JUNE/JULY 2019 | VOLUME 21/ISSUE 3

EUROPEAN PLASTIC PRODUCT MANUFACTURER

HELPING HANDS

MEDICAL MATERIALS – ALBIS IS HERE TO HELP

FLEXIBLE FORCE TESTING
AMETEK STC INTRODUCES THE NEW FLEXIBLE SERIES OF MOTORISED TEST MACHINES, THE CHATILLON TCM SERIES.

QUALITY, SAFETY, RELIABILITY
KRAIBURG TPE PRODUCT MANAGER DR THOMAS WAGNER SHARES HIS THOUGHTS ON THE MARKET, THE INDUSTRY, AND THE ENVIRONMENT.

SPACE COMMODITY
ESA'S HEAD OF MATERIALS AND PROCESSES DR THOMAS ROHR ON THE PART PLASTICS CAN PLAY IN SPACE.

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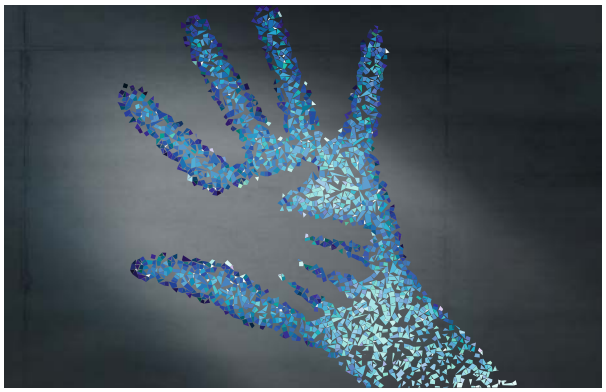

FOREWORD

Kim Christiansen, North Region Director, PlasticsEurope

PlasticsEurope's North Region Director Kim Christiansen discusses the potential pitfalls of the UK's proposed tax on packaging

The findings of an Ernst and Young (E&Y) study, commissioned by PlasticsEurope and the British Plastics Federation, have shocked Europe's plastics manufacturers. They reveal that the proposed Plastics Packaging Tax is likely to hit the UK's poorest families hardest.

The same study estimates that the increase in spending on essential products could be five times higher for the lowest income segment of the UK population, where almost half of households with children are facing food poverty, according to a 2018 study by the Food Foundation, and higher prices may lead to the removal of plastic packaging, thereby exacerbating the issue of food waste – this makes no sense.

The levy will also damage the competitiveness of the UK packaging industry if such packaging is exempt. 30 per cent of all prefilled plastic packaging is imported. Such an exemption on imported packaged goods is likely to force companies away from the UK, with associated job losses. In 2017 this sector was estimated to contribute £2.1bn (~€2.3bn) GVA, while supporting 33,400 jobs and yielding a tax contribution of £510m.

While the industry is increasing recycled content in packaging, insufficient material will be available due to inadequate recycling infrastructures and the necessary approvals for such materials in food contact applications when such a tax comes into force in spring 2022. The priority has to be ensuring food safety and hygiene.

The E&Y research shows that such a regressive measure is not required to boost recycled content, which is already rising due to industry and brand-owner initiatives, coupled with government-backed schemes and Extended Producer Responsibility. Even with no further intervention, the amount of packaging using at least 30 per cent recycled plastic will more than double by 2022.

On a European level, we have welcomed the launch of the European Plastics Strategy and believe that increasing recycled content is key to reaching circularity. It is in this spirit that the plastics industry announced its Plastics 2030 Voluntary Commitment with the goal of reaching 60 per cent re-use and recycling of all plastics packaging by 2030. Building on this, we joined the Circular Plastics Alliance to support the achievement of 10 million tonnes of recycled plastics to be included in Europe's products in 2025.

Rather than the UK tax proposal, a different form of policy could prove more effective. Overall sustainability/recyclability should be the focus, not recycled content. This approach could prove beneficial in terms of providing the right incentives to reduce single-use plastics waste in the UK, whilst ensuring that the best resource-efficient packaging is used.

Whatever happens, the plastics industry is ready to engage in dialogue based on a multi-stakeholder approach with the aim of increasing the circularity of materials.

> **Such a regressive measure is not required to boost recycled content, which is already rising**

ROB COKER

LETTER FROM THE EDITOR

Interesting times

Dear readers,

Welcome to the third 21st anniversary edition of EPPM.

What a period since the April-May edition: European Parliament-based subversion; Extinction Rebellion-led protests; Moon/Mars missions; Trump in Europe; a change of UK leadership; and still the pendulum swings towards the abolition of (single-use) plastics.

It appears that minds are made up, and what more can we do but keep presenting the case in favour of plastics – albeit in more useful, less disposable applications – to remind all concerned that human behaviour is as much the issue. With that in mind, the June-July edition looks to keep the argument interesting – to the trade expert, the curious novice, and the pro-abolitionists.

Opening with a review of my visit to Prague for the Vinyl Plus Sustainability Forum, the June-July edition looks at the appeal of testing and inspection technology, before segueing into the fundamental use of medical plastics, where I aim to show that living standards would be inferior if not for plastics in these sectors.

A quick round-up of the ubiquitous TPE and TPU materials, highlighting what the world could stand to lose if not for plastics, is followed by a series of interviews with engineers who utilise them in ways many haven't imagined. Everyone loves space, right? Surely we can unite behind this ultimate – and super-cool – use of plastics.

Eureka! takes a different angle in tribute to a true engineering plastics pioneer, whose invention has helped save lives and improve safety and security everywhere. Remembering the life and achievements of Stephanie Kwolek, EPPM celebrates the Polish-American scientist and one of her most famous creations Kevlar, which remains among the wonder materials that few environmentalists can begrudge.

As ever, I hope you enjoy this latest edition and feel free to get in touch whether you do or don't.

Rob Coker, Editor

> **It appears that minds are made up, and what more can we do but keep presenting the case in favour of plastics – albeit in more useful, less disposable applications**

EDITOR ROB COKER SUMMARISES HIS VISIT TO THE CZECH CAPITAL FOR THIS YEAR'S VINYL PLUS SUSTAINABILITY FORUM.

It was a cloudy, sunny day in May when I landed at the Václav Havel Airport in the Czech capital, Prague. A 20-minute journey by taxi brought me to the Old Town district of the City of Spires, where this year's Vinyl Plus Sustainability Forum was being hosted at the Hilton Prague, where Environment Minister Richard Brabec welcomed delegates from around the world.

"Let me say that the Czech Republic strongly supports the long-term sustainable management of plastic in the context of a circular economy," Brabec began. "As you all know, worldwide production of plastic products is constantly increasing. One the one hand, it is a sign of the development of our civilisation; plastics have a very wide use and allow us to do things we will never be able to do without them … It is possible to speak about the positives of plastics for quite a long time. However, plastics have also caused us many problems; you can see plastic pollution in almost every part of our planet."

Brabec agreed that the aim of the conference was similar to those of the Czech Government with regards to producing and consuming plastic products – particularly in the developing initiative of extended consumer responsibility – and was confident that it would help solve the problems, wishing delegates "many inspirational moments" in doing so.

These moments were provided by major stakeholders such as Vice President of Yunnan Zhenbang Technology Cathy Wang, Chief Executive of The Vinyl Council of Australia Sophi MacMillan, and Alessandro Marangoni, CEO of Italy-based strategic analysis and advisory specialist Althesys, on day one which ran under the theme of economics.

Day two spread the theme across society, education, the environment and innovation, with homegrown MEP Martina Dlabajová – who was instrumental in bringing this year's forum to Prague – highlighting the role of society and education.

COLLECTIVE RESPONSIBILITY

"What do you think are the main topics coming up in every debate, with any citizen?" Dlabajová asked. "Climate change, sustainability and the environment. The first question is always about these three and, very often, I use Vinyl Plus as an example of voluntary commitment and something which is feasible; something in which policy makers can co-operate with business leaders."

Education and employment are symbiotic, Dlabajová continued, and called for educational policy frameworks that are fit for the 21st century: "Education is a collective responsibility. We must give industries and businesses a bigger presence at the education level to make the young generation ready for future labour market needs. It is employers who can anticipate this change."

Joining Dlabajová in the day's discussion, and touching upon the momentum of young people, were The Natural Step's Richard Blume, Fulvia Rafaelli of DG Grow, WWF Policy Officer Jenny Walther-Thoss, and the second keynote speaker Ilcheong Yi of UNRISD.

Arab Hebollah, former head of UNEP SCP and current EU-Switch-Asia team leader, closed by corroborating Greta Thunburg and reminding us that we are not yet worried enough about the planet: "Just ticking the boxes is not enough. Stakeholders are still too afraid of change."

With a parting home truth, Hebollah concluded by reminding us that PVC and other plastics are not the problem, people misusing plastics is the problem.

With such high-level NGOs, manufacturers and policy makers convening from across the planet to actively engage in some of the pressing issues that plague it, it felt as though I wouldn't find it too difficult to find a champion in a conference room full of candidates. Properly placed and empowered, such players could be pressed to promote a sustainable, circular plastics strategy.

The Vinyl Plus Sustainability Forum 2020 will be held in Florence, Italy.

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MEDICAL DEVICES RANGE FROM SINGLE-COMPONENT TO COMPLEX SYSTEMS THAT NEED TO FIT AND WORK TOGETHER. IN THIS ARTICLE, WE EXPLORE THE COMPONENTS AND MATERIALS THAT MAKE UP AN INTRAVENOUS FLUID ADMINISTRATION (IV) SET, THEIR FUNCTIONAL REQUIREMENTS, AND SOME OF THE SOLUTIONS ALBIS CAN OFFER.

The advent of IV solutions has made possible the treatment of patients that cannot be achieved by other delivery methods. Whether by avoiding the digestive system, controlling the dose rate or replacing blood products or fluids quickly and effectively, there are five main uses for IV delivery: volume expanders, blood/blood products, medications, nutrition and buffer solutions. In principle, an IV set is a simple method of delivering substances into the bloodstream over a long period of time, using either gravity or a pump. By filling a tube with fluid and inserting this into the patient's vein, the fluid is administered passively and with little discomfort.

Since the 1950s, this has been done using plastic sets. The method is simple, but an IV set encompasses many plastic parts designed and manufactured to perform reliably, and connect to and work with their adjacent parts. Physical design plays a significant role in making a component that is easy to use, reliable, durable and effective, but consideration is also given to the physical and mechanical properties of the polymer to enable optimum design and functionality of each component, including consideration of the manufacturing process, dimensional control, bonding/connection method, sterilisation, printing, chemical resistance and shelf life.

HELPING HANDS

MEDICAL MATERIALS — ALBIS IS HERE TO HELP

BOTTLE, SEAL AND CAP

Both bottles and bags are used as IV fluid containers. In our example, we use plastic bottles. The role of the bottle is to store the IV solution, carry all the necessary identification, shelf life and instructions, keep the solution sterile and maintain its efficacy, control ingress and egress of water vapour and gases, and then empty when required.

Bottles – whether produced by injection moulding, blow moulding with secondary filling, or Blow-Fill-Seal (BFS) where in situ filling is done immediately after forming and sealing – need to be transparent to allow a visual check of the solution by the health professional. LDPE is the most widely used material due largely to its lack of additives – reducing leachable and extractable content – ease of processing, and ability to collapse while emptying.

LyondellBasell Purell PE 3020 D is the leading BFS-grade material. Purell PE 3220D and Purell PE 3420F have higher densities that allow increased sterilisation temperatures, thus reducing sterilisation time. If a sterilisation temperature of 121°C is required, PP would be considered. Purell RP270G contains a specific additive package to minimise interactions with IV solutions, making it the material of choice in these cases.

The bottle has a cap with a port or ports containing a seal, which will be pierced only on connection to the 'giving set'. The cap will often be the same material as the bottle, whilst the seal is typically made of thermoplastic elastomers such as Evoprene G 967, for example, which is TPS manufactured by Mexichem.

THE GIVING SET

Supplied as a sterile packed assembled kit, there are several components that collectively function to transfer the fluid from the bottle to the patient. The first is the port spike, which is used to pierce the seal to release the fluid into the tube. Materials need to be rigid enough to enable the seal to be broken whilst the integrity of the port is maintained. Albis can offer several materials with suitable properties. Ineos Styrolution's ABS Novodur HD M203FC G3, for example, with high stiffness and dimensional stability was designed with this application in mind.

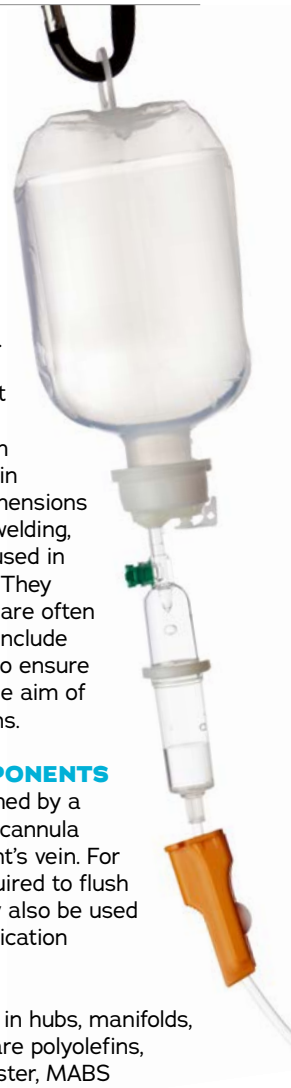
Below the port is the drip chamber, which is used to ensure bubbles do not enter the patient, as well as to set and monitor administration rates. It needs to be flexible (so it can be pumped to half-full) and clear (so the drop rate can be monitored). Albis can also offer Ineos Styrolution's Styrolux 4G60 (SBC), which was designed for this purpose and has excellent clarity, softness and elasticity, as well as good bonding properties.

