PRESS RELEASE **Paris, February 7th, 2019**

DISCOVER THE 30 FINALISTS SELECTED FOR THE JEC INNOVATION AWARDS 2019

JEC Innovation Awards celebrate the fruitful cooperation between players of the composite community. Over the past 15 years, the JEC Innovation Awards have brought in 1,800 companies worldwide. 177 companies and 433 partners have been rewarded for the excellence of their composite innovations. The JEC Innovation Awards reward composites champions, based on criteria such as partner involvement in the value chain, technicality or commercial applications of innovations.

3D PRINTING, A NEW CATEGORY IN 2019

In 2019, 30 finalists have been selected by an international jury of experts from more than a hundred applications. They compete in 10 categories, among which the new 3D printing one. *"The JEC Innovation Awards program is emblematic and recognizes pioneers in composite innovation. 3D printing plays a new role in our industry. The combination of lightweight, resistant materials that allow great design freedom, with a technology that allows complex shapes, is of interest to manufacturers. Many manufacturers have started using it to print automotive parts, aircraft parts, or building walls",* analyses Franck GLOWACZ, Innovation Content Leader at JEC Group. "*Due to the very high level of the nominees, the JEC Innovation Awards ceremony should be very rich! "*

A PRESTIGIOUS INTERNATIONAL JURY

- Anurag BANSAL, Manager Global Business Development, ACCIONA Infraestructuras
- Christophe BINETRUY, Professor, EC Nantes
- Robert BUCHINGER, CEO, SUNLUMO Technology
- Grahame BURROW, Global President, MAGNA EXTERIORS
- Dominique DUBOIS, CEO, CARBOMAN Group
- Karl-Heinz FUELLER, Manager Hybrid Materials, Concepts and AMG, DAIMLER
- Sung HA, Professor, HANYANG UNIVERSITY
- Murat OGUZ ARCAN, COO, Composites, Construction and Business Development, KORDSA
- Henri SHIN, Director – R&D Composites Innovation Center, KOLON
- Kiyoshi UZAWA, Professor/Director (Ph.D), INNOVATIVE COMPOSITE CENTER

SEE YOU AT THE JEC INNOVATION AWARDS CEREMONY!

The JEC Innovation Awards ceremony will take place on Wednesday 13 March at 4.30pm at the Agora stage of the JEC World 2019 exhibition.
Access to the ceremony is free, to obtain a visitor badge: **http://registration.jec-world.events/**
To discover the finalists, visit **www.jec-world.events**

KORDSA TEKNIK TEKSTIL KORDSA THE REINFORCER **: the partner of the JEC Innovation Awards**

ABOUT JEC GROUP:
JEC Group is the world's leading company dedicated entirely to the development of information and business connections channels and platforms supporting the growth and promotion of the composite materials industry. Publisher of the JEC Composites Magazine - the industry's reference magazine, JEC Group drives global innovation programs and organizes several events in the world, including JEC World (the foremost and world-leading international exhibition dedicated to composite materials and their applications), which takes place every spring in Paris.
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AEROSPACE • APPLICATION

COMPOSITE AILERON STRUCTURE CURED IN ONE STEP

Nominated for a JEC Innovation Award: **Compo Tech Plus SPOL, s r.o. (Czech Republic)**

Associated partner: **Aero Vodochody Aerospace a.s. (Czech Republic)**

Aileron structure for a span-wise box section connected by a robot-wound fibre layer with one-step curing. Process: automated production with no sandwich core structure or secondary bonding.

Key Benefits:

→Strong and reliable structure

→No secondary bonding

→Continuous outer skin

→One-step process for production and curing

→Production process can be automated

The innovation is an application process for robot-assisted filament winding and laying for the automated production of wing structures. The process involves the winding, with axial fibres, of various shaped sections that form the span-wise box beams. The box beams together form the profile of the wing section.

Before curing, the outer layers are wound with the tooling still in place, thus consolidating the internal beams and forming the shape of the aileron. The outer surface is then pressed using a flexible vacuum mould at room temperature and the part is cured in a single step, without any secondary bonded parts. The surface is then finished.

AEROSPACE • APPLICATION

PRIMARY STRUCTURE FOR SOUNDING ROCKETS

Nominated for a JEC Innovation Award: **Deutsches Zentrum für Luft – und Raumfahrt E.V (Germany)**

Associated partner: **AFPT GmbH (Germany)**

A thermoplastic composite component replacing a purely metal primary structure and allowing weight reduction through tailored thermomechanical properties.

Key Benefits:

→Optimized anisotropic structural behaviour

→Weight reduction leading to fuel and cost savings

→ In-situ thermoplastic AFP process with minimum production time

An automated fibre placement (AFP) process with carbon fibre-reinforced thermoplastic (CF-PEEK) tapes was used to manufacture a primary structure for sounding rocket missions. This part replaces a traditionally metallic component, thus contributing to an increased use of composites in space applications. Unlike other AFP processes using thermoplastic materials, no post-consolidation process was required to ensure structural integrity.

