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LATEST IN FABRIC FORMATION TECHNOLOGIES

Ahead of the forthcoming Techtextil exhibition in Frankfurt from June 21-24, JEC World, held in Paris from May 3-5, highlighted how the composites industry has influenced many recent advances in fabric formation technologies for technical textiles. A report.

by **ADRIAN WILSON**

Innovation in fabric forming techniques over the past 20 years has been significantly driven by the need for advanced reinforcements and structural components for the composites industry.

3D weaving, braiding, multiaxial knitting, and most recently, automated fibre placement (AFP) and automatic tape laying (ATL) are technologies which are all now being widely employed in this field, with a major aim being to reduce waste – especially with expensive carbon fibre.

Around 20,000 tons of waste is generated each year during the production of carbon fibre composites and in many hand lay-up processes that use carbon fibre woven material, for example, waste material can easily account for 50 per cent or more of the total carbon used. Some of this waste is generated as the fabric is initially being cut before impregnation with the matrix material. Additional waste is generated after the composite has been cured and during the post processing steps where the shape of the final part is further refined.

Such carbon fibre can be a valuable material for recycling, but it is obviously preferable not to create the waste in the first place.

By building up multiple layers of fabrics into pre-forms to be as close to the shape of the desired final

GE AVIATION

The LEAP Engine: The fan blades and fan case of the LEAP engine are made from 3D woven carbon fibre by AEC at its plants in Rochester, Commercy in France and Queretaro, Mexico.

composite component – known as 'near-net shape' structures – considerable material savings are achieved.

Carbon fibre is also an isotropic anisotropic material, which means that all fibres in a single layer have to point in the same direction as the force-lines through the material. This is something that is being greatly exploited in built-up reinforcement structures.

The density of carbon fibre is also considerably lower than that of steel, making it ideal for applications requiring low weight, and this has ensured its continuing success in aerospace applications.

LEAP

3D carbon weaving, for example has been pioneered by companies like Albany Engineered Composites (AEC), a division of Albany International, headquartered, in Rochester, New Hampshire, in its work on the highly successful LEAP engine for Airbus and Boeing.

The fan blades and fan case of the high-bypass turbofan aircraft engine are made from 3D woven carbon fibre by AEC at its plants in Rochester, Commercy in France and Queretaro, Mexico.

Unlike conventional laminated composites, which are usually only reinforced in the plane of the laminate, or metallic alternatives, AEC's 3D engineered composites are reinforced in multiple directions, including the through thickness direction.

This enables a component to be designed, for example, to provide increased shear strength in one area and increased axial stiffness in another.

By controlling the fibre architecture in this way, the company is able to engineer components that meet specific performance goals while simultaneously satisfying component cost, qualification, certification, and eventual production needs.

With contour weaving, either single or multi-layer 3D woven axisymmetric structures with contoured cross-sectional profiles can be manufactured so that the final woven preform shape is similar to that of the final component (near-net shape). AEC can also 'steer' reinforcement fibres to turn and follow the natural geometry of a part.

These advanced weaving techniques both reduce part production costs and improve the structural performance of the final product.

IMPROVEMENTS

The LEAP engine is manufactured by CFM International, based in Cincinnati, Ohio – a joint venture between GE Aviation, of Evendale, Ohio, and Snecma (Safran), of Courcouronnes, France.

From its launch in 2008, the engine provided double-digit improvements in fuel consumption and CO_2 emissions compared to previous models, along with dramatic reductions in engine noise and exhaust gas emissions.

By 2018, there was an eight-year backlog for LEAP engines and AEC was on course to produce more than 40,000 fan blades and 2,000 fan cases a year by 2020 for them.

However, in March 2019 the Boeing 737 MAX passenger airliner was grounded worldwide due to safety concerns, followed less than a year later by the COVID-19 pandemic, which left many more planes standing for considerable periods.

CELC

NATURAL FIBRE VILLAGE

The European Confederation of Flax and Hemp (CELC) showcased the high-performance properties of flax and hemp in a specially created Natural Fibre Village at JEC World 2022.

These lightweight natural fibres can provide benefits such as high specific stiffness, fatigue performance, impact resistance, thermal insulation, acoustic performance, radio transparency and vibration damping, which can be engineered to create structural and semi structural composite parts.

In the Natural Fibre Village, CELC members exhibited a range of products that have been specifically optimised for industrial scale applications – from automotive interiors to bio-composite building facades, bio sourced panels and motorsport components.

Among highlights was the first natural fibre reinforced satellite panel developed by Bcomp working with the European Space Agency (ESA). It was based on Bcomp's powerRibs and ampliTex sustainable lightweighting fabrics, and meets ESA's technical readiness standards for the space environment.

As a consequence, in 2020, GE Aviation is reported to have lost 1,900 orders for the engine with a value of $13.9 billion, while more than 1,000 Boeing 737 Max orders were cancelled.