Alternatively, an advanced polyolefin-based solution is using a blend of Purell RP270G (Raco PP) and PurellKT MR 07 (PB-1), which provides very good transparency and squeezability.

Alongside compatibility with all the possible substances they may be used with, the materials need to be both clear enough for the healthcare professional to check for bubbles and have a resistance to kink. Albis can offer solutions from Ineos Styrolution and LyondellBasell with Styroflex 2G66 (SBC) and, again, a blend of Purell RP270G with PurellKT MR 07. On the tube connected to the drip chamber will be a device for controlling fluid flow. Roll clamps are typically used and may be produced using one or two materials for the wheel and the housing. The combinations available are considerable, with typical examples including HDPE/ABS, PP/HDPE, PP/ABS, HIPS/PP.

The Albis proposals for this component include multiple options, e.g. materials such as Ineos Styrolution's high impact polystyrene materials and NOVODUR HD (ABS), LyondellBasell's Purell (PE/PP), and Covestro's Makrolon (PC). Pinch clips could be present in some circumstances, particularly where multiple lines are connected. These can be produced using Purell PP or BASF's Ultradur PRO (PBT).

A set may include several connectors, stop taps and side ports. For small bore connectors, polycarbonate (e.g. Makrolon Rx3440) and copolyesters (e.g. Tritan MX731) are often the first choice because of their good chemical resistance against the aggressive drugs typically used in oncology.



Everything has to fit together as components are often produced by different suppliers using various materials, so functionality and dimensions are critical. Whether bonded or connected by a push-fit or luer lock, they must also be compatible with the other components in terms of type of fit, dimensions and, if applicable, any welding, adhesives or solvents used in the assembly process. They may include seals and are often coloured or otherwise include coloured components to ensure discriminability, with the aim of avoiding misconnections.

ADDITIONAL COMPONENTS

The giving set is attached by a further connector to a cannula inserted into the patient's vein. For an IV set, a port is required to flush the cannula. Ports may also be used to dose additional medication by syringe.

Typical materials used in hubs, manifolds, ports and connectors are polyolefins, polycarbonate, copolyester, MABS or polyamide.

Many of these components will have a cap to keep them clean and prevent injury from spikes or needles where applicable. They are typically made of polyolefins as engineering plastics are generally not justified from an economic point of view for this application. This simple dosage method involves many critical plastic parts that can be produced from a wide range of materials. Albis is not only able to supply a considerable number of medical-grade plastics, but supports the selection of adequate products with regards to regulatory requirements. The range of materials produced by world-leading manufacturers is complemented by Albis' customised compound solutions under the brand of ALCOM^{MED}. Our dedicated healthcare team can guide you through the material selection process.

INTERTEK RENEWS UGANDA CONTRACT

TQA PROVIDER INTERTEK HAS EXTENDED ITS CONTRACT WITH THE UGANDA NATIONAL BUREAU OF STANDARDS (UNBS) TO CONTINUE TO MANAGE ITS PRE-EXPORT VERIFICATION OF CONFORMITY STANDARDS PROGRAMME (PVOC).

The PVoC programme verifies the conformity of all regulated products in the respective exporting countries within a range of sectors, including: food, chemicals, electricals and electronics, textiles, health and beauty products, machinery, building products and toys. This ensures they comply with the applicable Ugandan technical regulations and quality standards, assuring Uganda's citizens of the quality and reliability of imported goods.

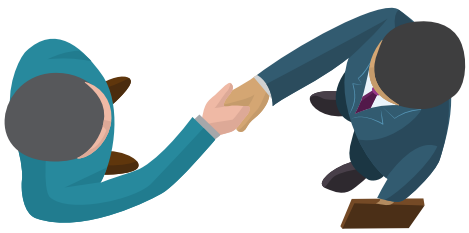
Intertek has been supporting the programme since its inception in 2012.

Thomas Kordick, Global Business Line Leader, Government and Trade Services, Intertek said: "We are delighted to continue to work with UNBS in supporting them with the ongoing success of the PVoC, giving Uganda's consumers the assurance they need when buying imported goods and protecting them from sub-standard products."

Exporters to Uganda are required to provide a Certificate of Conformity for Customs clearance in accordance with Government regulation. This certificate can only be obtained from an Approved Inspection Body such as Intertek.

Intertek is also approved for the Tanzania and Kenya PVoC's, giving exporters to East Africa an ever better service by taking advantage of the synergies of using one provider for their certification needs.

Intertek are the pioneers of PVoC programmes having introduced the very first one over 20 years ago through a network of more than 1,000 laboratories and offices worldwide.



TWI AND LONDON SBU LAUNCH POLYMERIC

A collaboration between TWI Ltd and London South Bank University (SBU) has resulted in the creation of a new world-class centre of excellence for polymer technology – named PolyMERIC (The Polymeric Materials, Engineering, Research and Innovation Centre) – which aims to advance the research and development of polymeric materials, and how they can be used by the industry.

Polymer-based materials are increasingly sought-after for their lightweighting properties, versatility of application, and ability to achieve high performance levels in aggressive environments. PolyMERIC will seek to create new polymeric materials, and associated testing and inspection techniques that can be adapted and integrated for use across a wide range of industries. Specific areas of focus will include materials innovation, smart polymers, recycling, selection and evaluation of existing polymers for new applications, and PhD studies to enhance proprietary research.

Speaking on his appointment as Director of PolyMERIC, Amir Khamsehnezhad, formerly of TWI's Polymer team, said: "This Innovation Centre will advance innovation in polymer materials, techniques and applications at TRLs one to three, building the base and providing new knowledge for the use of non-metallics across the industry ... Our aim is to make a high impact amongst the engineering community and to raise the profile of polymers."

PolyMERIC is one of a growing number of Innovation Centres, hosted by TWI, achieving technology excellence and accelerating research to meet socio-economic and environmental challenges.

The centres share research and technology capabilities and undertake joint research programmes to develop the next generation of technologies and engineers in selected research disciplines.

FLEXIBLE FORCE TESTING

AMETEK STC INTRODUCES THE NEW FLEXIBLE SERIES OF MOTORISED TEST MACHINES, THE CHATILLON TCM SERIES.

The Chatillon TCM Series consists of two force testers offering fast, effective and affordable force testing up to 350lbf (1,500N) at an affordable price.

The TCM100 is suitable for low capacity testing up to 100lbf whereas the TCM350 is suitable for testing samples at a capacity of up to 350lbf.

Both force testers feature a standard crosshead travel of 406mm and are available in extended editions with a crosshead travel of 812mm. A throat depth at a full 100mm enables the operator to perform force tests including tension, compression, bending, peeling, adhesion, insertion and extraction on samples up to 200mm. This leaves the operator with a wide variety of testing options at a large working area while keeping a compact footprint.

A large LED display indicates travel speed and similar information so the operator can continuously monitor the test. With haptic feedback, the TCM Series reduces time spent on test configuration and rectifying operator errors. The universal adapter plate with international threads sizes (ASM and metric) provide flexibility for installing custom and standard fixtures.

The tactile buttons have no moving parts or membranes. Durability, therefore – especially in production environments – is maximised. A high rate return speed is built into the TCM force testers to maximise production throughput. Adjustable upper and lower mechanical limit switches are integrated for safety and used for different modes of operation, including cycling and return-to-zero.

MEASURING UP

Coupling the TCM Series force testers with the digital Chatillon DF Series force gauges offers a load accuracy that exceeds 0.1% full scale, as well as added benefits such as drive-to-limit. For fast and easy analysis, the Chatillon ForceTest software can be added to the solution, enabling seamless serial data communication from the force tester to a computer, test set-ups for faster workflow, live data viewing during tests, and easy exporting of test results to CSV or PDF.

A wide selection of grips and fixtures is available, keeping the TCM Series force testing solution flexible for use in any industry.

The Chatillon TCM Series is the latest series of specialised force testers from AMETEK STC and replaces the company's current Chatillon LTCM Series of force testers.

Chatillon is a brand under AMETEK Sensors, Test and Calibration (STC), which offers a comprehensive range of force and materials testing equipment for medical devices, pharmaceuticals, packaging, food, plastic and rubber. As one of the world's leading manufacturers and developers of materials testing equipment, AMETEK ensures the high quality, handcrafted equipment that Chatillon products are known for. Chatillon test equipment is manufactured at the company's own factory in Berwyn, Pennsylvania, US.

> **With haptic feedback, the TCM Series reduces time spent on test configuration and rectifying operator errors**

CONTAMINATION COMBINATION

INSPECTION AND ANALYSIS OF RAW MATERIALS BEFORE THEY ENTER THE PRODUCTION PROCESS IS THE INDUSTRIAL STANDARD AND ENSURES THE HIGHEST MATERIAL QUALITY.

Plastics used in medical, aerospace and automotive applications require the highest quality standards, as well as reliable raw materials control. Contamination may occur during pellet extrusion, for example, in the form of black specks due to temperature peaks. If they enter the next stages, the purity of the product is no longer guaranteed – sometimes with severe consequences. During the production of medical tubes, contaminants in the raw material lead to a full loss of production. In injection moulding, purity is crucial.

DISTINCTIONS

A distinction between manual light tables and automated optical inspection systems is often made. The former are commonly used for visual sample testing and incoming goods inspection. The material is illuminated on a table and manually inspected – a time-consuming method that depends on the auditor's form and experience, amongst other factors. Reflective and transparent pellets bring further complications as the human eye can be fallible.

The latter provide an alternative optical inspection system by feeding test materials through a hopper into the inspection area where images are taken. Distinct allocations of contamination, as well as a follow-up inspection, however, are not possible.

TWO OF A KIND

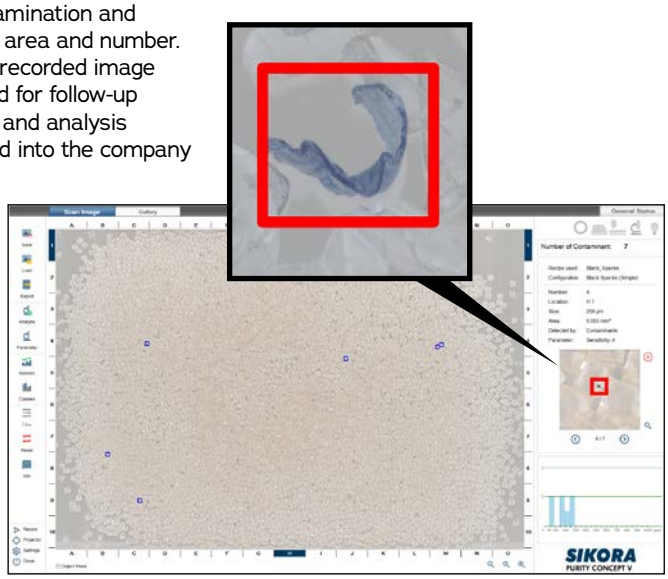
The combination of visual light table and automated sample testing is an innovative technology wherein the operator places the test material on a sample tray, and the automatic light table transports it through the inspection area, which is equipped with a CMOS line scan colour camera. The inspection takes place within seconds. A projector marks contaminated material directly on the sample tray, simultaneously displaying and marking the size and area of the contamination on the monitor.

By analysing the images, contamination such as black specks starting from 50µm and discolourations are automatically detected, visualised and analysed in both transparent and opaque material. An X-ray technology system is available for the detection of metallic contamination both internally and superficially. Individual contaminated pellets can be selected, followed up, and removed.

The combined optical inspection and analysis system contains a specially developed analysis software for the detection, visualisation and evaluation of contamination. This includes an image gallery of detected contamination and statistics regarding size, area and number. Furthermore, previously recorded image material can be imported for follow-up analysis. The inspection and analysis system can be integrated into the company network via a LAN interface in order to export and process the data. For example, by establishing a central and constantly updating database, conclusions regarding sources and causes of contamination are possible. Existing processes can thus be optimised to ensure comprehensive quality control.

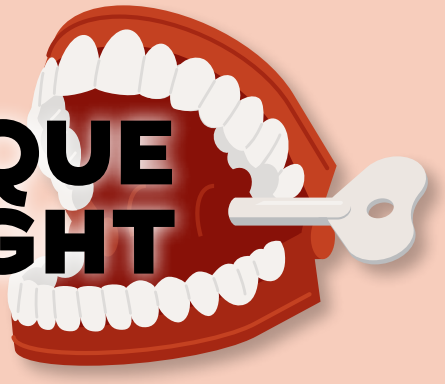
Flakes, micro granulates, films, and extruded and injection moulded parts can all be inspected on the sample tray. Approximately 100g of pellets can be inspected and analysed per run. Additionally, the system is as suitable for both incoming and outgoing goods.

Quality requirements are continuously increasing, as is the complexity of production processes. Periodic offline sample testing is required to ensure consistent quality from raw material to final product. Manual light tables and automated visual inspection devices are used as standard in the plastics industry. An innovative optical technology can now combine the advantages of both. Clear allocation and prompt and precise follow-up inspection enable the combination to be more reliable than the human eye and result in an efficient process optimisation.



SPECIAL-PURPOSE MACHINERY MANUFACTURER JONAS & REDMANN (J&R) PUTS ITS TRUST IN INTEGRATED PROCESS MONITORING BY KISTLER TO GUARANTEE THE FUNCTIONALITY OF MIXING NOZZLES FOR DENTAL APPLICATIONS.