This single-step (in-situ) manufacturing method has long been a target in the thermoplastic community, eliminating expensive and time-consuming vacuum-bagging processes. The method used to produce this component also displays a significant advantage over winding processes, where roving intersections lead to fibre undulations and hence decreased stiffness and strength. Instead, excellent geometrical tolerances and inter-ply consolidation quality were achieved.

This was verified by ultrasound, X-ray, and infrared thermography non-destructive testing. Operational loads are transferred to the structure via HI-LOK screw rivets, with qualification testing under compression, bending, and shear conditions having been successfully completed in 2018. With its imminent launch date as part of the DLR ATEK mission (VSB-30), this component has successfully cemented its place in history as one of, if not the first, in-situ AFP-produced components to complete a major role in real flight.

AEROSPACE • APPLICATION

INJECTION FORMING OF GEARS ON CF-PAEK DRIVE SHAFTS

Nominated for a JEC Innovation Award: **Herone (Germany)**

Associated partners: **TU Dresden (Germany), Victrex Europa GmbH (Germany)**

Injection forming of CF-PAEK composite profiles with CF-PEEK – a smart progression of the overmoulding technology to reach the next-level of connection strength for integral composite profiles.

Key Benefits:

→Highest part quality due to textile preforming of UD tapes (porosity < 0.5%)

→Herone's consolidation technology enables 15-minute cycle times

→Injection forming enables integral part design for an all-thermoplastic solution

→Integral design for reduced number of parts and assembly costs

→Increased performance by combining cohesive bonding and form locking

The all-thermoplastic geared CF-PAEK drive shaft system (e.g. for door closing mechanisms in an aeroplane) is the proof of concept for functionalizing CF-PAEK hollow profiles with CF-PEEK using the injection forming technology invented by Herone. In the first process step, thermoplastic UD tapes are braided to load adapted tape preforms, called organoTubes. By using fully-consolidated thermoplastic UD tapes, the challenging and time-consuming fibre impregnation step is already completed prior to preforming.

This significantly increases the process efficiency and guarantees the highest quality for the shaft body. Furthermore, braiding enables high deposition rates and thus makes the process suitable for large-scale industrial production. The CF-PAEK organoTubes are then moulded to consolidated drive shaft bodies using Herone's unique moulding technology. In the second step, the gears are injection formed onto the consolidated drive shaft body. Utilizing the heat and pressure of the injection compound, the drive shaft is thermoformed to create a form-locking connection between the composite shaft body and the injection-moulded gear.

Thereby, the cohesive bond between the composite body and the gear is strengthened by additional form locking. The drive shaft is made from Victrex UD slit tape based on the new PAEK polymer, VICTREX AE™ 250, with a melting temperature around 40 K lower than conventional PEEK. The gear is made from Victrex's short carbon fibre-reinforced PEEK 90HMF40. Selecting a material with a 40 K difference in the melting temperatures obliterates the need to pre-heat the shaft above its melting temperature prior to injection forming.

This improves resource efficiency, process reliability and interface strength tremendously.

AEROSPACE • PROCESS

A+ GLIDE FORMING: AUTOMATED MANUFACTURING PROCESS

Nominated for a JEC Innovation Award: **Applus+ Laboratories (Spain)**

A+ Glide Forming is a new continuous process used to form CFRP stringers with complex contours in only one shot. This is a versatile, high-productivity and low-investment forming solution.

Key Benefits:

→Quality: able to form high-quality long contoured parts "wrinkle-free"

→High flexibility: one single machine for many different stringers

→Cost efficiency: high productivity, one single machine for different shapes

→Energy saving: no tool heating required, very simple tool and process

New composite airplane structures are made out of panels reinforced with stringers, either frames or ribs. Typical fuselage stringers are omega sections, while T stringers tend to be used in the wings. Stringers are usually long, narrow parts. Fuselage stringers can be 4 to 12 metres in length, and wing stringers up to 40 metres in a large airplane.

The A+ Glide Forming technology was developed to form long and curved stringers from flat, full-thickness prepreg lay-ups made on Automated Tape Lay-up (ATL) or Advanced Fibre Placement (AFP) machines. This innovative technology can be used to form curved stringers with different sections, lengths, thicknesses and curvatures using a single machine that accepts different tools.

AEROSPACE • PROCESS

FULLY FST COMPLIANT 16G COMPOSITE AERO SEATBACK

Nominated for a JEC Innovation Award: **Cecence (UK)**

Associated partners: **Acro Aircraft Seating LTD (UK), FTI (UK)**

Rapid hot compression moulded, fully composite 16g carbon seatback with FST compliance built in to its core, negating the need for fire proof dressing and with an out of mould paint ready surface.