RECOVERY

As expected for AEC, sales and profits declined as the commercial aircraft supply chain destocked, but the company executed a deliberate plan to be ready to efficiently re-ramp its LEAP components production as the commercial aviation markets recover.

In 2022 so far, all the signs are that this is now happening. In March, for example, CFM International reported a new contract with UK-based Jet 2 for up to 150 LEAP engines to power its 75 Airbus A321 NEO aircraft.

In April, Air France-KLM further entered into negotiations with CFM International for the acquisition of up to 200 LEAP engines to power its new fleet of Airbus A320neo and A321neo aircraft.

AEC is also aiming to diversify the uses for its 3D woven carbon structures and is already working with customers on parts for unmanned, hypersonic and electric vehicles, as well as providing automated fibre placement (AFP) composite wing skins for the Lockheed Martin F-35 joint strike fighter and complex components for the Sikorsky CH-53K helicopter.

PIONEER

3D weaving machines have been pioneered by Lindauer Dornier, of Lindau, Germany, which has its roots in the aerospace industry. A dedicated division – Dornier Composite Systems – was formed in 2016 in response to growing demand from the composites industry.

A hundred years ago, the company has pointed out, all aircraft were constructed from composite fibre materials based on natural wood and coated with woven cotton fabric, reinforced with piano wire.

More than 90 years ago, it was Professor Claude Dornier who opted to replace these materials with more expensive and heavier aluminium, but in 1973 the Alpha Jet, designed by the French military aircraft specialist Dassault with the help of Dornier, saw the return of composites, with series-produced structural components made of carbon fibre. The basic material was a carbon fabric produced on a Dornier rapier weaving machine.

Today, 90 per cent of all woven carbon fibre fabrics worldwide are estimated to be manufactured on Dornier rapier weaving machines, with up to 80 per cent of the structural parts on the latest aircraft consisting of reinforced carbon fibre composites.

POSSIBILITIES

Dornier's 3D Jacquard weaving technology significantly expands the possibilities for the production of reinforced, multiple layer semi-finished structural woven parts.

It is also possible to weave flat textiles and unfold them, such as in the creation of 'I-beam' structures which can be woven endlessly as the basis of parts with extremely long lengths.

The advantages of such fabrics are that the layers are fully connected, which means there is no possibility of delamination, and the near-net shape is realised without the pre-forming stages that would otherwise be required.

The thick structures which can be produced cannot be wound like thinner conventional fabrics. So, Dornier has developed a horizontal take-up system which pulls the fabric out of the machine using two independent clamping bars.

Dornier 3D weaving: Today, 90 per cent of all woven carbon fibre fabrics worldwide are estimated to be manufactured on Dornier rapier weaving machines.

A.WILSON

AMRC

Herzog braiding machine at the Advanced Manufacturing Research Centre (AMRC) in Sheffield, UK.

PROTOS AND TRITOS

Dornier's latest machines for manufacturers of composite preforms include the PROTOS – *polymer and roving to sheet* – and the TRITOS – *textile roving into three-dimensionally oriented structure.*

The latest P2 roving rapier weaving machine for the production of high-performance fabrics made of carbon, glass and aramid fibres meanwhile benefits from a higher frame stiffness and improved filling insertion performance, as well as the maintenance-free, patented Dornier SyncroDrive drive concept and an optimised positive centre transfer.

According to product manager Michael Langer, the P2's improved shed geometries ensure an absolutely symmetrical warp thread path, which means that carbon fabrics can now be produced even more reliably.

BRAIDING AND WINDING

As a result of COVID-19, the textile machinery branch of Germany's VDMA – the Frankfurt-headquartered mechanical engineering industry association – has held no less than 30 online webinars showcasing the technologies of its members.

The association has a number of member companies providing essential services to the technical textiles and composites sectors, such as Eschwege-based Georg Sahm, which manufactures winders and automated bobbin handling systems designed for effectively dealing with high performance fibres. These include aramids, ultra-high molecular weight polyethylenes (UHMWPE) like Dyneema, Vectran fibre, which is spun from liquid-crystal polymers (LCPs), glass, polytetrafluoroethylene (PTFE) and polyvinyl alcohol (PVA) coated yarns, and especially carbon.

Such fibres form the basis of products such as bulletproof vests, helmets and other personal protection equipment (PPE), as well as automotive components.

In addition, Georg Sahm, which is part of the Starlinger Group, produces special winders for monofilaments and tapes for end-use applications such as carpet backing and artificial turf, geotextiles, filters, sunshade fabrics and nets.

According to business development manager Bena Manasieva Cavus, effective winding is an essential component in the high-speed production of such high strength fibres, with each specific fibre requiring special attention and having certain weaknesses.

"Aramid is not strong against UV for example, and Dyneema doesn't like water," she said.