TORQUE TONIGHT



J&R was founded in Berlin almost 30 years ago and has since built a reputation around its high-calibre machines and systems for assembly and process automation, as well as its focus on sunrise industries such as medical engineering, photovoltaics and energy storage.

J&R's Head of Medical Engineering Frank Polak said: "Most of our customers are large corporations with global reach, and several are DAX-listed. Standards in the medical technology sector are always high, but our customer base means we have to meet even more demanding requirements, hence why every plant, sub-assembly and add-on component must be appropriately qualified and validated."

Many of the projects in the medical technology segment revolve around single-use medical products, where high quality is an absolute necessity. To guarantee the functionality of the sub-assembly, a friction coefficient test (<0.5Nm) – performed with a Kistler torque sensor to ensure automatic segregation of good and bad parts – is carried out on the mixing mechanism of the assembled nozzle. The measurement technology is also integrated into the solution, so the signal is transmitted directly to the machine control.

"This product is a plastic sub-assembly consisting of four parts that are joined in the machine and then tested. Thanks to Kistler's solution, we can guarantee the quality of about five million units per year – and at the same time, we can ensure traceability," Polak said. "Traceability is an essential requirement in today's medical sector – and responsibility for it is increasingly passed on to the special-purpose machinery manufacturer."

The combination of Kistler's 4502A torque sensor and the maXYmos BL evaluation system ensures end-to-end inline process monitoring. The torque curve for each product can be tracked accurately on the maXYmos system.

No automated plant from Jonas & Redmann would be complete without a pre-integrated mechanism for segregating bad parts. The measurement value produced by the torque sensor is used to generate an OK/NOK signal that is then transmitted directly to the control – so any parts with insufficient torque can be segregated immediately. Polak added: "With a production rate of 40 parts per minute this poses an enormous challenge. That's why we're so highly satisfied with Kistler's solution – because it does exactly what we need for the application."

TRIED-AND-TESTED TECHNOLOGY

Andreas Nowak, Head of Mechanical Engineering and Operational Technology at Jonas & Redmann, has opted for solutions from Kistler in the past: "In our joining processes, we already make use of Kistler's electromechanical joining systems: they ensure effective automation because they feature high efficiency and precise control. But there could also be further applications for medical engineering in the future, especially as regards process monitoring."

The prototype of the new plant to produce the mixing nozzles, with integrated Kistler components, was showcased on J&R's stand at the 2018 Automatica trade fair. The two teams quickly devised a test rig to verify the solution's feasibility and, at the very first attempt, confirmed that the transducer shaft was suitable, and the assumed theoretical values for frictional torque were almost entirely identical to the actual torques measured. The transducer shaft used has since proved its excellence on the market many times over, and both J&R and Kistler are eager to hear about the end users' experiences.

> **Every plant, sub-assembly and add-on component must be appropriately qualified and validated**

TECHNICAL Cleanliness

EVA SÖHNLEIN, SENIOR MANAGER OF HANS GEIGER SPRITZGIESSTECHNIK GMBH, ADDRESSES THE GROWING REQUIREMENTS OF THE CIRCUIT-BOARD INDUSTRY.

Particles (skin, pollen, dust, etc.) increase the risk of faults in electronic components and non-functioning conditions. The causes – everyday contaminants – are easily overlooked. Manufacturers, however, are steadily tightening their prevention measures and cleanliness requirements, both for themselves and for suppliers such as injection moulding specialist Hans Geiger Spritzgießtechnik GmbH.

Geiger's products are used in circuit boards that must meet the highest quality standards, and the company has responded by developing an enclosed production line which meets all the criteria of a cleanroom. This enables clean manufacturing to individual specifications, without added costs or time for additional parts cleaning, and the savings are passed on to customers.

Particle-free production is already common in many industries. It is not a new criterion in the electronics industry, but the demands placed on components for installation in circuit boards have risen considerably in recent years. Since more and more plug connections are used, Geiger's products need to be particle-free. High-quality final products are possible only with the use of essentially particle-free components.

The main causes of contamination in the injection moulding process include ambient air and the mould itself. For example, metallic particles caused by friction could access the components and cause serious faults, including changed friction, shorter clearances and creepage distances. To prevent this, Geiger added a clean production line in October 2017.

CLEAN PRODUCTION WITHOUT ADDED TIME EXPENDITURE

In 2016 the Geiger Sales Team and Process Engineering Department analysed the growth in application areas for technically clean components. They identified many future applications for this kind of product and thus took the logical step of investing in production technology. There are several ways to produce technically clean products. Often, part of a building will be converted into a cleanroom; industrial parts cleaning following production is another often preferred method. Geiger, however, decided to enclose a production line in Plexiglas – rejecting the usual time consuming and expensive methods.

Two laminar flow boxes on the sealed enclosure create a constant overpressure, while a steady air current prevents particles from settling. The line has its own filter units and merely needs to be cleaned before production and following tool changes. To prevent particles being generated during production by the line itself, all sliding and moving elements are specially coated and operate lubricant-free.

> **Geiger decided to enclose a production line in Plexiglas – rejecting the usual time consuming and expensive methods**

CUSTOMISED FOR CLEANLINESS

The line is an automated compact production system that makes, removes and places parts on the cooling line without danger of contamination. The finished products are then automatically counted and packed, ensuring that they reach the customer in clean condition. The manufacturing process is controlled, reproducible and audit-safe. All told, it enables a cleanliness level corresponding to cleanroom class 7.

Having decided against standard categorisation, however, and since many of the company's larger customers have their own standards of technical cleanliness, Geiger carefully examines each customer's criteria and evaluates its ability to meet them. When a purchase agreement is reached, each batch is examined by an external test laboratory for compliance with the required specifications prior to delivery.

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Qompliance

US-BASED MEDICAL COMPONENT SUPPLIER QOSINA STOCKS COMPONENTS THAT COMPLY WITH ISO 80369-7, WHICH SPECIFIES DIMENSIONS AND REQUIREMENTS FOR THE DESIGN AND PERFORMANCE OF SMALL-BORE CONNECTORS FOR USE IN INTRAVASCULAR OR HYPODERMIC APPLICATIONS.

Qosina stays abreast of regulatory changes and safety standards in the industry, and provides solutions to achieve compliance, to minimise patient risk, and to innovate design.

Founded in 1980, Qosina is a leading global supplier of OEM single-use components to the medical and pharmaceutical industries. Qosina's philosophy is to address its customers' needs to reduce time to market by providing thousands of stock components through a vast catalogue featuring more than 5,000 products in full-scale illustrations. Qosina offers free samples of most items, low minimum order requirements, just-in-time delivery, modification of existing moulds, and new product design and development.

Qosina is ISO 9001, ISO 13485 and ISO 14001 certified and operates in a facility with an ISO Class 8 Clean Room.

Qosina's full component offering and latest products are available to view on the company website. Qosmedix, Qosina's cosmetics division, is a certified global supplier of beauty supplies to the cosmetic, skincare, spa and salon industries.

PLASTIC SURGEONS CREATE HAND MODEL TO TEACH FRACTURE PINNING

A GROUP OF CANADIAN PLASTIC SURGEONS HAVE USED 3D PRINTING TO CREATE A REALISTIC HAND MODEL TO HELP YOUNG SURGEONS LEARN VALUABLE SKILLS.

As technology has improved, so have opportunities for young surgeons to learn in a safe, controlled environment in order to improve surgeon training and outcomes for the patient.

CNW Group/The University of Manitoba Section of Plastic Surgery

MANUAL METHODS

Many simple hand fractures can be treated without incisions by utilising metal pins placed through the skin. This is difficult to perform as the procedure is performed by feeling – the surgeon cannot see the pin after it enters the skin.

Dr Christian Petropolis, a University of Manitoba Plastic Surgeon and pioneer of the technology, added: "To help teach young surgeons these skills, we created a realistic three-dimensional model with bones which can be drilled into. We made the joints all mobile as they would be in a real hand, but the skin is translucent so that young surgeons can better gain an appreciation for the wires once they enter the skin."

Initial feedback to the model has been very favourable by both students and teachers.

The study's additional lead authors are Dr Julian Diaz, University of Manitoba, and Dr Sarah Shiga, University of Ottawa.

TO ENSURE CLEAN AND SAFE WATER THROUGHOUT THE TREATMENT SYSTEM, UK-BASED COMPANY PENTAIR USES BASF'S ULTRASON E 6020 P.

BASF ENABLES HIGH-PURITY WATER TREATMENT MEMBRANES

With this high-performance polyethersulfone (PESU), ultrafiltration membranes can be produced for water purification and decontamination. Pentair uses PESU for at-the-source membranes in water distribution systems, as well as in point-of-use filters for infection control.

Ultrason E shows the unique combination of a high flux of water and a narrow pore size distribution, enabling UF membranes with microscopic pores to meet drinking water standards without super-chlorination after filtration.

AT-THE SOURCE SOLUTION

Pentair uses Ultrason E to produce X-Flow membranes for filtration systems in hospitals, health centres and hotels to help avoid possible contamination of pathogenic waterborne bacteria. A narrow pore size distribution in UF membranes enable high throughput water production at low pressure.

POINT-OF-USE SOLUTION

The BASF PESU can also be employed in point-of-use filtration. The unique filters are designed for hospitality and medical facilities, including high-risk areas such as ICUs.

A high-purity material with a low content of gels and oligomers, Ultrason E shows low fouling tendencies and can be easily cleaned. Repeated sterilisation with superheated steam (at 134°C), ethylene oxide and gamma-radiation is possible without harm to the pore structures.

The BASF material is usable on a wide pH-range (0-13) without degradation. It complies with FDA and European standards for food contact at repeated use.

VISIONARIES

BASED IN EINDHOVEN, THE NETHERLANDS, LUXEXCEL IS A PIONEER OF 3D PRINTED OPHTHALMIC LENSES MADE WITH ACRYLATE MONOMER RESIN.

The proprietary 3D printing technology having now advanced from the pilot phase to printing commercial lenses, more than 5,000 lenses have been printed on several 'VisionPlatforms' in the US and Europe, enabling Luxexcel to bring the technology to a level where commercial lenses are shipped daily.

Fabio Esposito, Luxexcel CEO, said: "By achieving this level of maturity we are ready to further grow the incredible potential of this technology and develop unique lenses both in ophthalmic and in smart eyewear. 3D printing is uniquely positioned to bridge the gap between traditional lenses and the future of eyewear."

The Luxexcel VisionPlatform consists of industrial-grade 3D printers, lens-design software and workflow integration tools that enable customers to manufacture ophthalmic-quality lenses that meet industry standards.

Luxexcel is the only company in the world with technology that can 3D print custom ophthalmic lenses. Having optimised its technology for prescription lenses, enabling customised ophthalmic products, Luxexcel and IFB Solutions – a US-based non-profit – celebrated one year of partnership by sharing the technology with schoolchildren, who received a free pair of eyeglasses and a comprehensive eye exam. The eyeglasses featured lenses made with IFB's 3D printer.

For several children, this was their first pair of glasses. According to Prevent Blindness America, one in four school-age children has vision problems that can affect learning.

Guido Groet, Luxexcel CCO, said: "The cool technology of 3D printing is for everyone, especially for the next generation. A great way to improve lives and to celebrate our innovative partnership."

SIGHT FOR MORE EYES

Traditional subtractive manufacturing originates in the time of the ancient Egyptians, yet the fundamental principle for manufacturing an ophthalmic lens has remained much the same.

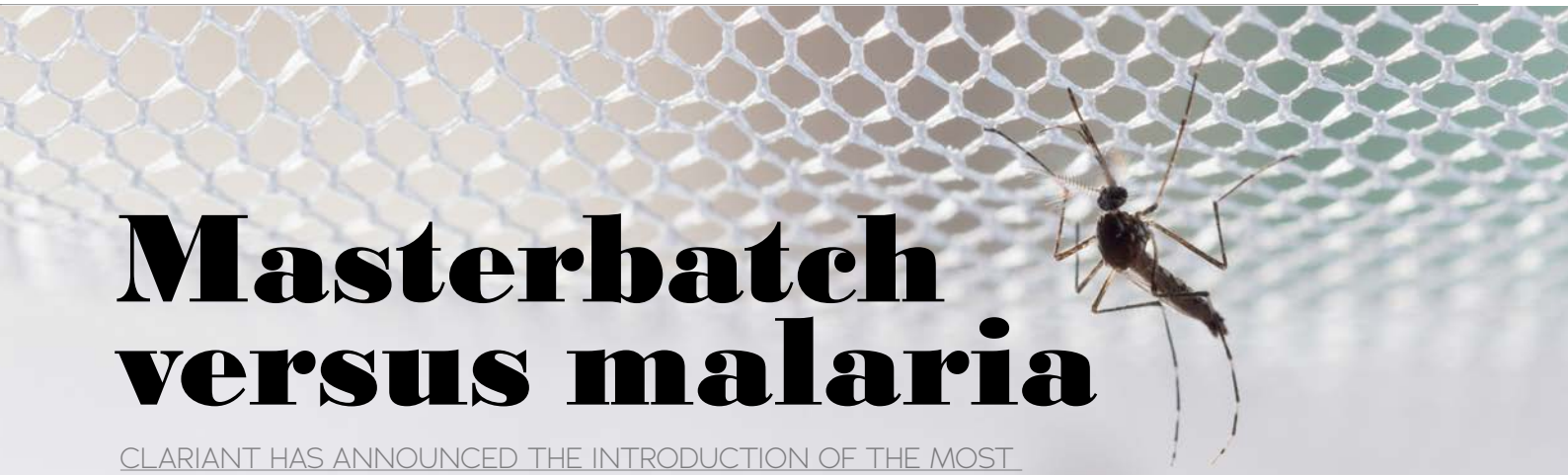
Traditionally, a lens blank is created, shipped to the lab where it is stored, selected from a large inventory of blanks, and then the finishing process begins. Excess materials are cut away in several steps to create the final shape and the lens is polished to obtain a smooth surface. The process requires many manual handling steps and more than 10 machine processing steps.