Key Benefits:

→Low wastage through almost zero use of consumables

→Rapid hot press moulding of snap cure materials reduces manufacturing costs

→Phenolic and bio resin systems are less expensive than epoxy systems

→Potential for net moulding removes further processing needs

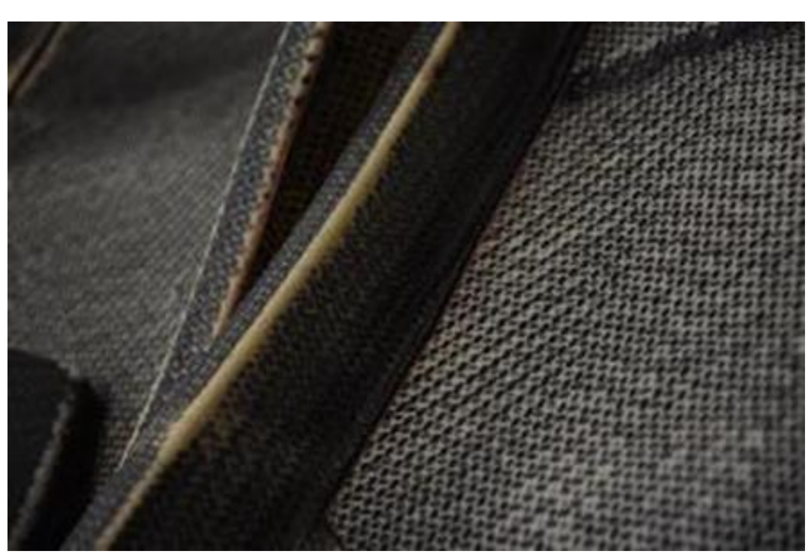
→This advance is a step closer to one shot moulding of a complete component

Cecence proved it was possible to manufacture a fully compliant lightweight carbon composite seat back using hot compression moulding, that could pass FST requirements and achieve 16g HIC. This seat back is an integral part of Acro's Airbus line fit approved seat and is now in-service. The aircraft operator has a product that is aesthetically pleasing with a smooth finish and which achieves the weight target.

The material allowed Acro's design engineers to create shapes that would not have been possible in metal and to make space savings on the aircraft to allow for increased passenger comfort.

The technological breakthrough of the innovation is both in the rapid manufacturing process and the resulting seat back where the FST compliance is built into the structural component and is not reliant on additional dressing to act as a fire barrier.

Cecence invested heavily in early stage R&D, designing and engineering a structural material that would be FST compliant, easy to work with, fast to process, with an excellent surface finish. They worked closely with prepreg manufacturer FTI to combine Cecence's carbon fibre selection and orientation with a work place friendly 0% formaldehyde phenolic resin system.



AEROSPACE • PROCESS

ZERO-DEFECT MANUFACTURING PROCESS

Nominated for a JEC Innovation Award: **Profactor GmbH (Austria)**

Associated partners: **Airbus Defence and Space GmbH (Germany), Danobat (Spain), Dassault Systemes SA (France), FIDAMC- Fundación para la Investigación, Desarrollo y Aplicación de Materiales Compuestos (Spain), IDEKO S. COOP (Spain), InFactory Solutions GmbH (Germany), M. Torres Diseños Industriales SA (Spain), Profactor GmbH (Austria)**

The development is a zero-defect manufacturing process for large composite parts. It uses inline monitoring and decision support systems to avoid defects showing up only during final NDT.

Key Benefits:

→No (or substantially reduced number of) defects showing up during final NDT

→Substantial productivity gains during lay-up due to automated inspection

→Optimized infusion and curing processes through direct sensor feedback

→Qualified decisions about re-work based on analysis of the part as manufactured

→Global view of the whole process using part flow simulation

At the heart of the zero-defect manufacturing process are the automated dry fibre placement (DFP) and automated dry material placement (ADMP) lay-up processes and the subsequent infusion and curing processes. The processing chain involves four steps:

(1) An inline quality control system scans the laid material during the lay-up process, providing immediate feedback about any quality problems that might exist. Once the layer is finished, the machine operator can immediately initiate any rework if required or continue with the next layer. Manual inspection after each layer is not needed.

(2) Process monitoring during the infusion and curing process generates information that cannot yet be controlled directly. Through the integration of a sensor, the flow-front during infusion, temperature and state of cure can be measured along the whole sensor (not just in single positions). This allows a detailed analysis of the process, so that it can be stopped at the right time.

(3) Defect data are collected in a “manufacturing database” that is then used with finite-element methods to calculate the impact of defects on the part’s mechanical strength. This allows an assessment of the part as it is manufactured and provides important input for rework processes.

(4) A decision support tool merges all the above-mentioned data sources and combines them with a logistical part flow simulation. This information is presented to the operator to help decide about different rework strategies. Through these process monitoring steps, a wide range of typical defects can be detected and reworked if needed, so that substantially fewer (if any) defects show up during end-of-line inspection.

JEC WORLD INNOVATION AWARDS
Celebrating the best composites breakthrough

AUTOMOTIVE • APPLICATION

COMPOSITE PATCHES FOR IMPROVED NVH PERFORMANCE

Nominated for a JEC Innovation Award: **Hexcel (UK)**

Associated partner: **Saint Jean Industries (France)**

By locally reinforcing optimised aluminium subframes with Hexcel's HexPly® carbon patches, the noise and vibration performance can be significantly improved while keeping additional weight to a minimum.

