low melt materials, such as PVC and EVA, as well as being able to process nylons, PP, PE, wood plastic composites, and many other processes typically only processable on co-rotating twin screws."

Farrel Pomini has developed continuous mixing equipment ideally suited for processing recycled and other temperature-sensitive materials. Principle applications include highly-filled compounds, white and black masterbatch, flame retardant compounds, PVC and flooring. The company's continuous mixing technology is based on two counter-rotating, non-intermeshing rotors running in a large free volume mixing chamber. The large chamber allows for liberal material circulation and good distributive mixing, while the specialised rotor geometry enables efficient levels of shear and dispersive mixing.

The CPeX Laboratory Compact Processor is Farrel Pomini's most recent development, comprising an independently controlled mixer and extruder mounted on a single frame with a nominal production rate of 10–30 kg/h. The CPeX design allows compounders to conduct laboratory-scale product development trials, extend product application portfolios, expedite time to market and reduce development costs.

Shifting capabilities

Economic and environmental influences placed on the compounding industry as a whole are leading processors to be nimbler and more efficient,

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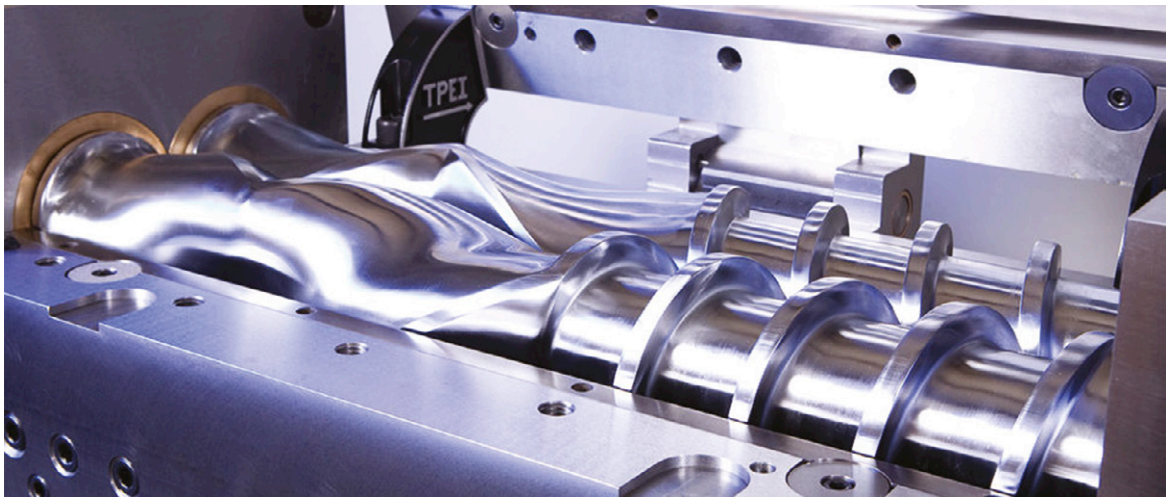

IMAGE: TECHNICAL PROCESSING AND ENGINEERING (TPEI)

Right: TPEI says continuous mixers are attracting attention for their high efficiency and uptime

according to **Technical Processing and Engineering (TPEI)**. "Companies that can shift their capabilities to follow market demand are going to have an advantage in a more volatile market place," says Slayton Altenburg, responsible for Sales, Logistics and Research at the company. "Continuous mixers improve that ability, being able to process a wide variety of resins and additives efficiently without costly reconfigurations. For instance, if your core business is compounding for the automotive industry and yet you have the ability to produce materials for PPE and the medical industry while avoiding large capital expenditure, it is possible to take advantage of market opportunities."

Altenburg says continuous mixers are attracting attention for their efficiency and uptime. "These qualities make the technology attractive to mature, as well as growth, sectors. While commodity compounding still commands the largest segment of the industry, high performance resins and additives are growing at the highest rate. High performance resins for lightweighting and metal replacement are being implemented in new end uses daily," he says. "In addition, new additives such as graphene and other nano-materials offer incredible performance benefits. As their applications expand, demand for end-use specific compounds and masterbatches will increase as well."