Around 80 per cent of original materials are wasted in the cutting process and, although some of the material can be re-used, subtractive manufacturing often results in stockpiles and low yield.

As a development reaching maturity, 3D printing has taken manufacturing to a new level in many industries through unlimited customisation and large volumes on-demand. Many different materials can be 3D printed for applications in various industries, but ophthalmic lenses production has thus far been an elusive application due to requirements in transparency, smoothness, and accuracy.

3D printing reduces industry expenses by combining efficiency and flexibility in the production flow. There is no need for stocking blanks, stock picking, blocking, taping, grinding, polishing, marking, de-blocking and de-taping. Multiple steps of traditional subtractive manufacturing technology can now be replaced with a single step: 3D printing the ophthalmic lens.

> **The cool technology of 3D printing is for everyone, especially for the next generation**



Masterbatch versus malaria

CLARIANT HAS ANNOUNCED THE INTRODUCTION OF THE MOST TECHNOLOGICALLY ADVANCED ANTI-MOSQUITO MASTERBATCH FOR USE IN ROYAL GUARD LONG-LASTING INSECTICIDE-TREATED NETS (LLIN).

The new product is the result of a decade-long effort to deal with increasing resistance of malaria-carrying mosquitos to pyrethroid insecticides.

Francis Baud, Global Business Development Manager for Clariant Masterbatches, said: "As efforts to control malaria have ramped up over the last 10 years, particularly in sub-Saharan regions, there has been a dramatic increase in the use of pyrethroid insecticides in treated nets and in indoor spraying campaigns. Although pyrethroids have been very effective, their widespread use has led to a dramatic increase in resistance. Globally, malaria still kills almost half a million people each year, and hundreds of millions of people, especially children and people with weakened immune systems, are at risk."

Resistance threatens to undermine progress against malaria, and all stakeholders are trying to find solutions to this very complex problem.

"As we prepare to mark World Malaria Day on April 25," Baud continued, "Clariant and Disease Control Technologies, are excited and proud to announce the introduction of our new dual-action masterbatch solution and first in class Royal Guard LLIN."

Disease Control Technologies LLC (DCT) has been a leading innovator in LLIN technology and is the first to use the dual-action Clariant Masterbatch in nets offered under the new Royal Guard brand name.

The safety, quality and efficacy of the product has been evaluated by the World Health Organization and DCT's Royal Guard LLIN, containing a pyrethroid and insect growth regulator, was added to the list of prequalified vector control products in March of this year.

The additives include pyriproxyfen, which inhibits the ability of female mosquitos to reproduce by limiting egg laying, larval-pupal transformation, and the emergence of functioning young adult mosquitos, thus reducing the overall population. What makes the Clariant technology special is the way in which the insecticides are blended into the masterbatch, allowing a permanent but slow release to the surface.

LLIN are made of HDPE monofilaments, to which the masterbatch is introduced during extrusion. Orientation of the PE molecules binds the precise amount of insecticide inside each filament before they are knitted into nets. Once in use, and over the three-year service life, small amounts of the active ingredients migrate to the surface so that mosquitos that land on them are immediately affected. Because the active ingredients are tightly bound on a molecular level, the LLIN nets can be washed up to 25 times with no loss of efficacy.

DCT introduced its first LLIN, the Royal Sentry, in 2008. Earlier this year the Royal Sentry 2.0 was launched. Both are pyrethroid-only nets. With the introduction of Royal Guard LLIN, the company now offers three different mosquito control nets, all of which take advantage of the innovative Clariant masterbatch technology.

The anti-mosquito masterbatches have qualified for the Clariant EcoTain label for products that offer outstanding sustainability advantages. EcoTain products significantly exceed sustainability market standards, have best-in-class performance and contribute to sustainability efforts.

> **Malaria still kills almost half a million people each year, and hundreds of millions are at risk**

Image: ©Clariant

OVER THE PAST FEW YEARS, EPPM HAS BEEN KEEPING IN TOUCH WITH THE DEVELOPMENT OF ALEX BERRY'S 3D-PRINTED HANDHELD SUTURING DEVICE MARKETED THROUGH HIS START-UP COMPANY SUTRUE. AS PART OF THE LATEST MEDICAL PLASTICS FEATURE, EDITOR ROB COKER CONTACTED BERRY TO PICK UP WHERE ROSE BROOKE LEFT OFF IN LAST YEAR'S EDITION.

BACK TO THE SUTURE

It happened that Sutrue had been planning a move away from manufacturing with 3D printed plastics in favour of metals now that the prototyping phase was over, and that Berry was now looking forward to design meetings with the Manufacturing Technology Centre (MTC). However, the Sutrue Founder and CEO was happy to learn, for a number of reasons, that plastics was the better option after all – just not 3D printed plastics. With moulding having emerged as the most feasible production method, Berry shared his explanations as to why.

"We needed plastics for a coating, and for more grip on the needle. Once you have the coating, the underlining materials are not so important, so the steps we're taking are towards moulding because 3D printing won't work due to regulatory requirements.

"3D printing has been incredibly useful in bringing down the costs of prototyping. As we've finished that phase and are now moving into trials and regulation, we are ensuring that we raise the necessary investment to fund those processes. Our Company Director Nia Dokova is leading our fundraising effort. She can now present the device better than I can – and I invented it.

"The transition from 3D printing to traditional manufacturing is going to be an interesting case study, and that's happening in the next three or four months, hopefully, which in itself is a good story for plastics."

MOULDING FOR MANUFACTURING

Asked whether moulding would be a slower process, Berry's philosophical response showed how he was guided by the necessary regulations for medical devices: "Once the final design is established, the trials have to involve what will be the end product, so we have to mould it regardless of how time-consuming or costly. It is a burden we have to bear and that isn't going to change for some time in regulatory terms."

There were 38 main prototypes created through 3D printing. Including the device's rollers, Berry quickly calculated around 500 prototypes in total – equating to somewhere between 1,800 and 2,000 different components during the development phase. Once complete and functional, it was time to move on and test its marketability.

The obvious testbed is in the veterinary sector, where regulation is similar to that of household appliances, and where

Berry can place the device straight into the hands of an expert. “We now have a well-known veterinary distributor ready to start plugging it on our behalf,” he said.

Presuming the in vivo veterinary trials are successful, and the human clinical trials equally so, EPPM was curious as to where the device could find a market. Berry expects the main medical application to be in quickly stitching a wound in situ, but adds to this the potential benefit of needle-stick prevention. Just one in nine needlestick incidents is reported in the UK, and in order to gain an idea of just how common needlestick is, one would have to file a freedom of information request with every hospital in the UK.

“HIV and Hepatitis can be transmitted to healthcare workers via needlestick, so everything requires that extra bit of time to be careful. Nearly everybody has said that they would need to have one in order to try it, but a lot of medical experts agree. Until we have some clinical trials, however, we can’t be certain since the way the device stitches is different due to the angle of where the needle comes out, so there needs to be some practice before we can quantify the evidence. Not enough medics have tried it yet, and we’ve been very limited in who we can hand it to, as well as in how long it would work for before parts wear down.”

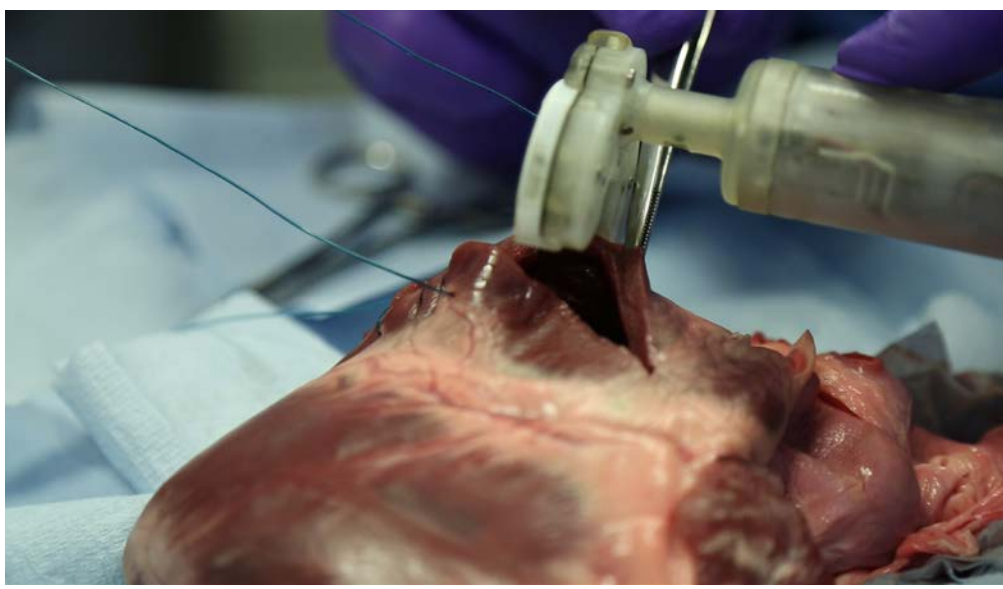
DEVICES AND DEXTERITY

While the current population of experienced doctors and surgeons acknowledge that the device is a good idea, targeting the next generation – who are arguably more reliant on handheld technology – is where the Sutrue CEO sees the device coming into its own, but with a bit of caution: “Yes, it’s next-generational and surgeons would say that they can hand-suture better than a machine, but there is a worry that young medical students are not as good with their hands having played with phones and tablets rather than with Lego as children. One of the indicators was when they were trying to do stitching, so we’ll be targeting the new generation of doctors. Many surgeons are like lightning when performing very delicate work inside a body, and no technology could be better, but when closing a patient up it tends not to be a surgeon but a junior practitioner, and that’s where most complications come from.”

The device is not targeted to junior practitioners alone, though. There is a particular part of a heart operation that requires metal clips to hold the heart together but “they’re not perfect”, as Berry concedes, and are often the cause of problems. “A surgeon friend,” Berry concluded, “thinks that if we have a small enough needle in the device he will be able to use stitches instead of clips, which will be beneficial for the patient.”

All being well, Berry aims for the beginning of 2020 as the period when the UK’s vets will be using it in earnest. Human medics will then be able to see how the vets use it: “The trial phase for human use will effectively be on animals, but instead of blinding beagles with make-up, we’re helping them.”

> **There is a worry that young medical students are not as good with their hands having played with phones and tablets rather than with Lego as children**



USP Class VI silicones for medical manufacturing

SPECIAL SILICONE PRODUCTS' BUSINESS DEVELOPMENT MANAGER DOMINIC J TESTO SHARES WHY MEDICAL MANUFACTURERS NEED SAFE ELASTOMERIC COMPONENTS FOR DIRECT AND INDIRECT PATIENT CONTACT.

Silicones are used in many healthcare applications, but not all medical silicones are the same. Platinum-cured silicones are purer and cleaner than peroxide-cured silicones. Yet choosing the right silicone is about more than just the cure system.

Medical manufacturers need high-quality, easy-to-source, on-time, and cost-effective materials. They also need proof that silicones are properly tested and validated. Without this, compliance issues or product recalls may result.

Some medical silicones need to meet USP Class VI, FDA CFR 21 177.2600, and RoHS requirements. The RoHS, an EU Directive, restricts the use of certain substances, but manufacturers also need to know whether all the ingredients in a medical silicone are made of compliant materials.

For its part, USP publishes test instructions and standards for plastics, polymers and elastomers used in medical applications. These tests measure biocompatibility and correspond to numbered classes so that the healthcare industry can identify materials in a standard way.

USP Class VI materials meet the most stringent requirements and include silicones that pass a systemic toxicity test, an intracutaneous test, and an implantation test. Class VI silicones may seem like a shortcut to safety, but medical elastomers differ.

Some silicone suppliers use compliant ingredients but can't guarantee a compliant end-product. To mitigate these risks, medical manufacturers must require certificates, or risk invalid silicones.

A certificate of conformance (COC) from a third-party testing laboratory and a certificate of analysis (COA) from the silicone supplier's Quality and Compliance department provide this proof.

SSP manufactures USP Class VI, FDA, and RoHS compliant silicones. In 2018, SSP submitted a sample of 50-durometer SSP-2390 to NAMSA, a contract research organisation for medical devices, to prove that SSP-2390 meets all USP Class VI requirements.

NAMSA performed three USP Biological Reactivity Tests in vivo with a test article: the USP Systemic Toxicity Study injected it into mice; and the USP Intracutaneous Study injected it into rabbits. In both, the saline, alcohol in saline, polyethylene glycol and sesame oil extracts did not produce a significantly greater systemic reaction than the blank extractants.

NAMSA also performed a Muscle Implantation Study in rabbit muscle for one week. The macroscopic reaction was not significant when compared to the USP negative-control plastic. For all tests, the SSP article was prepared at a ratio of 60cm 2:20mL and extracted at 121°C for an hour.

At its New York facility, SSP provides complete certifications to demonstrate the quality of its SSP-2390 silicones. COAs report the test results for a specific batch of materials, and COCs attest to a batch's compliance with those requirements.