To compensate, Sahm has developed the YarnStar 3+ system for high-speed unwinding, coating, cooling and winding, to add functionality such as hydrophilic/phobic, antibacterial or flame retardant properties, colour flexibility and softness/hardness.

PARTNERS

Georg Sahm has been long established in the processing of carbon fibres for the composites industry, with solutions for Polyacrylonitrile (PAN) precursor yarns, carbon fibres, prepregs and towpregs.

Consequently, the company frequently partners with Oldenberg-based Herzog, which is a global leader in the braiding technologies which are widely employed in the creation of near-net shape carbon preforms – 3D textile structures as close to the shape of the final finished component as possible – with key customers in the automotive industry including BMW, Mercedes and Porsche. Suppliers to Airbus and Boeing are likewise partners for aerospace components.

Herzog managing director Janpeter Horn – the current chairman of the VDMA Textile Machinery Association – explained that while braiding looks complicated, it is really quite simple, involving the building up of three, four or more yarns in oblique directions to their edges.

"It's a two-step process exploiting centrifugal forces to create structures with unique characteristics, which can have high flexibility and high torsion stability under load," he said. "The fibres are secured by interlocking with equal load division throughout the length of the product in both biaxial and triaxial configurations. There are so many markets for these braided products that we have delivered more than 550 types of customised machines to over 60 companies."

In addition to composite preforms, two other key growth areas for braided textiles are ropes and medical products.

REPLACING STEEL

"The ability to replace steel with high strength fibres such as aramids, Dyneema and Vectran has resulted in ropes that have 75 per cent less weight with all of the advantages that brings in terms of towing, mooring, anchoring and lifting and lowering," said Dennis Behnken, Herzog's head of sales. "In addition, ropes made from these fibres have ten times the working life of steel equivalents."

To further enhance high strength fibre braided ropes, Herzog has developed a temperature-controlled heat setting unit which can be integrated directly into its braiding lines to further enhance the physical properties of the rope structures.

In medical products such as sutures, artificial ligaments and stents, braided fabrics are increasingly the preferred choice for their flexibility in terms of the customised shapes and patterns that can be achieved and the specialised fibres that can be accommodated.

WIND POWER

In 2019, LM Wind Power in France unveiled what is currently the world's longest wind turbine blade at 107 metres. Offshore wind power generation is becoming more efficient and cost-effective all the time, primarily as a result of the longer wind turbine blades that are now being manufactured.

Contributing to this success story are the sophisticated textile structures of glass, carbon and aramid fibres produced on multiaxial warp knitting machines – often referred to as non-crimp fabrics – as reinforcements for the composite wind blades.

In the multiaxial system, layers of unidirectional reinforcement material – yarns, strands, tapes or rovings – are stacked and oriented by means of a weft insertion system in predetermined directions that can vary widely between 0° and 90°. As such, the fabrics can be unidirectional, biaxial, triaxial or quadaxial, laid down in separate layers known as 'plies'. Additional stitching yarns applied by the system bind the layers together to prevent slippage and other reinforcing materials such as chopped strand mat can be added to the multiaxial structure during the manufacturing process.

According to the latest report from AVK, the German Association of Reinforced Plastics, the market for non-crimp fabrics has grown by almost 40 per cent over the past ten years, from 220,000 tons in 2011 to 302,000 tons in 2021, with the key end-use markets being wind energy, in addition to boat and ship building.

PLANT 17

A leader in the production of multiaxials for the wind power industry is Saertex, headquartered in Saerbeck, North Rhine-Westphalia in Germany, which has just opened its 17th plant in Ciudad Juárez, northern Mexico.

The company, which has annual sales of €350 million and around 1,400 employees, is a specialist in the manufacture of multiaxially knitted fabrics, as well as core materials for the production of fibre-reinforced composites.

In addition to the wind power industry, Saertex supplies them to customers in the aerospace, automotive, sports and boat building industries to achieve lighter weights, enhanced stiffness and corrosion resistance in composite components.

Saertex has delivered more than 3,000 separate multiaxial designs. Depending on the fibre type, surface weight and angle combination, they provide specific mechanical characteristics, and are individually configured for customers to be optimally adapted to a range of subsequent composite manufacturing processes such as vacuum infusion, RTM (resin transfer moulding), pultrusion, prepregging, compression and more.

REGIONAL NETWORK

"Our strategic goal is to ensure our customers benefit from a reliable supply chain coupled with regional, sustainable sourcing via our production network," explained Christoph Geyer, Saertex Group CEO. "Our new site in Ciudad Juárez represents an important milestone for achieving sustainable cooperation with our customers in the composites industry, including the wind sector, which is strongly represented through its rotor blade manufacturing facilities in Mexico. By strategically shifting manufacturing capacity from the US to Mexico, we are simultaneously strengthening our US plant in Huntersville, North Carolina, which is now able to focus on our emerging business in the field of industrial applications."