Key Benefits:

→Improved noise and vibration (NVH) performance

→Optimised stiffness/weight ratio

→Lower production costs and production flexibility

→Increased driver comfort

→lEnergy savings

Hexcel and Saint Jean Industries worked together on an innovative project to find a solution to improve noise and vibration performance (NVH), especially on EV (Electric Vehicles), and maintain the best stiffness/weight ratio of lightweight aluminium subframes.

Hexcel provided carbon patches developed with in-house simulation software, especially designed to locally reinforce aluminium parts and provide additional noise and vibration management functionality.

The HexPly® prepreg patches consist of unidirectional carbon fibre and an epoxy matrix. This fast-curing prepreg cures and bonds to metal in a highly efficient one-step process. The cured parts can easily withstand the extreme temperature and humidity conditions to which the subframes are subjected. The resin cures in two minutes at 170° C, with a glass transition temperature of 145° C. A light glass veil between the aluminium and carbon avoids any galvanic corrosion. Saint Jean Industries tested the new technology on an 18.5kg rear aluminium subframe from a series production vehicle.

They performed a modal analysis over the range of frequencies experienced by the subframe, covering the different engine types across the range of vehicle speeds. Based on the SJI analysis, Hexcel calculated the carbon layers and orientations required while optimising the mechanical performance in regard to the vibration response.

Even the geometry and position of the reinforcement patches on the part were studied in vibration simulations. In total, 500 grams of composite material were added to the structure. Once stiffened, the demonstrator was bench-tested again.

It showed a significant modification of the natural frequencies from 10 to 25 Hz. When looking at the test results, it can be concluded that the use of Hexcel's prepreg patches positively changes the vibration characteristics of the subframe and helps to control the part's NVH performance and weight.

AUTOMOTIVE • APPLICATION

LIGHTWEIGHT CARBON FLOOR LCF

Nominated for a JEC Innovation Award: **Kandge Composites CO., LTD. (China)**

Associated partners: **Kangde Composites Co., Ltd (China), KDX Europe Composites R&D Center GmbH (Germany), KDX Roding Europe Automobile Design Center GmbH (Germany), NIO (Germany)**)

Highly-integrated carbon composite rear floor for low weight, outstanding safety and improved vehicle performance. Cost-efficient, high-volume application globally engineered and mass produced in China.

Key Benefits:

→Cost efficiency: near-net shape; tooling and process cost reduction

→Performance: torsional stiffness 44,930 N·m; 5-star NCAP safety; enhanced durability

→Lightweight: >30% weight saving compared to Al baseline; higher system efficiency

→High volume: low cycle time (2.5min); fully automated; process level of JPH 20/h

→Global network: engineering to production; sketch to SOP; global suppliers

The NIO Lightweight Carbon Floor (LCF) is a composite module that combines high functional integration with cost-efficiency for high volumes. The LCF strengthens the whole rear end of the BiW structure and consists of three main CFRP sub-assemblies.

The design focused on four aspects:

1) Functional integration: the LCF covers the most critical load cases and requirements from stiffness/NVH, over crash/safety to durability load cases.
2) Load path optimised design: layup optimisation loops derived from functional requirements were conducted to achieve better lightweighting performance.
3) Production-based design: the design guidelines were considered from the beginning to enable a smoother production phase using the latest WCM technology.
4) Multi-material design: the LCF of the NIO ES6 is embedded in an overall aluminium BiW structure. Challenges such as different thermal elongations between carbon fibre and aluminium, contact corrosion, adhesive joining (two types), inserts, bond studs and fasteners were managed and validated by CAE and physical tests.

State-of-the-art fibre (50K, high-strength CF), textiles (150/300 gsm UD-NCF) and resin system (fast curing 2-K EP) were selected for the best compromise of economic efficiency and mechanical properties. Multi-level validation was completed from the material/coupon level, over the component and sub-system to the system/vehicle level.

The processing and assembly solution is cost-competitive due to continuous process optimization and a fully-automated process for part production and vehicle assembly (adhesive application, part placement, and IR curing), lower labour and energy costs and the efficiency of an Industry 4.0 intelligent manufacturing platform (Kangde Group) that continuously improves the process using the generated production data.

The main benefits include 50% tooling cost savings compared to metal stamping, 30% process cost savings, near-net-shape due to the high material utilisation rate, low cycle times (2.5min) and a process level of JPH 20/h at NIO.

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AUTOMOTIVE • APPLICATION

COMPOSITE GUIDE RAILS FOR A ROLLER-BLIND SUNROOF

Nominated for a JEC Innovation Award: **Polyscope Polymers (Netherlands)**

The first time that a thermoplastic composite successfully replaces aluminium for guide rails on roller-blind sunroof modules.

Key Benefits:

→Plug-in unit, one-step robot installed, eliminates 2-3 assembly steps

→Increased space available over passenger heads

→Family modular mould saves tool and production costs. Total savings 20%

Traditional extruded profile aluminium guide rails for sunroofs require additional time and labour to finish assembling the sunroof sub-components before mounting the system on the top of the vehicle on the assembly line. A pretested module is now available and ready to install robotically in a single step.