SSP's USP Class VI platinum-cured silicones are translucent, supplied as compression-moulded sheet stock or continuous rolls, which support a variety of cutting methods, and come available in custom colours and as ready-to-mould compounds that support transfer and compression moulding.

Specialty Silicone Products offers shorter lead times than many other suppliers and provides on-time deliveries. SSP's ISO 9001:2015 certification underscores its commitment to quality.

New TPEs exhibit superior adhesion

TEKNOR APEX HAS INTRODUCED A NEW GENERATION OF TPES FOR OVERMOULDING THAT EXHIBIT SUPERIOR ADHESION TO ENGINEERING THERMOPLASTICS.

The Monprene OM compounds mould more easily and are more economical than the company's previously available comparable compounds.

Monprene OM compounds are based on advanced technologies for adhesion modification that exhibit improved bond strength when overmoulded onto rigid polymers used in consumer products, small appliances power tools, and other components requiring soft and hard material combinations.

Hilarie Rubin, Teknor Apex's Senior Market Manager for Consumer Products, said: "These new-generation overmoulding TPEs are more thermally stable than our earlier products. Monprene OM compounds can be moulded at higher temperatures, which are more conducive to obtaining good adhesion."

Three of the four Monprene OM standard series (19300, 19400, 19100) are based on styrenic TPE technology and exhibit dry haptics for good tactile properties in grips, handles, and other soft-touch components. The fourth (19100v) is based on TPV technology for improved chemical resistance.

Monprene OM-19300 ranges in hardness from 30 to 70 Shore A with compounds designed for adhesion to general-purpose and high-impact polystyrene and styrenic copolymers such as MBS.

Monprene OM-19400 ranges in hardness from 40 to 70 Shore A and can be overmoulded onto PC, ABS, PC/ABS blends, copolyester, PET, PBT, acrylic (PMMA), acrylate copolymers, and acetal.

Monprene OM-19100 is designed for overmoulding onto nylon with a hardness range from 40 to 70 Shore A; Monprene OM-19100V is similar but exhibits enhanced chemical resistance with a hardness range from 65 Shore A to 40 Shore D.

Teknor Apex

Four New TPE Series for Over-Molding

	Monprene OM® Styrenic TPE Series			Monprene® OM TPV Series
	OM-19300	OM-19400	OM-19100	OM-19100V
Shore hardness	30A – 70A	40A – 70A	40A – 70A	65A – 40D
Substrate PS & styrenics	✓			
PC		✓		
ABS		✓		
PC / ABS		✓		
Copolyester		✓		
PET		✓		
PBT		✓		
Acrylic & acrylates		✓		
Acetal		✓		
Nylon			✓	✓

Source: Teknor Apex Company

COVESTRO COMPLETES TPU EXPANSION IN TAIWAN

LEADING POLYMER MANUFACTURER COVESTRO HAS EXPANDED ITS TPU CAPACITY AT ITS MANUFACTURING SITE IN CHANGHUA, TAIWAN, FOLLOWING SUCCESSFUL EXPANSION IN THE US AND THE TAKEOVER OF THE MAJORITY OF THE JAPAN JOINT VENTURE – ALL WITHIN 12 MONTHS.

Covestro

Dr Thomas Roemer, Global Head of TPUs at Covestro, said: "The Changhua site is Covestro's largest TPU production site in Asia, supported by Covestro's APAC TPU Research and Development Center. With the capacity expansion, we will cater to the market's needs in APAC with diverse and innovative products, such as bio-based TPU."

With the expansion, the site's production capacity increased by 30 per cent in order to benefit from growing demands in the region.

Expansion and growth

The global TPU market is expected to grow at six per cent CAGR in the forecast period 2017 to 2022, with the majority of such growth in the APAC region.

Dr Stephan Ehlers, Covestro's Head of TPU Production and Technology, added: "One of our strategies is to participate in this growth with our capacity expansion. It will allow us to better serve our customers, meet the rising market demands, and sustain our strong presence."

TPU's lightweight and versatile qualities further boost its market demand.

Covestro's presence in Taiwan makes it an important innovation partner for players in the IT and footwear industries.

Quality, Safety, Reliability

KRAIBURG TPE HAS BEEN WORKING IN THE MEDICAL DEVICES, PHARMA PACKAGING AND IN VITRO DIAGNOSTICS INDUSTRIES FOR MORE THAN 10 YEARS AND HAS COLLECTED A WIDE RANGE OF EXPERIENCE AND SKILL SETS IN THAT TIME.

Dr Thomas Wagner

As a member of the council that drafted the VDI Guideline 2017 for Medical Grade Plastics, which defines the common standards for materials sold, the Germany-based thermoplastic elastomers manufacturer has helped increase the safety of end products for patients and practitioners alike.

Here, EPPM speaks with KRAIBURG TPE Product Manager Dr Thomas Wagner to discover what this means for the market, the industry, and the environment.

WHAT ARE TPES CURRENTLY DOING FOR THE MEDICAL PLASTICS INDUSTRY?

In contrast to other industries, TPEs did not enter as grip materials or simple design elements. In the market of medical devices, pharma packaging and in vitro diagnostics, TPE was from the beginning targeted to either replace existing elastic materials or open new doors in device concepts by the new possibilities it offered in material behaviour and processing. For example, TPEs are used for sealings, plugs, closures, valves or membranes in the medical sector, and each day new ideas for applications are added.

HOW DOES THE VERSATILITY OF PRODUCTS ALLOW TPES TO TRANSCEND SECTORS AND WHAT CAN WE EXPECT THE PRODUCTS TO CONTINUE DOING IN THE FUTURE?

The thermoplastic elastomers of KRAIBURG TPE are used in the automotive, consumer and medical industries, amongst others. As KRAIBURG TPE is a leading specialist in this material class, we have developed different materials offering custom-engineered solutions for requirements special to each market.

We focus on demanding applications for flexible applications and achieve reliable adhesion to many different thermoplastics in two-component injection moulding. And we realise high material quality and purity in combination with high levels of haptic and colouring. Our success is based on customer and application engineered co-operation and a customer-focused way of working.

HOW ARE TPES CONTRIBUTING TO NEW DEMANDS IN SUSTAINABILITY, THE CIRCULAR ECONOMY, AND ENVIRONMENTAL SOLUTIONS?

In general, the thermoplastic elastomers of KRAIBURG TPE can be recycled almost up to 100 per cent. Due to uncured polymer chains, it is possible to melt and reshape thermoplastic elastomers again and again. This characteristic allows customers – as long as there are no regulatory obstacles – to trace the thermoplastic elastomers back to the manufacturing process. Therefore, customers save material, can produce at shorter cycle times, and help preserve the environment in even more ways.

In the medical sector, however, recycling is seen differently, as the market has higher regulatory limits and is quite often based on single-use parts. KRAIBURG TPE is certified to ISO 9001, ISO 14001, and ISO 50001, and one of the central targets of our environmental management, as well as of our employees, is the reduction of waste and emissions.

HOW IS THE COMPANY CO-OPERATING WITH ACADEMIA/NGOS/ AUTHORITIES IN ORDER TO MEET ITS BUSINESS AND ENVIRONMENTAL TARGETS?

The medical market is authority driven. As opposed to other markets, there are strict and clearly enforced laws to be fulfilled. The main driver is patient safety – hence the single-use preferences. These are even more important than environmental issues – both of which we take very seriously here at KRAIBURG TPE. We offer a unique service package which guarantees a maximum of quality, safety and reliability for the market.

> **We have developed different materials offering custom-engineered solutions for requirements special to each market**

TPU ELASTOMERS DEMAND REMAINS CONCENTRATED IN APEJ, FUELLING INVESTMENTS BY LEADING PLAYERS

THE GLOBAL TPU ELASTOMERS MARKET SURPASSED $2.5BN (~€2.2BN) IN 2018 AND A NEW STUDY BY IRELAND-BASED MARKET ANALYSTS FACT.MR ANTICIPATES REVENUE GROWTH AT 5.4% IN 2019.

According to the study, increasing demand for TPU elastomers in the emerging economies of Asia Pacific excluding Japan (APEJ) continues to create sizeable opportunities for manufacturers.

APEJ continues to hold more than 50 per cent share of TPU elastomers globally.

Analysing the key factors fuelling TPU elastomers demand in APEJ, the study reports that a strong presence of leading chemical companies, along with increasing penetration of small- and medium-scale companies, remain key growth drivers. Increasing investments by top-tiered players and rapidly growing end user industries continue to attract investments by market leaders, the study finds.

The study also assesses the business and product strategies of key players in the TPU elastomers market. Investments and expansion in Asia Pacific continue to be a key focus for stakeholders. BASF's investment in Expanded Thermoplastic Polyurethane (E-TPU) Infinergy at Changhua, Taiwan, and The Lubrizol Corporation's investment in Songjiang plant in Shanghai are indicators of the growing prominence of APEJ among stakeholders.

ENVIRONMENTAL CONCERNS TRIGGER MANUFACTURING INNOVATIONS

The study finds that although TPU elastomers have been witnessing incremental demand across versatile industrial applications, meeting the evolving sustainability requirements continues to be a challenge for stakeholders. Negative impacts of thermoplastics on the environment have been restricting manufacturers from exploring new niche applications. Leading stakeholders in the TPU elastomers market have been therefore focusing on innovation in manufacturing strategies and technologies to discover biocompatible and biostable TPU elastomers.

According to the study, the focus on finding sustainable solutions is also driven by stringency in environmental regulations. In many APEJ countries, environmental regulations have become more stringent, and manufacturers have had to adapt to the changing status-quo.

Some notable examples include Lubrizol International, Inc. who in March 2019 announced the launch of a new, toluene-free Pearlbond TPU for films and adhesives. Toluene exposure can have hazardous impact on the environment and on human health. The company announced that the new Pearlbond TPU is toluene-free and recyclable, environment-friendly, and can be used in various applications such as furniture, footwear, automotive films, and apparels.

Similarly, in February 2019 Applicazioni Plastiche Industriali SPA (API) announced the launch of the new recyclable TPU APILON52 A/C-series, declaring that the new portfolio of its TPU elastomer products reduces the production cycle time by around 70 per cent, while significantly cutting energy consumption and production costs.

Finally, in October 2018 Covestro AG discovered a new carbon dioxide-based technology for manufacturing environmentally friendly TPU elastomers. With growing concerns regarding ecological fallout, Covestro established partnerships with research institutes and other companies to boost the use of CO2 technology as a synthesis platform for the large-scale production of TPU elastomers.

The study tracks developments in the TPU elastomers market for the assessment period 2019-2027. According to the study, the TPU elastomers market is expected to envisage impressive growth at a CAGR of 5.9% during the assessment period.

> **In many APEJ countries, environmental regulations have become more stringent, and manufacturers have had to adapt to the changing status-quo**

COMBINATION PRODUCTS FOR MEDICAL DEVICE DEVELOPERS

LUBRIZOL LIFESCIENCE'S MARKETING SPECIALIST NICK DIFRANCO EXPLORES POLYMER SELECTION AND DESIGN OPTIONS FOR IMPLANTED DRUG-DEVICE COMBINATION PRODUCTS.

Nick DiFranco

Combination products are defined as therapeutic and diagnostic products comprising two or more regulated components – i.e. drug/device, biologic/device, drug/biologic, or drug/device/biologic – that are physically, chemically, or otherwise combined or mixed and produced as a single entity (21 CFR 3.2(e)).

This broad definition includes products ranging from pre-filled syringes to drug-coated implants. For medical device companies, combination products provide an attractive route to improving performance or extending lifecycles.

Broadly speaking, drugs and implants are used together for two reasons: the device as a drug delivery vehicle or the drug is included to enhance the performance of the device. For medical device developers, the most relevant examples involve the addition of a drug to an existing medical device (antimicrobial catheters, steroid-coated pacemaker leads, and antibiotic bone cements, for example).

Polymer selection is a critical component of medical device development, and the same guidelines apply when choosing a polymer for a combination product. Combination product developers should ensure that their chosen polymer(s), as with any key component, will be available in the grade necessary for an implant and that the manufacturer can provide the needed documentation and support.

PATHWAY TPU EXCIPIENTS

TPU use in combination products is increasing. Non-biodegradable TPU excipients, including Lubrizol Life Sciences' Pathway offering, are versatile and customisable to a broad range of chemical and physical properties (Fig. 1).

The ability to modify TPU chemistry makes these excipients compatible with a wide range of APIs (hydrophobic and hydrophilic) and allows them to provide different drug-release kinetics (short and long-term) depending on the application.

TPUs come in a range of durometers and are amenable to many processing methods, including hot-melt extrusion (HME), solvent casting, and injection moulding. Lubrizol's TPUs have a long history of in vivo safety, stability, and biocompatibility. As a result, they have been used for decades in biomedical applications such as pacemakers and defibrillators. Additionally, Pathway TPUs have established Drug Master Files (DMFs) and are manufactured under IPEC-PQG GMP guidelines.

PRODUCTS AND PRODUCTION PROCESSES

The drugs incorporated with devices may be either impregnated or surface-coated. Many polymers – including polyolefins, polyurethanes, and ethylene-co-vinyl acetate polymers – have been combined with drugs through HME. Silicone rubber can also be combined with drugs through reactive injection moulding. In cases where temperature sensitivity is an issue, drug loading may be accomplished with the use of solvents.

Drug-eluting devices can take several forms (Fig. 2). In the case of matrix-type products, the drug is uniformly dispersed throughout the polymer. Drug release from matrix-type products typically follows first-order kinetics, often with an initial burst of drug and a release rate that decreases over time. In cases where a device is hollow or surface protection is critical, a drug-containing coating made from biodurable or biodegradable materials can be applied. These may demonstrate a wide range of release rates depending on composition, thickness, and environment.