Wind power generation is becoming more efficient primarily as a result of the longer wind turbine blades that are now being manufactured.

LM WIND POWER

CAPACITY

Another key supplier of multiaxial fabrics is Istanbul-headquartered Metyx, which has rapidly responded to the growth of the wind industry in both Greater Europe and the US.

Five years ago, the company installed 12,000 tons of annual multiaxial knitting capacity at its main plant in Manisa, Turkey, and in 2019 added a further 11,000 tons of annual capacity at its plant in Ranlo, North Carolina.

Metyx has developed an extensive range of multiaxial non-crimp glass and carbon fibre technical fabrics for reinforcing wind turbine composite parts including the spar caps, shear webs, blade shell and root segments, nacelles and spinners.

The company's multiaxial warp knitting technology was supplied by Germany's Karl Mayer, the leading manufacturer of warp knitting machines and now, following its acquisition of Stoll, of flat knitting machines.

COP MAX 4 AND 5

Karl Mayer's Technical Textiles business unit, which continues to expand its portfolio, makes two key machines for this production:

- The Cop Max 4 for the manufacture of multi-layered, multiaxial fabrics with ply orientations of between +20° and −20° from continuous filament yarns of glass, carbon and aramid fibres.
- The Cop Max 5, designed especially for the production of lightweight multiaxial fabrics made from carbon fibres.

In addition, the company manufactures the Wefttronic II G for warp-knitted fabrics with weft insertion, while the Sim.Ply UD unit efficiently produces fibre composite tapes with continuous fibre reinforcement and thermoplastic matrix systems, while operating with uninterrupted process control at extremely high production speeds.

FORCES

For the production of rotor blades for wind turbines, the Cop Max 4 produces multiaxial textiles which are able to withstand enormous forces.

Premium-category wind turbines have a power rating of 6.1 MW and a rotor diameter of 126 metres, on which a centrifugal force of roughly 1.1 MN is exerted at a wind speed of 14 m/s. For comparison, 1 MN corresponds to the weight force of 70 small cars. On the Cop Max 4, the starting material is inserted using two laying devices at angles of 80 degrees in each case.

FLAX

At the 2022 JEC World show, Karl Mayer highlighted developments in more sustainable raw materials, with new solutions for composites made from flax on the Cop Max 4.

"We have been focusing on this topic for about two years," said Hagen Lotzmann, sales manager at Karl Mayer Technical Textiles. "As a renewable raw material, flax is a sustainable alternative to glass and carbon, which can only be manufactured using a great deal of raw materials and energy."

Similarly, Saertex has just announced a partnership

Flax yarns being laid at angles on Karl Mayer's Cop Max 4.

KARL MAYER

with Normandy-based Terre du Lin – one of the world's largest suppliers of flax fibres.

AUTOMATIC FIBRE PLACEMENT

Finally, over the past few years there has been a notable growth in the commercialisation of new automatic fibre placement (AFP) and automatic tape laying (ATL) systems for the rapid and accurate positioning of technical fabrics, generally based on carbon fibres as reinforcements, often in complex geometrical plies and 3D shapes.

AFP equipment has become significantly faster and more reliable in recent years and now that it has been proven for a variety of parts, many companies are considering AFP equipment to replace their existing processes.

In addition to speeding up processes, AFP has the appeal of significantly reducing waste.

AFP systems have been in operation for some time within the highly automated aerospace and automotive industries, but until recently, adoption of the technology has been limited to only the biggest corporations due to the high costs involved.

Now, however, commercial 'off-the-shelf' systems and variants such as automatic tape laying (ATL) and fibre patch placement (FPP) have been introduced by European technology developers such as Cevotec and Voith of Germany and Mikrosam of Macedonia.

CEVOTEC

Headquartered in Munich, Germany, Cevotec calls the process carried out by its Samba system FPP, involving the dry fibre preforming of complex 3D shapes and load-path-oriented reinforcements.

FPP enables the fully automated production of such geometries in a continuous process, from virtual design to the fibre preform.

The Samba unit has been designed to allow a precise orientation of each patch to achieve perfect fibre architecture in complex load conditions, for increased strength and stiffness. In addition, it significantly reduces scrap and eliminates additional forming processes through 3D near net-shape preforming.

The Samba Multi is for multi-material that usually require a lot of time-consuming and cost-intensive manual lay-up work.

Sandwich structures employed in aircraft construction for example, can include carbon and glass fibre, as well as adhesive films and aluminium honeycomb cores.

The development of the Samba Multi is in response to the demand for automated lay-up processes for such parts. It is based on the FPP technology and features parallel feeding units for different materials to be processed and placed precisely on 3D sandwich cores and lay-up moulds. By mounting the placement robot and feeding unit on a linear axis, the concept also enables the production of particularly long and wide components in aerospace applications.