The composite rails are injection-moulded from a 15% glass-reinforced styrene maleic anhydride/acrylonitrile butadiene styrene (SMA/ABS-GF) composite to achieve precise dimensions, tight tolerances, good stiffness and strength, and excellent bonding to metal and glass substructures via a polyurethane (PUR) structural adhesive.

AUTOMOTIVE • PROCESS

FAST MANUFACTURING OF COMPLEX TP COMPOSITES

Nominated for a JEC Innovation Award: **Evopro Systems Engineering Kft. (Hungary)**

Associated partners: **eCon Engineering Kft. (Hungary), HD Composite Zrt. (Hungary), the Budapest University of Technology and Economics, Faculty of Mechanical Engineering (Hungary) and the Hungarian Academy of Sciences, Research Centre for Natural Science (Hungary)**

Automated, short-cycle-time production of thermoplastic polymer composites with a special focus on high functional integration, complexity and recyclability of the parts, based on T-RTM technology.

Key Benefits:

→Recyclable, homogeneous PA6 composite structural sandwiches for high stiffness

→Recyclable, homogeneous PA6-coated composite for a near Class A surface

→Automated, fast production with Industry 4.0 manufacturing

→Higher level of functional integration of the composite parts

→Up to 20% reduction of manufacturing cost of structural composites

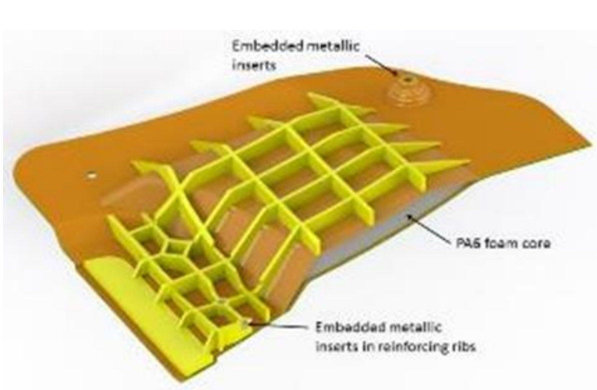
Evopro's R&D programme focuses on high-speed, automated composite production for automotive applications. The company extensively developed the T- RTM technology to produce structural composite parts based on a PA6 matrix. The goal was to use T- RTM with in-situ polymerization of E-caprolactam, supported by fully-automated preforming, according to Industry 4.0 principles.

The technology is known already with the application of overmoulding/back injection (with injection moulding) and some results were published in the past years and presented at JEC World as well. Furthermore, Evopro made significant steps in the frame of their programme to create fully-homogeneous, PA6 shell, core-based sandwich structures (for improved mechanical properties and recyclability) and to apply PA6 in-mould coating to create a near Class A surface on the product.

Sandwich structures are very important for the high dimensional stiffness of low-density composite parts. Usually, closed-cell-structured foams such as PES, PET, PVC or PU foams, balsa wood and honeycombs are used as core materials.

The application of these core materials would rise difficulties in the recycling of PA6-based composites. With this solution, PA6 foam cores can be used for PA6-based composites to create homogeneous sandwich structures for optimal recyclability, which is a key factor for automotive applications.

The surface quality of continuous fibre-reinforced thermoplastic composites does not allow their application on visible surfaces because of the polymer shrinkage and fibre read-through. In-mould technology is a known solution in the case of SMC, for example, and other processes based on thermoset materials, but the application of a thermoset coating does not allow the recycling of PA6 composite parts due to the inhomogeneous material complex. With Evopro's process, a PA6-based surface coating can be created on PA6-based composite parts with in-mould coating. This process allows the use of different fillers, pigments and additives.



AUTOMOTIVE • PROCESS

EVOLUTION OF PAINTING FOR CFRP AUTO BODY PANELS

Nominated for a JEC Innovation Award: **Hyundai Motor Group (South Korea)**

Associated partners: **Hyundai Motor Group (South Korea), Hyundai Steel Company (South Korea), Hyundai Motor Group - Polymer research lab (South Korea), Mitsubishi Chemical Corporation (Japan), SK Chemicals (South Korea)**

This innovation sheds light on the challenges of achieving a Class A surface finish using on-line/in-line painting processes. It proposes a new method for producing a CFRP trunk lid based on PCM and SMC processes.