Reservoir-type combination products are less common for modifying medical devices. The drug-filled stent, for

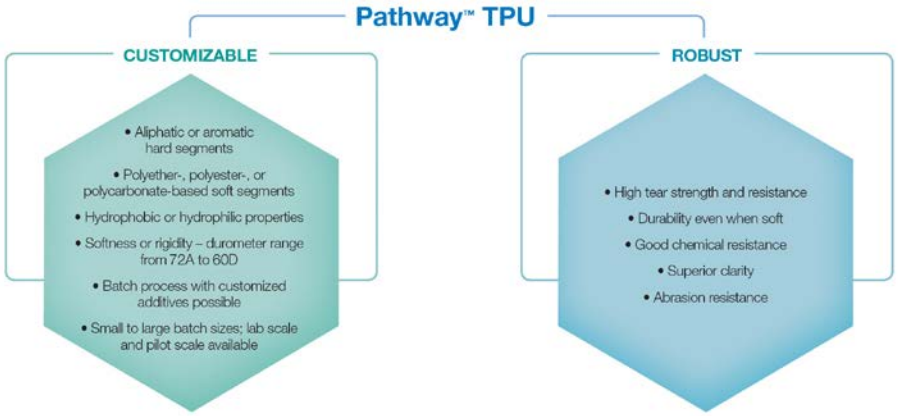


Fig. 1 Pathway TPU excipients: A versatile drug delivery option

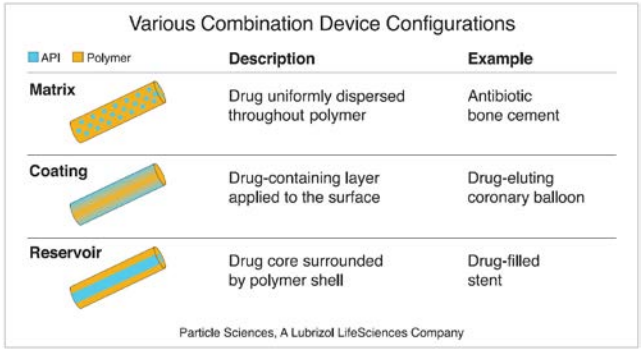


Fig. 2 Various drug-device combination product configurations

example, has laser-drilled holes that allow continuous elution out of the device and prevent restenosis of a vessel. Reservoir designs are appealing because they can achieve steady drug release over time, also known as zero-order release. For medical devices, the burst release of a matrix-type product may be desirable to help fight an initial infection risk or inflammatory response.

Whatever the goal of a combination product, the drug incorporation method and material selection can be optimised by experienced developers to achieve the desired drug release rate.

The addition of a drug to a medical device can greatly enhance safety and efficacy, providing differentiated product performance. A wide range of combination products have been commercialised and continue to be developed as medical device companies seek ways to improve product lines. However, combination products present unique development challenges, including the complex selection of polymers, drugs, and device designs to achieve a specific goal. Any successful combination product development requires an understanding of both the drug and device. Using an experienced development partner such as Lubrizol LifeSciences can mitigate much of the risk by closing knowledge gaps and shortening the time between developmental inflection points.

As a growing number of medical devices make the leap to combination products, the benefits of drug inclusion become more apparent. Drugs have allowed devices to last longer in the body, perform therapeutic actions more effectively, and mitigate unwanted effects. As long as drugs continue to improve the safety and efficacy of both existing and novel medical devices, combination products will remain an area of significant growth.

> **Lubrizol's TPUs have a long history of in vivo safety, stability, and biocompatibility ... they have been used for decades in biomedical applications**

PLASTICS AND PARALLELS

IN CELEBRATION OF 21 YEARS OF EPPM, EDITOR ROB COKER SUCCINCTLY FOCUSES ON THE PARALLELS BETWEEN THIS AND THE JUNE-JULY 2000 EDITION

The socio-political parallels between 1999 and 2019 are astounding and numerous. Too numerous to dedicate half a page of editorial to, so let's look at the similarities of this and the June 2000 edition, which included a Testing and Inspection ad that introduced me to 'flame chambers'. I don't know what these are, but it would be a cool name for a band – or a horror movie.

TPEs are abundant in the June 2000 issue, just as they remain in our lives. One article describes 'A brand-new super-soft, water-clear, non-oily, and non-tacky TPE,' which is as informative as it is compound adjective-laden. It's humbling to think I may have used numerous Versaflex products without knowing.

In the matter-of-fact titled 'Compounds and Elastomers', an image of a golf ball perched upon a grey and yellow tee showed how MA Hanna exhibited its range of 'PA6, 66, 6/666, and EDGETEK compounds based on ABS, PC, PPO, and PC/ABS' at that year's Plast in Milan, Italy. It's my belief that Engineering Plastics have come a 'fairway' since then.

There was even a reference to this edition's cover story suppliers Albis, who were exhibiting from booth number 8205 at NPE 2000 in Chicago.

As some things change and others remain the same, as history repeats itself and we find the past echoing in present parallels, one can't help but wonder about the next 21 years and where we'll be politically, environmentally, as an industry, and as people.

Solvay names AM Cup winners

SOLVAY HAS REVEALED THE AM CUP 2019 WINNERS, THE COMPETITION IN WHICH THE WORLD'S UNIVERSITY STUDENTS FABRICATE SPECIFIC SHAPES USING RADEL PPSU AM FILAMENT.

Winners were selected from 35 student teams from 32 universities across three continents.

Gekko Performance from the Technical University of Munich, Germany, secured first prize with its ability to achieve 100 per cent z-axis strength in the Type V size tensile bar, dimensional accuracy, surface uniformity, and a mechanical performance that endured a burst pressure test of 1,400psi for two hours. The jury also evaluated the creativity of each 3D printing method.

Two teams from Ghent University, Belgium – PPSUsual and PPSUPER – were awarded second and third place respectively.

Each team received a spool of Radel PPSU AM filament with the challenge of replicating an ASTM D638 Type V size tensile bar in the z-axis and a wavy-shaped pressure pipe, which is a difficult shape to create by injection moulding.

Ryan Hammonds, R&D Platform Manager for Solvay's Specialty Polymers, said: "It was inspiring to see the various approaches to solving the challenges. The winning team demonstrated once more that 3D printed parts can virtually match the performance and quality of conventional injection moulded parts, provided material, hardware, and process are optimised together."

The top three teams received ten, five and three thousand euros respectively, to be reinvested in academic, societal or entrepreneurial activities.

Solvay's range of filaments also includes KetaSpire PEEK AM filaments, including medical-grade formulations for limited-contact healthcare applications. Both have been added to the Digimat simulation software database of e-Xstream engineering.

Solvay exhibited the winning entries of its AM Cup 2019 at the Rapid + TCT show in Detroit, US, in May.

Solvay

EVONIK AND EVOLVE STEP UP FOR AM APPLICATIONS

EVONIK AND EVOLVE ADDITIVE SOLUTIONS HAVE ANNOUNCED A JOINT DEVELOPMENT AGREEMENT WHEREIN THE COMPANIES WILL WORK TOGETHER TO FORMULATE EVONIK'S THERMOPLASTIC MATERIALS TO BE USED IN EVOLVE'S SELECTIVE THERMOPLASTIC ELECTROPHOTOGRAPHIC PROCESS (STEP) FOR ADDITIVE MANUFACTURING SOLUTIONS.

The initial development efforts will focus on polyamide 12, PEBA, transparent polyamide, and polymer of the polyamide 6 series. The combined efforts will result in a wider range of materials for STEP users with more 3D printing material choices.

Evolve's STEP technology will complement traditional manufacturing processes on the factory floor, augmenting production capabilities and enabling freedom of design, as well as faster time to market capabilities.

STEP is still in the alpha development stage and is expected to be commercial in Q4 2020.

NEW POSSIBILITIES

Steve Chillscyzn, CEO of Evolve Additive Solutions, said: "STEP has been developed for volume manufacturing, so offering the widest range of thermoplastic materials to our customers is a critical element for production. The joint development agreement with Evonik allows us to broaden the spectrum of STEP materials ... but more importantly to debut a whole new set of materials, opening up more applications that can take advantage of everything additive manufacturing offers."

Head of the Additive Manufacturing Innovation Growth Field at Evonik Thomas Grosse-Puppendahl added: "Evolve's entirely new technology approach will allow us to expand the range of applications of our high-performance materials, which are produced through a unique production process. With more than 20 years of experience in 3D printing, we will also develop a wider range of customised material formulations to unlock the full potential of the STEP technology."

Ascend offers EV solutions at Chinaplas

Ascend Performance Materials, one of the largest fully integrated producers of polyamide 66 resin, presented on PA66 at Chinaplas 2019.

The presentation is the latest demonstration of Ascend's growing presence in Asia. Last year the company strengthened leadership in the region by hiring Dr Kevin Wu as Ascend's Senior Vice President and Managing Director for the Asia-Pacific region.

Global EV sales grew by 62 per cent last year with China accounting for over half of all EVs sold in 2018. But EVs still lag behind internal combustion engine vehicles, largely due to concerns around range and safety.

Commenting on the changing market, Wu said: "China is currently the biggest EV market and is driving the trend to transition away from ICE vehicles. However, the technology is still evolving – consumers are expecting more in the areas of EV safety, reliability and performance. For EV adoption to continue, we need to meet these expectations."

The company offers a number of Vydyne PA66 solutions for EVs, from its corrosion-resistant J series for electrical connectors to its impact-modified grades that protect EV battery cells from puncture.

"PA66 is an excellent material for lightweighting, battery protection and cooling, and fast charging applications," Wu added.

Xeducation

IN THE FIRST OF FIVE IN AN INTERVIEW-LADEN FEATURE, EPPM ASKS TU DELFT GRADUATE, MATERIALS ENGINEER, AND CARBONX FOUNDER AND CEO RUTGER VAN RAALTEN ABOUT HOW PLASTICS CAN ENGINEER THE FUTURE.

Rutger van Raalten

COMING FROM ACADEMIA, WHAT SUPPORT DID YOU RECEIVE WHILST STARTING UP?

We are affiliated with Delft University of Technology and CarbonX was founded in 2014 after an infamous Friday afternoon experiment, which resulted in the finding of this new material. It was very exciting, but we had no clue what to do with it. Instead of getting a spherical carbon structure, as expected, we made this fibre-containing porous network; TU Delft afterwards helped in filing for patents and then we all wondered what to do with it. The incubators were less active and the University didn't really have the ability to do anything further so – long story short – I came up with a plan to test this material and see how we could bring it to market. A pitch event at the YES!Delft incubator then introduced us to the venture capitalist we still work with today.

Being located at the incubator, we operate and control our own lab space with support functions and subsidies facilitated by the university, the government and TNO, but the only way we still depend on TU Delft is for equipment for scanning electron microscopy or transmission electron microscopy – which they allow us to make use of to characterise the material.

WHAT ARE THE MAIN AREAS OF APPLICATION?

We have recently moved into security, automotive, and even space-based applications. One of the biggest challenges, and also one of the most fun markets to work in, is the space sector. Here in the Netherlands are some of the most well-known space agencies, with whom we collaborate. They look at three key pillars: thermal and electrical conductivity, and light-weighting, all of which we can definitely help with.

Thermal conductivity is very important as heat needs to be conducted through lightweight composites, but, if you look at an epoxy material or a honeycomb structure, there is usually carbon filaments wherein conductivity is great, but the fibres aren't always aligned, causing areas of poor heat transfer. This is something we're now working on by adding our 3D networked carbon material to the resin to address the 'hotspots'.

It's not all about thermal conductivity per se, it's about getting the additive properly embedded into the resin without affecting viscosity, and then preferably at low density so it can be lightweight. While carbon is a very welcome candidate, any metal or mineral will outweigh the benefits based on conductivity alone, so there is definitely a gap to fill.

Industrial rubber goods, e.g. seals, conveyor belts and hoses, is where we see some traction of customers who will benefit. A substitute for the carbon they already use, but with better performances, anti-static hoses are now amongst our main applications and the markets we really focus on. In the meantime, we are working with global car manufacturers too, who are testing and prototyping our material. A much slower process, but they are seeing benefits with rolling resistance and friction, which could reduce CO_2 emissions and improve heat transfer.

continues overleaf >

WOULD THE ENGINEERING WORLD BE JUSTIFIED IN BECOMING EXCITED ABOUT PLASTICS AGAIN?
What we're trying to do is change the focus on plastics and elastomers as a more durable and long-term compound rather than a single use, low-quality material. This is definitely a fantastic material that can be reused, it has beneficial properties, we just need to add the right features to make it even more valuable so that the way people use it will change.

The way we're using plastics took a wrong turn, and people should look at it again from a high-value engineering perspective.

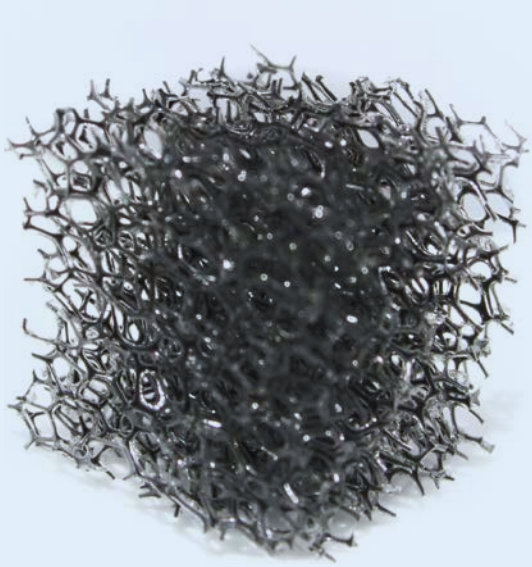
This is something I cannot emphasise enough, it is about carbon productivity – a measure of the value created from a carbon source. You can use carbon as a fuel or you can make building materials from it, or you can use it in applications that last longer and reduce emissions when it is properly used. It also opens up new design opportunities. You can design lithium ion batteries with a higher energy density because we now develop heat shields that can deal with the additional heat generated.