CEVOTEC

Cevotec's Samba's fibre patch placement system effects the rapid build-up of complex 3D shapes and load-path-oriented reinforcements.

Artist Studio is the company's CAD-CAM software platform which allows production preparation to be significantly shortened for the rapid creation of production data relating to the introduction of new parts. It consists of two modules: Patch Artist creates patch-based high-performance preforms with the help of powerful, proprietary algorithms, while Motion Artist navigates the preform architecture for an automatic and collision-free offline programming of the Samba system's two interacting robots.

Cevotec is a spin-off from the Technical University of Munich and partners with the European Space Agency (ESA) and Airbus.

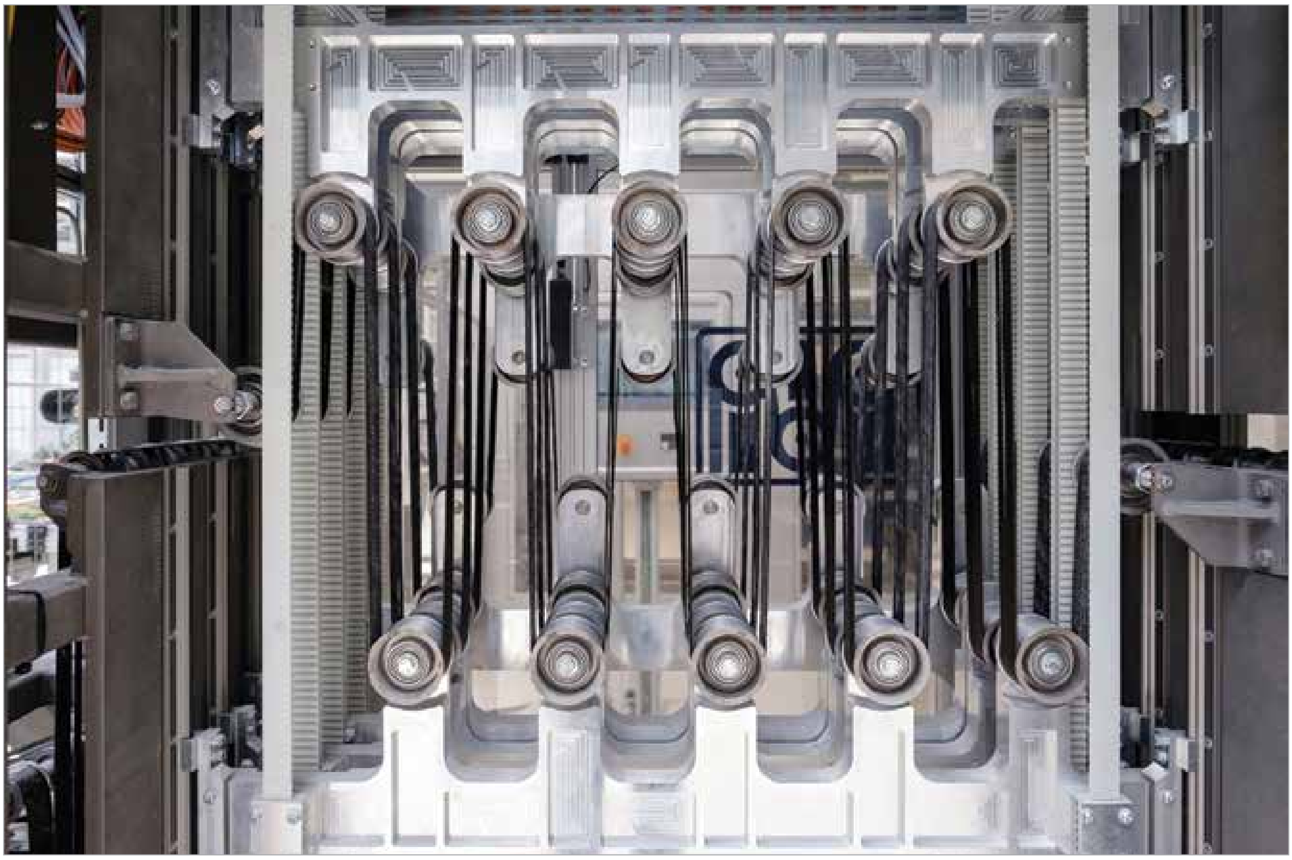
VOITH

Voith Composites, of the Heidenheim, Germany-headquartered Voith Group, has developed the Voith Roving Applicator (VRA), another AFP technology.

The VRA has been designed to make near-net-shape dry preforms directly from carbon fibre roving, with almost no waste. The carbon fibre roving is spread to form a 50 mm wide tape which can be placed at any angle to produce a 2D multiaxial preform optimised to the mechanical requirements of the part. The VRA can deposit four tapes simultaneously and the tape width is assured by an online camera which measures transmitted light.