Key Benefits:

→CFRP on-line/in-line painting for mass production, solving "colour matching" issues

→Class A surface with a conventional automotive painting process

→Energy saving in the painting process due to a low-temperature-curing 2K clear coat

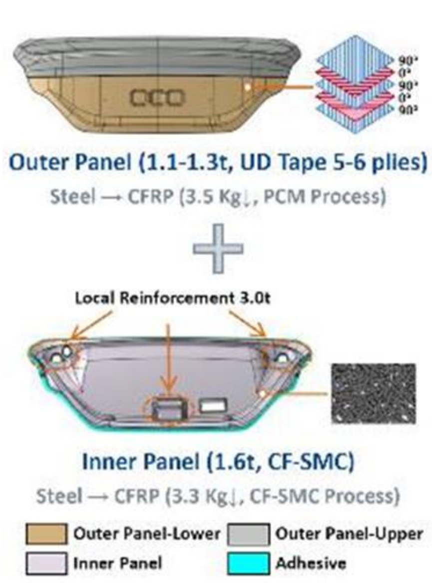
→Lightweight CFRP trunk lid with a 60% weight reduction through design optimization

→High cycle production of 5-minute cure PCM prepreg

CFRP parts for the automotive industry should be produced with well-defined engineering procedures, using a qualified manufacturing process in fit-for-purpose facilities. The autoclave process is the most commonly used for producing high-quality structures in the composites industry; however, it has its drawbacks. Due to its shortcomings, it was necessary to specifically address the need for a low-cost, high-quality manufacturing process. The new multi-material trunk lid developed by Hyundai Motor Group uses two novel curing techniques (PCM and carbon fibre SMC) for mass production. It was adopted for the Genesis G70 sports car, the new luxury sedan from Hyundai Motor Group that won Motor Trend's 2019 Car of the Year Award.

This trunk lid results in a substantial weight reduction (up to 60%, 6.4 kg weight saving compared to conventional steel structures) and great component performance. The outer body panel uses 5 to 6 plies of unidirectional prepreg and the inner panel features 1.6-3.5mm-thick carbon fibre SMC in several locations for local reinforcement to reduce stress concentrations. The design concept was evaluated based on finite element numerical analyses and a series of structural tests involving repetitive open/close durability, oil canning and long-term environmental durability were conducted.

This innovation can be implemented by introducing a new non-conductive primer (acryl-olefin) and a topcoat layer for painting auto body CFRP panels. Follow-up trials showed that CFRP panels that received a single primer coating after automated grit-blasting sanding can eliminate the fibre texture. A thick, non-conductive primer enables on-line painting and enough adhesion to the intermediate coating by increasing surface tension on the CFRP substrate. The surface quality is equivalent to conventional steel parts according to combined factors such as gloss, dullness and orange peel.



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AUTOMOTIVE • PROCESS

FIBERJECT – 3D THERMOPLASTIC COSMETIC CARBON PARTS

Nominated for a JEC Innovation Award: **Mubea Carbo Tech GmbH (Austria)**

Associated partners: **Mubea Carbo Tech GmbH (Austria), Porsche AG (Germany)**

Fiberject manufacturing of complex-shaped, fully-integrated and high-accuracy cosmetic carbon parts for high volumes using a thermoplastic matrix.

Key Benefits:

→Good visual appearance, higher clarity and depth effect than standard CFRP

→Possibility to manufacture complex cosmetic CFRP components using thermoplastics

→85% cycle time reduction and up to 50% cost reduction

→Usable for interior and exterior applications with the possibility to avoid VOC

→Recyclability due to the usage of a thermoplastic matrix

Common cosmetic CFRP parts are made from prepregs or thermoplastic organo sheets. Cosmetic CFRP parts using thermoset resins are limited in lot size and productivity, as many process steps demand accurate manual labour and the preforming, curing and completion cycle times are already near their technical limits.

Furthermore, functional elements such as clips or mounting points have to be manufactured separately and glued to the component. Organo sheets, on the other hand, have technical limits. Complex shapes with high degrees of drapery, undercuts or split lines cannot be realized. The described limits of thermoset prepregs and organo sheets prohibit the high-volume production of complex-shaped, fully-integrated cosmetic CFRP parts. To make this possible, Mubea Carbo Tech GmbH (MCT), Salzburg, Austria, developed a novel process to produce a 3D cosmetic organo sheet that combines the design freedom of conventional thermoset applications with the countless advantages of thermoplastic series production. To validate the technology, MCT worked together with Porsche AG (Stuttgart, Germany) and produced a cosmetic CFRP component based on a series product geometry. With their patented process, MCT manages to produce the most demanding shapes of cosmetic CFRP parts using thermoplastics without wrinkles or warpage.

These intermediate products can be back-moulded to integrate functional elements to the parts. This process step enables functionalization with a significantly higher positioning precision than manual gluing. The final products show a superior surface quality than state-of-the-art products, as the thermoplastic surface layer compensates sink marks even after climate testing. To fulfil the highest demands of automotive standards, a customized thermoplastic compound was developed. This compound even allows for exterior application without a protective clear coat.

CONSTRUCTION & INFRASTRUCTURE

BENDABLE TP COMPOSITE REINFORCEMENTS FOR CONCRETE

Nominated for a JEC Innovation Award: **Arkema (France)**

Associated partners: **Arkema (France), National Cooperative Highway Research Program – NCHRP (USA), Sireg (Italy), University of Miami (USA)**

Readily bendable thermoplastic composite bar and cable for reinforced and prestressed concrete revolutionizing the durability of construction.