SO THE COMPOUND HAS ENVIRONMENTAL ABILITIES AS WELL AS AUGMENTED ENGINEERING CAPABILITIES?
Exactly. One of the main technical features is that you can add it without affecting processing, so viscosity or hardness doesn't change as normally happens when you add carbon, nanotubes or graphene, or specialty carbon blacks. Rubbers stay flexible, which helps with reinforcement and the transfer of heat and electrons. If you can transfer that into applications you can lower friction in dynamic properties, including in conveyor belts, resulting in less energy use – it's the same for a tyre: you reduce CO2 emissions because you use less fuel or energy.

COULD THAT THEN HELP OTHER COMPANIES BOOST PRODUCTION?
Sure. One of the ideas that the conveyor belt compounders came up with involved faster belt speeds with higher load capacities, tensile strength and elongation. So yes, we could definitely improve productivity for our customers because they can now run longer lasting belts that can withstand higher loading capacities and at faster speeds.

WHICH NEW MATERIALS OR PROCESSES HAD TO BE DEVELOPED TO CREATE CARBONX'S PROPERTIES?
What we found out – the hard way – was that we cannot make changes in the industry or get industry to adapt to our product, we had to adapt to the industry. One of the benefits we've seen is that CarbonX can be processed on standard equipment pretty well, mainly due to the larger particle structure. Also, the network structures can withstand high pressures and forces. CarbonX provides new safety design opportunities too, as it can conduct away excessive heat or prevent uncontrolled anti-static discharge. Luckily, the processing equipment is the same, but the settings have to be slightly adjusted. A common mistake we see happening is that most of our customers initially treat the material as a delicate nanotube or graphene, resulting in too little shear and poor mixing. We always encourage them to give it a proper beating.

> **The way we're using plastics took a wrong turn, and people should look at it again from a high-value engineering perspective**



Space commodity

ARGUABLY, THE PINNACLE OF APPLICATIONS FOR ANY ENGINEERING MATERIAL IS IN THE SPACE SECTOR. WHETHER IN SATELLITES AND SPACECRAFT OR, LOOKING FURTHER AHEAD, AS A CONSTRUCTION MATERIAL IN EXTENDED EXPLORATION MISSIONS ON THE MOON OR MARS, NEW WAYS OF PRODUCING ENGINEERING PLASTICS ARE OPENING UP NEW WAYS OF USING THEM IN HI-TECH APPLICATIONS.

Dr Thomas Rohr
credit: ESA – A. Conigli

Science fiction has always shown us temporary tent-like structures for such endeavours, but what do the scientists and materials experts at ESA envisage? What part can plastics play in space? EPPM spoke to Dr Thomas Rohr, Head of the Materials and Processes Section at ESA, to find out.

WITH PLASTICS ENDURING NEGATIVE ATTENTION HERE ON EARTH, WHAT USES COULD THEY HAVE IN SPACE?
It's quite a diverse range, actually. We talk here about applications for spacecraft a lot and we're using a wide range of polymers for that purpose. Almost exclusively, we are talking about engineering polymers and not commodity polymers for their mechanical performances and their ability to deal with radiation or environmental exposure, not to mention durability, when in orbit.

The largest portion of such materials would be carbon fibre-reinforced composites, typically epoxy, but we use a lot more. There are epoxy and silicone adhesives, polyurethane and silicone paints, insulation and thermo-control materials made from polyimide or fluoropolymers, EPDM and fluoroelastomers. Polyurethane and silicone coatings are also used for electronics assembly with PCBs either of rigid glass fibre or flexible polyimides.

Either way, my initial background is in polymer chemistry and I am now responsible for the selection of materials and processes for all space applications, making sure they are fit for purpose and for end use.

WHAT MUST A MATERIALS SCIENTIST TAKE INTO ACCOUNT WHEN SELECTING PLASTICS FOR ENGINEERING PURPOSES, PARTICULARLY GIVEN THE CHALLENGES OF SPACE-BASED PROJECTS?
It depends on the mission: the orbit, the vacuum, and the level of exposure, not to mention the temperatures which during an Earth orbit vary between plus and minus 100-150 degrees Celsius; if we go sunward, as the BepiColombo mission is, we reach in excess of 500 degrees

Celsius; the deep space environment could reach 40 Kelvin. We also have to factor in light from the Sun; particle radiation; in a low Earth orbit we have atomic oxygen and synergistic effects. We have our own simulation and test capabilities as part of a network of laboratories across Europe – part of which is hosted by industry, part by academia – because we are here, of course, to help our own projects in testing and simulated exposure scenarios.

It could be chemical, it could be thermal, it could be radiation – whatever is necessary – and we can test the materials to European standards through subsequent chemical and physical analysis. But no one organisation can do that alone, which is why a cross-sectoral network of experts all play their parts.

Such capabilities are in pretty much all ESA member states; some are highly specialised and unique, some are more generic but more commonly used. It depends on the many different needs and on what they want to achieve. It is a network complementing itself. We have to discriminate what happens at the materials level from the testing of spacecraft and their component systems as these are very different. It is important to note that ESA is not producing or manufacturing satellites, but supporting those procuring them and ensuring that the materials are fit for purpose.

HOW HAS 3D PRINTING CHANGED THE DYNAMIC FOR SPACE-BASED ENGINEERING?

There is quite a difference between metallic and non-metallic applications when it comes to 3D Printing and in terms of technology readiness. We are much more advanced in metallic materials but recognised the potential of 3D Printing 15 years ago. When we introduced advanced manufacturing in 2015 with the purpose of reducing limitations in traditional manufacturing, as well as improving performances, design freedom, lead times, and costs, we had the aim of creating new capabilities.

Advanced manufacturing is very important – we can expect it to foster competitiveness alongside Industry 4.0 developments, and we have certainly recognised much innovation in non-space sectors. We try to weave this innovation into space-based applications and, in turn, we are helping other sectors to establish and develop capabilities for 3D Printing so that there is spin-off potential. Everything is going in the direction of the advanced manufacturing initiative wherein we try to identify new technologies and engineering materials. My job is to help make them fit for purpose for their respective space applications.

Within this initiative, additive manufacturing is probably the most prominent example of an advanced process. It is not the only one, however. There are many other things ongoing but additive manufacturing remains the most prominent and progressive.

As mentioned, we are more advanced in metallic materials compared to polymers but there are applications for the latter – not yet structural, but certainly under development. We are also developing 3D Printing capabilities in orbit. So far, we have developed a demonstrator capable of printing engineering polymers in microgravity, and we are developing payloads for the ISS, which serves as an ideal testbed.

We are looking to use the technology in the exploration of the Moon and Mars where we will require construction, maintenance and repairs capabilities. This is the target but, on the ISS, we have a beautiful testing environment where 3D Printing has been demonstrated to be a good way of creating on-the-spot spare parts, tools and repairs. Again, the real aim is in long-term exploration, where additive manufacturing is enabling logistics and construction, including the use of in situ resources.

HOW FAR AWAY IS 3D PRINTING FOR OFF-WORLD CONSTRUCTION?

We have already demonstrated utilising regolith from the Moon and Mars for structural applications. You can use the regolith and mix it with a binder that might have a polymeric base, for example, but there are many possibilities using different binders. Even more economically, you could use the light of the Sun for solar sintering.

Also, and of course, we are looking into recycling concepts. You could consider using polymers for structural applications and, currently, we mainly use epoxy composites, which are thermoset resins, but we could equally consider using thermoplastic resins which are easier to recycle. For these purposes, thermoplastic polymers such as PEEK are ideal because we can re-process them.

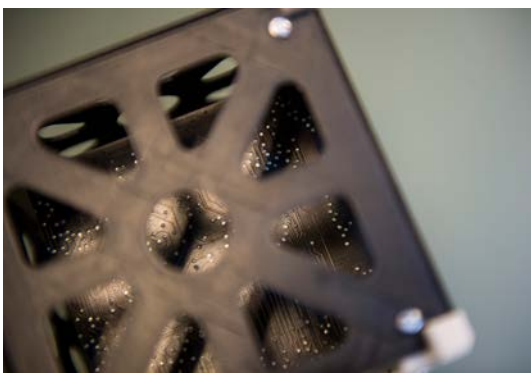
There is a lot to learn until the technologies that enable and ensure safe operation of autonomous missions are available. In return, the experience we gain will contribute to accomplishing sustainable living on Earth.

> **So far, we have developed a demonstrator capable of printing engineering polymers in microgravity, and we are developing payloads for the ISS**

Image left:
3D-printed ceramic parts made from lunar regolith

Image below:
3D-printed CubeSat body

credit: ESA – G. Porter



FASTER HARDER STRONGER BETTER

AREVO IS A SILICON VALLEY-BASED SME SPECIALISING IN THE HIGH-SPEED, CUSTOMISED PRODUCTION OF 3D PRINTED COMPOSITE PARTS FOR THE TRANSPORT, AEROSPACE AND ENGINEERING SECTORS. EPPM SPOKE WITH CO-FOUNDER AND CEO HEMANT BHEDA TO LEARN MORE ABOUT PLASTICS USE IN THE US'S ENGINEERING AND TECHNOLOGY CAPITAL.

Hemant Bheda

ULTRA-STRONG LIGHTWEIGHT COMPONENTS HAVE SEEN EXPONENTIAL GROWTH IN RECENT YEARS. HOW MUCH OF A PART IS PLASTICS PLAYING IN THAT?

In AM or 3D Printing, there are a number of solutions primarily driven by fused deposition modelling (FDM) technology invented by Stratasys – but now a number of other players offer it, including HP, Carbon and FormLabs. However, in AM-made ultra-strong and lightweight composite components replacing metal parts, there aren't many solutions out there. This is what AREVO is pioneering. We create structures from composite materials using fibres and thermoplastic polymers with enough strength to replace metal parts.

We've already begun production of composite, unibody bicycle frames. The majority of frames shipped today are metal, whether aluminium or titanium; there are even composite bike frames made with 27-28 parts glued together. It's a manual and messy process. AREVO DNA technology allows these products to be manufactured in a fully automated way, as a single part.

ARE YOU LOOKING TO REPLACE METAL ALLOYS WHOLESALE OR IN SPECIFIC SECTORS?

The main industries are transportation, aerospace and construction. If we look at the penetration of composites, aerospace has the highest with 23 per cent. The 787 and A380 use a lot of composites but there is still a long way to go. Overall, we are not specifically looking at one particular industry application – we believe the tech has broad applications across many industries, and we hope AREVO DNA can make a difference globally with more sustainable manufacturing.

IN WHAT WAYS IS SOFTWARE CHANGING PROTOTYPES AND STREAMLINING MANUFACTURING PROCESSES, AS WELL AS GETTING NEW PRODUCTS FROM CONCEPT TO POS FASTER?

Our tech is now enabling the serial production of additive manufactured composite parts. For example, an aircraft seat bracket is currently an assembly of four metal parts. AREVO generative software created a single composite part, which used the least amount of material with perfect fibre orientation in 3D space while meeting the required performance specifications. It's important to have software tools not only to create optimised design, but to reliably predict performance. This is the only way to immediately deploy new and unique parts manufactured on-demand with AM technology. The whole process took less than two days from receiving the CAD file design to having an optimised carbon fibre composite part in hand. Previously, the process took almost two years from design to final part.

This technology can be applied to manufacturing customised consumer products. For example, each one of a potential 200,000 bike frames can be unique with different designs and sizes. That is the beauty of this tech, all driven by algorithms.

HOW DOES MANUFACTURING AT THIS PACE BENEFIT CONSUMERS, OEMS AND YOUR BUSINESS?

Highlighting bike frames again as something we have already started manufacturing, bike brands have to forecast demand and place an order

with the off-shore manufacturer about a year ahead, then they have to add a down-payment to book the factory capacity. The order cannot be changed and they get what they get. Today's manufacturing process is completely manual and rigid. Typically, 55 people are involved in making each frame and, as a result, no two frames are the same with potential quality issues.

Furthermore, it takes 18 months for new product introduction; the design process is trial and error due to lack of software tools; they then have the frame made, evaluate with feedback, change the fibre orientation and layout, and go through 15-20 iterations before settling on the performance that they like. In our case, the very first bike frame design that we did in 18 days met the design and performance needs. All those variations were done in the software rather than in physical manufacturing.

In the case of the composite bike frame industry, AREVO is leading the transformation of global manufacturing, enabling neighbourhood bike shops to make custom bikes on demand. Conscientious modern consumers care where and how their parts are made. A unique bike, hyper-customised to their size, design, and comfort, has not been possible until now. It's a new paradigm and it's really exciting.

WHY IS CFRTP THE BEST MATERIAL?

Compared to thermoset (TS) material dominantly used today, CFRTP is recyclable, doesn't have limited shelf life, and doesn't require refrigeration for storage. It doesn't require secondary curing operation in an oven, which is energy intensive. All of these mean a more sustainable, efficient, and cost-effective production. Furthermore, from an engineering performance point of view, TP is tougher and not as brittle. So, in an impact, TP will perform a lot better than TS.