Spreading heavy carbon tows into tapes has become an effective way of preparing it for processing, to ensure the unidirectional structure of the fibres is maintained without the twist introduced in conventional yarn manufacturing.

By using the Voith Composites direct fibre placement process, semi-finished products such as multiaxial fabrics or woven textiles which then have to



On the Voith VRA, the carbon fibre roving is spread to form a tape which can be placed at any angle to produce a 2D multiaxial preform optimised to the mechanical requirements of the part.

be laid in plies and shaped are completely eliminated. Automating the preforming process, which is often a manual activity, increases efficiency, and in achieving a near-net shape, subsequent processing requirements are minimised. These factors combine to deliver increased production rates and reduced costs.

The preform produced by the VRA is loaded into a stack carrier by robot and moved to a draping tool, where the approximate form of the part is introduced. The next step is a high-pressure resin transfer moulding (HP-RTM) press where epoxy resin is injected and the part is cured. The cured part is transferred to a milling machine for finishing and drilling of holes, and then washed to remove any dust. All the machines are connected by Voith's Manufacturing Execution System (MES).

Voith Composites is already manufacturing carbon fibre-based rear bulkheads and parcel shelves for the Audi A8 on a VRA machine at its site in Garching near Munich, following some years of collaboration with the auto maker.

Voith and Audi announced their collaboration to develop an automated manufacturing process suitable for high volume production of carbon fibre reinforced plastic (CFRP) components in 2011. Voith received its first order from Audi in May 2015 and the new production line at Garching was commissioned in September 2016.

MIKROSAM

Another company involved in this area of technology is Mikrosam, based in Prilep, Macedonia, where its smart laboratory is equipped with all the machines and additional equipment necessary for designing and manufacturing composite materials and structures using ATL and AFP technologies, in addition to filament winding, prepreg making and prepreg slitting and rewinding.

Among variants of these technologies, Mikrosam has developed a unit that integrates heads for both AFP (intended for thermoset composites) and ATL (for thermoplastic prepregs) in a single robotic cell.

Advanced parts – whether flat or highly contoured – can be produced with automated computer-controlled placement of both UD carbon or glass and epoxy slit tapes and thermoplastic prepreg tapes. The temperature of the thermoplastic material is controlled via a compaction surface laser with a heating temperature up to 400°C integrated to the ATL head, and an infrared method heating the surface up to 100°C.

The automated fibre/tape placement manufacturing processes are enabled by Mikrosam's own tools – MikroPlace, an intelligent machine-independent software for off-line programming, design, simulation and analysis, and MikroAutomate, a software system for online process control and data acquisition tailored to the specific needs of AFP/ATL production.

The company has also developed a hybrid AFP and filament winding solution to exploit the advantages of both technologies.

MIKROSAM

Mikrosam AFP system: Advanced parts – whether flat or highly contoured – can be produced with automated computer controlled placement of both UD carbon or glass and epoxy slit tapes and thermoplastic prepreg tapes with the Mikrosam AFP system.

NACELLE

Greenboats, based in Bremen, Germany, has meanwhile developed the first offshore nacelle manufactured with natural fibre composites.

By incorporating the ampliTex flax reinforcements, balsa wood cores and bio-based resins, the nacelle's construction saves approximately 60 per cent CO_2 equivalent and reduces energy consumption by over 50 per cent compared to a nacelle made with existing glass fibre reinforced plastic (GFRP) technology.

In addition to the lower CO_2 footprint, the natural fibre composite structure also introduces viable options for the end of the product's life – an issue of increasing concern for the wind energy sector.

In December 2021, the Greenboats nacelle was delivered to customer Delft Offshore Turbine (DOT) and has initially been installed onshore to undergo an intense testing programme. Once this first series of tests is completed, the nacelle will be transported to a permanent offshore location.

FLOWER INTERREG

Lower cost flax preforms and reinforcements for the composites industry were developed in the 56-month Flower Interreg Project which commenced in February 2018.

The €4.6 million French/UK project, funded by the European cross-border Interreg cooperation programme and the European Regional Development Fund (ERDF), has brought together the University of South Brittany, INRA in Nantes, the University of Cambridge and the University of Portsmouth, and industrial partners EcoTechnilin, Howa-Tramico, Kaïros and Teillage Vandecandelaère.

One notable development is the Kairlin monolithic and sandwich structures made from flax and PLA which are recyclable and compostable, allowing point-of-sale and signage displays to be produced and recycled with low environmental impact. The panels are light weight and easy to machine, with a controlled thickness and mirror-like surface finish.

At each stage of the life cycle, from flax cultivation to end of life, Kairlin panels have been designed and validated at an industrial scale and are produced within a very short supply chain in Normandy. The panels are processed in a one-shot compression moulding step with a very short processing time at low cost.