Key Benefits:

→Elium rebars can be re-heated and then bent, reducing the cost of custom shapes

→TP composites enable the assembly of rods into flexible cables

→Equipment for concrete precasting remains the same as used for steel strands

→TP composites for prestressing revolutionize the durability of construction

Based on the Elium reactive liquid thermoplastic resin technology, a new generation of rebar and cables was developed that combines the qualities of composites with the new possibilities offered by the use of a thermoplastic matrix.

Unlike most thermoplastic resins, Elium can be easily processed through traditional pultrusion using exclusively standard equipment

CONSTRUCTION & INFRASTRUCTURE

CONTRIBUTION OF NANOTECHNOLOGY TO COMPOSITES

Nominated for a JEC Innovation Award: **Gazechim Composites Iberica (Spain)**

Associated partners: **Chem-Trend (Germany), Chomarat (France), Euromere (France), Graphenano Composites (Spain), Gurit (Germany), Look Composites (Spain), Nouryon (Netherlands), Obo (Germany), Omar Coatings (Spain), Owens Corning (Italy), Polymec (Spain), Polynt Composites (Spain), Talleres Xúquer (Spain)**

Gazechim Composites Iberica designed, developed and implemented a large, avant-garde design-inspired canopy for its headquarters in Valencia. The self-supported structure leverages graphene-based nanotechnology.

Key Benefits:

→Demonstrating the design freedom, flexibility and overall advantages of composites

→Highlighting the use of graphene nanotechnology to improve key properties

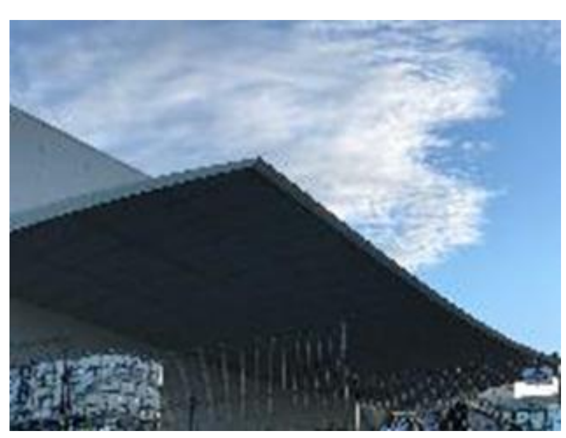
→Showcasing the future of construction in architecture

→Highly-industrialized manufacturing and implementation process

→Highlighting the ongoing innovations in composites

Capitalizing on the design flexibility and superior aesthetic characteristics of composite materials, Gazechim Composites Iberica designed, developed and implemented a fully-reimagined, large, avant-garde design-inspired canopy for its logistics headquarters building in Valencia, Spain.

The self-supported structure leverages graphene-based nanotechnology over a total surface area of 340m² and resembles the hard top of a boat. It is the first construction application using nanotechnology in a polymeric matrix to enhance composite performance. The matrix was doped with graphene to enhance its flexural modulus and tensile strength properties, while reducing the overall weight of structures.



CONSTRUCTION & INFRASTRUCTURE

COMPOSITE DIKE STABILIZATION SYSTEMS

Nominated for a JEC Innovation Award: **Solico Engineering BV (Netherlands)**

Associated partner: **JLD International (Netherlands)**

A new dike stabilization method was developed by JLD International. All the structural parts in this system are made of composite materials. These parts were designed by Solico Engineering.

Key Benefits:

→Sustainability

→Cost effectiveness

→Lightweight

The JLD dike stabilization system is a sustainable, flexible and innovative solution that was developed for the reinforcement of existing dikes. The JLD dike stabilizer is applied in the inner slope of the dyke and installed from the inner slope or crest. Therefore, no widening of the relevant dyke is required in many cases. The dike stabilization system consists of several parts, including three important parts made from composite material: the anchor rod, the transverse load carrying element (LDE) and the anchoring plate. The anchor rod is a 25mm basalt fibre-reinforced rod with a specially formed thread on the outside. Basalt fibre was chosen because of its higher tensile strength compared to E-glass and better sustainability in the ground.

The anchor rod is pretensioned to a required load level, based on soil mechanics calculations. The pre-tension in all anchors is monitored constantly with loads cells. The transverse load carrying element (LDE) is an E-glass composite pultruded profile designed to carry the shear force at the moment the dike is collapsing. The LDE is a star-shaped pultrusion with a wall thickness up to 25mm.

The anchor plate is a flat rectangular plate (1m x1m) designed to transmit the anchor force (up to 10 tons) to the soil. It has to be lightweight (for installation), sustainable and very cost effective. A very important feature is that the plate has to be perforated, with about 25 holes of 50mm diameter. The 40mm-thick GRP plate is produced by vacuum infusion. The perforation is already present in the mould, thus avoiding expensive drilling. The plate is constructed as a kind of sandwich structure with recycled GRP as a core material and stitched biaxial glass fabrics as skins.

SUSTAINABILITY

SOLUBOARD®

Nominated for a JEC Innovation Award: **Jiva Materials Ltd. (UK)**

Associated partner: **Eco-Technilin SAS (France)**

Jiva and Eco-Technilin created Soluboard®, a revolutionary bio-composite material manufactured with Eco-Technilin's FlaxTape™. Soluboard® is designed to redefine the way PCBs are manufactured.