WHAT CAN TRADITIONAL MANUFACTURERS LEARN FROM AM SO THAT THEIR PRODUCTS ARE NOT LEFT BEHIND?

The adoption of AM will provide a cost-effective and efficient way to replace traditionally made parts, especially in customised volume. Whether for mass production or customised volume amounts, AM is not just about prototyping – this is real production at scale.

Aerospace qualification requirement, for example, is very stringent and takes a long time. A chief composite officer at a major aerospace company came to AREVO to learn about our bike programme and wanted to discuss how we took a bike frame to production in less than nine months. She wanted to understand our process so that the lessons learned can be applied to aerospace applications.

The traditional composite industry is very much compartmentalised into companies supplying material, machines and software, and there is no co-operation or collaboration between them to advance the technology. None of these companies have a complete knowhow to advance the technology, and the software is practically non-existent. The use of composites started about 30-40 years ago when computers were not so fast, and they were expensive. The industry hasn't really changed much in these years but the computation power, however, is abundant and needs to be applied to rethink design and manufacturing through digitalisation. Done right, digitalisation can lower manufacturing costs, achieve scalability, accelerate design processes, and unleash new design power never before realised. This can only be done through a multi-disciplinary approach. At AREVO, we built a team with expertise in computer science, material science and robotics under one roof to develop the technology that is transforming the traditional industry.

Taking the seat bracket again as an example, traditional technology would have taken two years to develop such a part. AREVO shrunk a two-year timeframe into two days with digitalisation. This is what traditional composite industries can learn from AM. Disruption and change are coming. People not willing to change, who continue to do things the old way, will become obsolete.

Aircraft seat bracket. Original manufacturing required four aluminium parts. Arevo 3D printed a single continuous carbon fibre part, taking design to production from two years to two days

Arevo unibody eBike frame of continuous carbon fibre

Malta: Not just for holidays

THE PICTURESQUE ISLAND OF MALTA PRIDES ITSELF ON BEING ONE OF THE PREMIUM EUROPEAN HOLIDAY DESTINATIONS, HOSTING OVER 2.6 MILLION VISITORS IN 2018. YET, BEYOND THE HOTELS AND HOTSPOTS, IT IS A HIVE OF INDUSTRY.

One of the major manufacturing firms in the country is a Trelleborg Sealing Solutions facility producing hundreds and thousands of polymer seals per day.

Trelleborg Sealing Solutions is a business area of Trelleborg Group, the almost $4bn (~€3.6bn) global polymer expert. While other manufacturing firms may turn away from European production, Trelleborg focuses on establishing a global-local footprint that means it retains significant sites within what some would deem high-cost locations. It produces in these effectively by investing in innovative processes and manufacturing excellence techniques. The Malta facility is a case in point.

At its location in Hal Far, the Trelleborg Sealing Solutions facility in Malta may perhaps have one of the most breath-taking views of any industrial complex in the world. Yet, behind its traditionally washed walls lies one of the leading manufacturing facilities in the Trelleborg Sealing Solutions manufacturing network. Focusing on the technical performance and quality assurance of the customised engineered sealing solutions it provides, the facility offers its customers from the automotive, agricultural and high-tech semiconductor industries, a full service, from product development, tool design, seal manufacture and after sales support.

The main seal materials used in production are elastomers including FKM, HNBR, EPDM and NBR. The material selection has recently been added to with the introduction of multi-component manufacturing in engineered plastics, including Nylon PA66, PPA and PPS.

Production is divided into dedicated manufacturing cells for each application and include compression and injection moulding, with integrated machine data capture in key areas. With more than 50 machine vision inspection machines, every part meets the highest specification.

In addition, the company has its own materials mixing and R&D facility, alongside in-house tool design, rapid prototyping, cleanliness testing and coating of parts in PTFE. This includes the innovative Seal-Glide Nano, which, at just a few hundred nanometres, is 10-50 times less than typical coating thicknesses. Despite the thinness, the coating significantly reduces the friction coefficient of elastomer seals and improves their stick-slip properties considerably.

High investment has been made over the last few years in a 3D printing laboratory. Over this time the lab has experimented with what can and cannot be achieved, gradually moving toward the use of more demanding materials and complex designs.

The 3D printed parts are regularly used for what Trelleborg calls 'show and tell' samples. This has transformed its customers' product development processes with large products scaled down and brought into a meeting room, or tiny products enlarged, helping designers visualise functionality and fit.

And what next? Always looking to the next big thing, like other Trelleborg Group facilities, the Malta facility is grasping the opportunities that Industry 4.0 developments offer. This is mainly influencing production processes with machine data being captured in key areas to provide the manufacturing floor with visual machine performance statistics in real time, visible to all operators.

So, if you are exploring Malta this summer, bear in mind that not far from your sun lounger millions of seals critical to your car or electronic equipment are being made.

> **The material selection has recently been added to with the introduction of multi-component manufacturing in engineered plastics, including Nylon PA66, PPA and PPS**

COMPANY CAR

WHEN EPPM HEARD THAT POLYKEMI'S AREA SALES AND MARKETING MANAGER ULRIK NILSSON WAS AN AMATEUR RALLY DRIVER IN HIS SPARE TIME, EDITOR ROB COKER GOT IN TOUCH TO FIND OUT MORE.

WHO OR WHAT INSPIRED YOUR LOVE OF MOTORSPORTS?

My older brother got me involved back in 1971 when I was seven. He was helping out a friend at a rally event and after begging him to take me along, he eventually did – that was my first ever event and I was told to sit in the back and keep my mouth shut.

I was almost 35 when I began to race because, as you can imagine, the costs involved are high for a hobby.

DO YOU DO YOUR OWN VEHICLE MAINTENANCE OR DO YOU HAVE A TEAM OF ENGINEERS?

I'm driving a 1991 Volvo 940, which is so simple that normal maintenance is done together with my co-driver, brother, nephew and by me, who comprise Team Nilsson R-Sport. It looks as good as a rally car with all the mandatory safety features, but drive-train parts are totally standard. If the gearbox breaks down, for example, I can go to the scrapyard and buy a second-hand replacement for €100. A specialised one could be €10,000. It's the cheapest way to rally in Sweden

HOW MANY RACES?

During a really good year/season we do maybe 10 events. I'm 55 now but I haven't been at it for 20 years consecutively, there have been intermissions, but easily 100 races locally. I don't compete on the national level, just in regional events.

HOW MANY VICTORIES?

I could count those on one hand but the most recent was at the end of April this year. Normally, I end up in the middle, doing it for the joy of rallying rather than competing. It's just fun and I do it to keep my family together; it's a great way to spend time together on maintenance, etc.

HOW IS POLYKEMI INVOLVED?

I've been working for Polykemi for over 20 years. It took a while before I could get the management involved because the company already sponsored other activities within the CSR system. I eventually piqued their interest when I asked our MD to be a co-driver. Normally, an experienced co-driver is required but in some small clubman events you can have a VIP co-driver. The MD said no but added, jokingly, that I could ask his wife, so I did – she agreed, and the rest is history. Polykemi's headquartered in Ystad, in Skåne County. Just north of here is one of the main plastic producing areas in Sweden, so it's good to drive a car with a Polykemi logo there – this may also have played a part in getting sponsorship.

WHICH POLYKEMI PRODUCTS ARE USED IN MOTORSPORT AND ENGINEERING?

Polykemi produces PPS for the automotive sector but not so much in motorsports, where every gram of weight is chased for optimum strength and performance. Polykemi does, however, produce lots of engineering plastics for automotive applications. One example is scratch-resistant PP-based compounds for interior parts for Scania trucks.

HOW DOES THE HOBBY COMPLEMENT THE PROFESSIONAL LIFE?

It's a perfect way to keep your mind off work. There is no time to think of customers or projects; it's a relief to have something like this in your life. It enables me to escape and focus on something else, for a little while anyway. You have to do something else in your spare time that benefits you on a long-term basis.

Polykemi is a Sweden-based custom-designed plastic compound producer and family business with subsidiaries and offices in Denmark, Germany, Czech Republic, China and the US.

EUREKA SPECIAL

Kevlar now has more than 200 applications

To mark five years since the death of polymer pioneer Stephanie Kwolek, EPPM takes a brief look at her achievements in this Eureka! special

Stephanie Louise Kwolek, an American of Polish heritage, took a temporary role as a chemist at DuPont's Buffalo facility in 1946 with the aim of raising money to study medicine. The position had become available as many men were still overseas following WWII. Her assertion, by her own admission, helped her to land the role after convincing the interviewer – William Hale Charch, the father of modern food packaging – to make the decision sooner than the fortnight indicated. 40 years later, Kwolek retired having become the first woman to win the company's Lavoisier Medal for outstanding technical achievement, as well as multiple awards for her work in polymer chemistry, including the National Medal of Technology, the IRI Achievement Award, and the Perkin Medal. In 1995 Kwolek became only the fourth woman to be included in the US National Inventors Hall of Fame.

Stephanie Kwolek

Perhaps her outstanding contribution to the plastics industry was the invention of the first of a family of synthetic fibres of exceptional strength and stiffness known as poly-paraphenylene terephthalamide – more memorably known as Kevlar.

Created in 1964 whilst the company anticipated a gasoline shortage, and thereby sought alternative materials with which to manufacture tyres, Kevlar now has more than 200 applications from sporting goods, mobile phones and protective clothing, to fire, bomb and bullet-proof equipment in the defence and security sectors.

Whilst considering the number of lives saved with her invention, Kwolek said: "I don't think there's anything like saving someone's life to bring you satisfaction and happiness."

The breakthrough moment came for Kwolek after learning that large numbers of polyamide molecules line up in parallel under certain conditions, forming liquid crystalline solutions that can be spun directly into oriented fibres. These polyamide solutions were both new and unique in DuPont's laboratories. Fluid, turbid, and opalescent when stirred, the spinning equipment specialist refused to spin the first solution fearing that the turbidity was caused by particles that would clog the spinneret. Perhaps again due to Kwolek's persuasive assertion, the spinner conceded, span, and witnessed the development of Kevlar.

Kwolek never profited directly from the ultra-strong lightweight material, having signed over the patent royalties to DuPont. She did, however, go on to lead the polymer research team, obtaining 17 individual patents and a further nine collaborative patents before retiring in 1986 to inspire and mentor young women interested in STEM subjects.

She died on 18 June 2014, aged 90.

> **"I didn't shout 'Eureka!' but I was very excited, as was the whole laboratory ... we were looking for something new – something different – and this was it**

Fine China

THIS YEAR'S CHINAPLAS TRADE FAIR WAS THE BIGGEST IN THE EVENT'S HISTORY. HERE'S WHAT SOME OF THE EXHIBITORS AND SPEAKERS HAD TO SAY.

UK DEPARTMENT FOR INTERNATIONAL TRADE (DIT) DEPUTY DIRECTOR FOR INNOVATION AND INDUSTRY DANIAL SHAIKH:
"DIT was pleased to work with the BPF in supporting the high-quality delegates attending Chinaplas in Guangzhou. The innovation and enthusiasm of the companies was very impressive and our teams across China stand ready to support them in pursuing the business leads that were generated."

EUROGRAV SALES MANAGER MARK RICHARDSON:
"Chinaplas provided an excellent platform for not only making our first major contracts in the Chinese market, but also allowed us to find agents and distributors in other nearby Asian and Southeast Asian markets."

CHEMTRADE ROTH GMBH MANAGING DIRECTOR PETRA HILBERT:
"Chinaplas gathers exhibitors from all around the globe. Although our company has some material suppliers from China already, I can find more at the show. Meanwhile, I can also meet many European suppliers."

DAVIS-STANDARD VICE PRESIDENT BUSINESS DEVELOPMENT, ASIA PACIFIC, SEKARAN MURUGAIAH:
"Chinaplas 2019 provided valuable networking opportunities and sales potential for Davis Standard's business in the region, specifically in China. We gathered insight and perspective regarding the tariff situation with the US, quietly concluding that the Chinese government will not allow Chinese investments in the US market to be impacted by potential tariff increases. The show was professionally managed and we had several key visitors at our booth. We are pleased with the outcome and look forward to the next show."

WITTMANN-BATTENFELD AREA SALES MANAGER FOR ASIA FLORIAN HERBST:
"We were very pleased with the amount and quality of visitors at Chinaplas 2019, especially when taking into account the current economic situation in Asia and in the rest of the plastics world. We had increased contacts from SEA, India and the Middle East at our booth. We do have a lot of contacts and projects to follow up on. This leaves us with a positive anticipation for K-2019 in Düsseldorf."

THORSTEN KÜHMANN, MANAGING DIRECTOR OF VDMA PLASTICS AND RUBBER MACHINERY
"We very much appreciate that Adsale at Chinaplas takes up the important topics of the time with the accompanying conference on Circular Economy – an event with a very good response. The bad image of plastics will continue to keep us busy, we will certainly see this at K 2019 as well."

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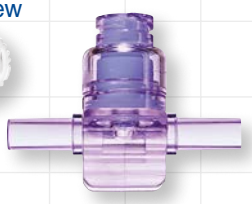

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with Dilator

99781
4-Way Stopcock
2 FLLs, Swivel MLL

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61212 NEW!
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Barbed

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- Does not require any changes to the rubber formulation or changes to the counter surfaces that comes on contact with the textured seal.
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(*) For example: DDDR 30_200_200_2.5 = Depth:30μm , Dimple Diameter:200μm , Distance:200μm, Roughness:2.50 Ra

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This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement Nº 760680. Programme of the European Union.

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