At end of life, Kaïros Environnement plans to collect the panels, grind them and incorporate them in up to 70 per cent of the raw materials for new Kairlin recycled panels. The company's patented recycling process retains 98 per cent of the mechanical and dimensional properties of the Kairlin panels. The patent relates to strict specifications for the large, stiff and thermoformable panels with controlled thickness, surface and tension properties.

The European Flax label provides composite manufacturers with fully traceable and certified premium-quality flax fibres that are sustainably grown in Western Europe and account for 80 per cent of global production.

INNOVATEC

Innovatec played a key role in the fight against COVID-19 installing new meltblown lines from both Oerlikon and Reicofil for facemask filter in 2020.

NONWOVENS SHOWCASE IN FRANKFURT

Techtextil is a major platform for nonwovens manufacturers, and especially Germany's own major companies specialising in durable materials for technical and industrial end-use applications. The trade fair will underline the leading position of Germany's engineered fabrics industry.

BWF GROUP

Notable German companies include the fifth-generation family-owned BWF Group (Hall 12.1, stand 65) which had annual sales of around €300 million in 2021, with 1,800 employees at 16 plants worldwide.

The company is involved in many industrial niche markets and its range of needlepunched nonwoven materials is one of the widest available from any single source. It is based around four interlinked business units – BWF Envirotec, BWF Feltec, BWF Profiles and BWF Protec.

The group is a leading provider of filter media primarily for industrial filtration and today produces over seven million ready-to-install filter media annually. These are supplied worldwide under the brand names Needlona and PM-Tec. Its technical felts also find many often-invisible applications in, for example, the automotive sector, for rattle protection, gaskets, loudspeakers, fittings, glove compartments and oil filters. Nonwoven products for both engine compartments and exterior trim are also supplied, as well as thermoformed parts for interior and exterior cladding. BWF's FireGuard and Fireblocker materials are in addition extensively employed in bus and train seating.

In January this year the group acquired its long-time partner, ACMA, of Barcelona, Spain, to expand its leading market position in air pollution control.

FREUDENBERG PERFORMANCE MATERIALS

Freudenberg Performance Materials (Hall 12.1, stand C51) has all key nonwoven technologies including drylaid staple fibre, wetlaid, spunbonded, meltblown, needlepunched, thermal bonded and hydroentanglement.

The company has recently acquired both Low & Bonar and Filc to further expand its technical textile solutions and among its latest developments, Evolon RE is a more sustainable version of the company's high-performance microfilament nonwoven. It is manufactured from an average of 70 per cent recycled polyester which the company makes by recycling post-consumer PET bottles in-house and available for various applications, including high-tech wiping and technical packaging, in weights currently ranging from 80-300gsm.

Another new product, Colback Plus is a pleatable medium with a built-in filtration capacity layer for use as a carrier in the manufacturing of cabin air, room air and HVAC filters. The well-known performance characteristics of Colback support media – ensuring low pressure drop and high pleat stiffness – is combined with a unique fine fibre technology, creating new capabilities for manufacturing and added value for customers.

A new nonwoven panel with Dripstop – an anti-condensation membrane – has been designed to provide a simpler and more economical way of controlling condensation in metal roofs.

When the temperature and humidity conditions reach the dew point, moisture condenses on the underside of an uninsulated metal roof and if there is a lot of condensation, drops of water form.

The traditional method for dealing with condensation is to try and insulate the roof so that the temperature on the panel never reaches the dew point. The Freudenberg roof panel provides a medium for trapping this moisture in the membrane's specially designed pockets. Dripstop holds the moisture until conditions go back below the dew point and it is released back into the air in the form of normal humidity.

INNOVATEC

Troisdorf-based Innovatec (Hall 12.1, stand C18) played a key role in the fight against COVID-19 in the supply of polypropylene filter nonwovens for use in protective face masks.

During 2020, the company installed new meltblown lines from both Oerlikon and Reicofil to give it a filter media production capacity that can be used to manufacture up to 2.5 billion operating room filter masks or a billion highly effective FFP2 masks per year. The company has also invested in a new Reicofil Bico spunbond line to expand its production of technical spunbond fabrics by 5,500 metric tons.

JOHNS MANVILLE

The technical textile operations of Johns Manville (Hall 12.1, stand D61) include glass fibres, glass fibre nonwovens, polyester spunbond, meltblown and glass fibre wall coverings.

Johns Manville is the market leader in HVAC (heating, ventilation and air conditioning) insulation, providing duct liner, duct board, duct wrap and poly-iso board solutions with superior consistency and quality.

These HVAC solutions are easy to fabricate for faster installation and provide a wide variety of options to both installing contractors and building

Freudenberg's Evolon RE is made from 70 per cent recycled plastic bottles.

FREUDENBERG

occupants. They promote consistent temperatures for less wasted energy and many help dampen unwanted noise and improve the comfort of buildings with improved air quality.