However, TPEI says new solutions are still sought for specific mixing problems as cutting-edge additives also bring challenges, such as low bulk density, slip, shear sensitivity and thermal boundaries. In addition, some high temperature materials, such as crystalline resins, are difficult to mix using frictional melt dissipation, which has made their processing on continuous mixers difficult in the past.

TPEI claims it has developed technologies that meet a number of these mixing issues. "Continuous mixers can convey 70 times the volume of material they are capable of mixing," says Altenburg. "By doubling the cross-sectional area of the feed opening of our mixer, we can feed low bulk density materials efficiently and consistently. The addition of a mixing dam will further enhance the dispersion by restricting the free volume and forcing those additives into the resin before it exits the machine."

For high temperature resins and additives that induce slip, he says the company has designed a new high temperature mixing chamber (HTMC). "Our standard chamber with 6 kW of heat can run at temperatures of around 475°F (246°C), while the HTMC provides 16 kW of heat and can process materials at around 750°F (399°C). This lowers the mechanical energy required to melt the resin and allows that energy to be utilised for dispersion and distribution of the additives," he says.

TPEI recently supplied an HTMC system to long-standing US customer Color-Master, which produces colour and additive concentrates and PVC and specialty compounds. "The company undertook a project that demonstrated the improved efficiency of the HTMC over the standard mixing chamber with the same formulation," Altenburg adds. "They are also helping us develop best practice for the compounding of ultra-high-performance resin systems, which to our knowledge had only been previously possible in single and twin-screw extruders."

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.mti-mixer.de**
- **www.zeppelin.com**
- **www.mixaco.com**
- **www.coperion.com**
- **www.loedige.de**
- **www.bplittleford.com**
- **www.farrel-pomini.com**
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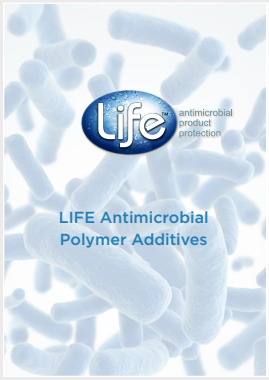

Life Material Technologies offers a full range of antimicrobial additives for protection of plastics from bacteria, fungi and algae, including silver inorganics, synthetic organics and natural botanics. Find out more in this four-page brochure.

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COPERION: FEEDING TECHNOLOGY

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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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LEISTRITZ: MASTERBATCH SYSTEMS

Additive and colour masterbatch production places specific demands on compounding equipment. This 16-page brochure from Leistritz explains how its ZSE 35 iMAXX masterbatch twin screw extruder rises to the challenge.

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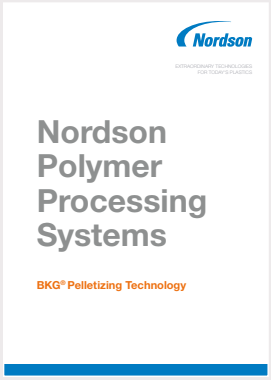
NORDSON: BKG PELLETISERS



The BKG range of pelletisers from Nordson Polymer Processing Technology includes underwater, water-ring and strand systems suitable for almost any thermoplastic pelletising application. Find out more in this six-page brochure.

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STRUKTOL: CREATIVE RECYCLING

Struktol offers a full range of additives to enhance performance of recycled compounds. This brochure details its extensive range of lubricants, PP viscosity modifiers, homogenisers and odour control products.

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Compounding World October 2020
The October edition of Compounding World looks at how additives can enable the use of recycled plastics, explores alternatives to twin-screw compounders, and investigates the state of the TiO_2 market.

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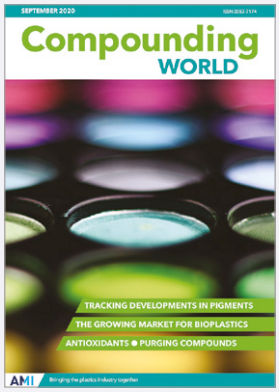

Compounding World September 2020
The September issue of Compounding World looks at the tougher demands being placed on pigments, examines how bioplastics applications are broadening, and covers stabilisers, PVC biocides and purging compounds.