In recent years, Johns Manville has also significantly expanded its proprietary polyester spunbond nonwovens production to support the growing demand for high-end polyester filtration media. Other materials supplied to the automotive industry include pre-moulded shaped mats and boards with special facings, and plain roll goods for lining applications.

During 2021, the company installed a €10 million thermal recycling unit for waste glass fibres at its Engineered Products plant in Trnava, Slovakia to drastically reduce the amount of glass fibre waste that is usually sent to landfill.

NORAFIN

Norafin (Hall 11.1, stand B41) manufactures speciality spunlace nonwovens used in technical applications, including heat and flame resistance barriers used in protective apparel for firefighters, as well as many other applications for the industrial, medical, composite and filtration markets.

The company's recently-introduced Extra Organic brand of nonwoven products for home interiors is based on hydroentangled nonwovens made from natural fibres, such as flax and hemp. Applications include room dividers, acoustic panels and ceiling panels, as well as a wallpaper consisting almost entirely of flax blended with a small percentage of viscose fibres, made from wood pulp derived from sustainably managed forests.

POLYVLIES

The main site of Polyvlies (Hall 12.1, stand C89) in Hörstel-Bevergem now houses 12 lines specialising in natural fibre nonwovens branded Naropur, Narodur and Naroplast, for the automotive and building and construction industries.

Six further lines are in operation across the company's Vitratex glass fibre plant in Saxony, a plant in Slovakia making Polytherm thermally-bonded nonwovens and Polyvlies France in Cernay, specialising in the production and finishing of lightweight nonwovens and specialities.

Two further lines split fifty-fifty between nonwovens made from synthetics such as polypropylene, polyester and polyamide and natural fibres including kenaf, hemp, flax and blends are now operational in Winston-Salem, North Carolina, in close proximity to key automotive customers, who are supplied with products ranging from wheel arch liners, acoustics, underbody trim, headliners and seating to parcel shelves and boot panels and liners.

SANDLER

Sandler (Hall 12.1, stand D50), headquartered in Schwarzenbach/Saale, increased both its revenue and the number of its employees in 2021. With 990 employees the company generated €365 million in turnover in 2021, an increase of 11 per cent on 2020.

BWF is a leading provider of filter media primarily for industrial filtration.

BWF

SANDLER

Among recent introductions to Sandler's expansive portfolio is bluefiber, a new brand of acoustic nonwovens products made from 100 per cent polyester and easily recyclable.

This growth is mainly attributable to the capacity expansion at the company's US subsidiary, Sandler Nonwoven Corporation in Perry, Georgia. In addition, there was double-digit sales growth in technical products.

Among recent introductions to the company's expansive portfolio is bluefiber, a new brand of acoustic nonwovens products made from 100 per cent polyester and easily recyclable. These nonwovens are odourless and, in contrast to other fibrous materials, do not pose health risks.

Bluefiber products are durable and, owing to their open-pore structure, efficiently dampen sound. In comparison with wood or other fibrous materials, polyester nonwovens are also considerably lighter, more resistant to breakage and easier to handle.

TENOWO

With plants in Germany, Italy, the US, Mexico and China, Tenowo (Hall 12.1, stand D83), headquartered in Hof, supplies multiple solutions primarily to the automotive industry based around its eight nonwoven technologies – needlepunch, chemical and thermal bonding, spunlacing, Malivlies, Maliwatt, Kunit and Multiknit.

The company is a specialist in stitchbonded materials, which have been described as being at the centre of where the performance properties of wovens, knits and nonwovens meet.

The specialised nature of the stitchbonding process gives these materials a voluminous fibre structure and they can have appealing surface structures for decorative applications, in addition to offering cost saving options in other applications.

Multiknit stitchbonded nonwovens also offer interesting added value options in seating applications in combination with woven fabrics and both real and synthetic leather, where they provide significant advantages as a carrier material replacing foam. These advantages include superior air permeability, less fogging, recyclability, adequate elasticity of compression, moisture absorption and cost saving compared to conventional sandwich constructions.

Among recent Tenowo developments, Zetaloft+ is a homopolymeric, voluminous and recyclable nonwoven with new acoustic properties. Interesting additional functions can be achieved in the end product thanks to the special arrangement of the fibres and possible thermo-mechanical after-treatments.

A new market for the company is that of recycled carbon fibre nonwovens based on PAN, pitch or cellulose. The carbon fibres can be blended with PP, PET or bicomponents with polyamide and reinforced with PET filament or glass. These fabrics are being supplied in weights of between 100-300gsm as the carrier materials for RTM prepreg and other composite manufacturing processes.

In cooperation with a manufacturer of X-ray equipment, Tenowo has also recently realised its first medical device project, with its carbon nonwovens being used as a reinforcement textile in the wall of an X-ray system.

Carbon nonwovens were qualified as a highly suitable material due to their excellent mechanical properties and ability to achieve X-ray transmission. The components have a sandwich structure with a foam core and carbon nonwoven cover layers. FF