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Injection World October 2020
The October edition of Injection World magazine delves into the new smart technologies emerging in injection machine control. It also explores some innovative surface decoration concepts and reviews developments in plastics for the fast growing e-mobility sector.

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Plastics Recycling World September/October 2020
The September/October 2020 issue of Plastics Recycling World magazine explores how better processing and smarter design is improving rigid plastics recycling, plus a review of the latest innovations in sorting technology and extruders for re-compounding.

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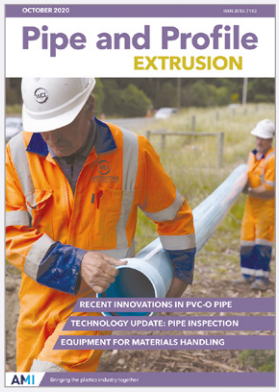

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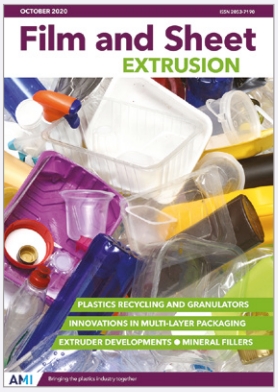

Film and Sheet October 2020
The October edition of Film and Sheet Extrusion looks at how machinery and materials suppliers are helping film and sheet producers include more recyclate in their products. Plus articles on the latest extrusion lines, mineral fillers and more.

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GLOBAL EXHIBITION GUIDE

2020	**4-5 November**	Compounding World Expo USA, Cleveland, USA **POSTPONED**	www.compoundingworldexpo.com/na/
	10-13 November	Plastimagen, Mexico City **POSTPONED**	www.plastimagen.com.mx
	1-5 December	Equiplast, Barcelona, Spain **POSTPONED**	www.equiplast.com
	5-8 December	Plast Eurasia, Istanbul, Turkey	www.plasteurasia.com/en
2021	**9-12 January**	Arabplast 2021, Dubai, UAE	www.arabplast.info
	11-14 January	Plastimagen, Mexico City **NEW DATE**	www.plastimagen.com.mx
	26-29 January	Interplastica, Russia, Moscow	www.interplastica.de
	4-8 February	PlastIndia, New Delhi, India **POSTPONED**	www.plastindia.org
	25 Feb-3 March	Interpack, Dusseldorf, Germany **NEW DATE**	www.interpack.com
	13-16 April	Chinaplas 2021, Shenzhen, China	www.chinaplasonline.com
	4-6 May	Kuteno, Rheda-Wiedenbrück, Germany **NEW DATE**	www.kuteno.de
	4-7 May	Plast 2021, Milan, Italy	www.plastonline.org/en
	17-21 May	NPE 2021, Orlando, FL, USA	www.npe.org
	1-2 June	Compounding World Expo Europe, Essen, Germany **NEW DATE**	www.compoundingworldexpo.com/eu/
	15-18 June	FIP, Lyon, France **NEW DATE**	www.f-i-p.com
	29 June -1 July	Interplas, Birmingham, UK **NEW DATE**	www.interplasuk.com
	14-18 September	Equiplast, Barcelona, Spain **NEW DATE**	www.equiplast.com
	12-16 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
	3-4 November	Compounding World Expo USA, Cleveland, USA **NEW DATE**	www.compoundingworldexpo.com/na/

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2-3 November 2020	Plastics Regulation Europe **VIRTUAL SUMMIT**
3-4 November 2020	Chemical Recycling Europe **VIRTUAL SUMMIT**
30 Nov-2 Dec 2020	Fire Resistance in Plastics Europe, Dusseldorf, Germany
26-28 January 2021	Thermoplastics Concentrates 2021, Coral Springs, FL, USA
2-3 February 2021	Polymers in Cables America, Charlotte, NC, USA
4-5 March 2021	Chemical Recycling North America, Houston, TX, USA
25-26 March 2021	Compounding and Masterbatch Asia, Bangkok, Thailand
20-21 April 2021	PVC Formulation North America, Cleveland, OH, USA

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

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