Key Benefits:

→A direct replacement for FR-4 with the same price and improved sustainability

→Decreasing the impacts from Waste Electronic and Electrical Equipment (WEEE)

→Decreasing the carbon footprint generated by electronic and electrical products

→Increased yields of precious metal recovery from PCB recycling

→Improved incentives for electronics manufacturers to internalise recycling

The substrate currently used in the printed circuit board industry is constructed using epoxy resin and fibreglass. This means that the only recycling method for PCBs involves shredding them down and incinerating them in order to extract the precious metals used in these boards. This is a very inefficient process with substantial loss of these metals during reprocessing as well as releasing toxins such as cyanide, mercury and dioxins into the environment.

Currently patent-pending, Soluboard® is intended to replace the current standard material used in the industry (FR-4). It is a competitively priced, fully-biodegradable material that can rival the outdated fibreglass and epoxy alternative. The primary ingredient in the composite material is Eco- Technilin's FlaxTape™, a patented tape consisting of unidirectional flax fibres with a lower density than alternative carbon and glass fibres. The unidirectional orientation of the flax fibres means they can be efficiently arranged to form the multilayer bio-composite structure of Soluboard®, giving the material strong mechanical properties. FlaxTape™ is also ideal for manufacturing lightweight products with improved mechanical properties and a lower environmental impact.

With nearly 45 million tonnes produced last year, electronic waste is now the fastest growing waste stream in the world. Dissolving a circuit board made from Soluboard® allows for 90% of its components to be reclaimed and then either repurposed or recycled in an overall much more efficient process.

JEC WORLD INNOVATION AWARDS
Celebrating the best composites breakthrough

SUSTAINABILITY

SERIES PRODUCTION OF BIO-BASED COMPOSITES

Nominated for a JEC Innovation Award: **Porsche AG (Germany)**

Associated partners: **Bcomp Ltd. (Switzerlands), Fraunhofer-Anwendungszentrum HOFZET (Germany)**

The small series of a motorsport car show the high potential of renewable resources by using their specific properties for the lightweight construction of a door and rear wing.

Key Benefits:

→Sustainable racing sports vehicle parts

→Use of conventional RTM systems for mass production of NFRP in the automotive industry

→Easy recycling compared to carbon fibre-reinforced plastics

The use of natural fibres in place of carbon fibres as a reinforcing material in a motorsport vehicle illustrates the relationship between application and material selection. The door, as a body part, and the rear wing, as a dynamically-loaded component, show the implementation of different load cases. The components meet the requirements with almost the same weight as components made of carbon fibre-reinforced plastics.

To achieve this, the tool geometry was adapted and specific properties of renewable raw materials were used. Balsa wood was successfully used as a sandwich core for the door leaf. With 25% less fibres, a similar bending stiffness was achieved as in the comparable component made of carbon fibre-reinforced plastics. For the rear wing, lattice structures (PowerRips®) were used instead of a core, so layers were saved and a high load of about 300 kg could still be collected in use. The resin transfer moulding process is used for the doors and the rear wing is manufactured in an autoclave process.

By adapting the process and modifying the tools, it is possible to process natural fibres in series-compatible processes despite the natural variation of their properties. For example, the challenge of a gap-free balsa wood core as a core material in the RTM process was successfully met. The components are already produced in small series of 700 vehicles by means of conventional serial production processes, clearly distinguishing this door from a prototype and showing the application potential of a natural fibre-reinforced plastic material.

SUSTAINABILITY

BIO4SELF – SELF-REINFORCED PLA COMPOSITES

Nominated for a JEC Innovation Award: **Technical University of Denmark (Denmark)**

Associated partners: **Centexbel (Belgium), Comfil (Denmark), Fraunhofer-Gesellschaft (Germany)**

Bio-based, easy-to-recycle self-reinforced composite materials using high-stiffness PLA fibres for use in sports, automotive and medical applications.

Key Benefits :

→Biobased: composites made from two PLA grades with different melting temperatures

→Performance: high mechanical strength, temperature and hydrolytic stability

→Cost: far below carbon fibre composites, comparable to or even below SR-PP

→Upscalable: using commercially-available materials and industrial equipment

→EoL: re-usable, recyclable or industrially compostable as the composite is made of PLA

Driven by the wish to tackle environmental issues and work towards the EC Plastics Strategy, the composite materials developed in the Bio4self project are fully bio-based, easily recyclable, reshapable and even industrially biodegradable. The composites are produced using one type of material: poly(lactic acid) or PLA, a thermoplastic bio-polyester derived from renewable resources such as agricultural waste, non-food crops or sugar cane.

Apart from some medical applications (e.g. tissue scaffolds), PLA use is currently very limited, e.g. low-demanding packaging or agrotextiles. Bio4self brought PLA to the next level of application, such as parts for automotive and home appliances, by combining two types of PLA to form so called self- reinforced PLA composites (PLA SRPC).

Two different PLA grades are required to produce SRPCs: a low melting temperature PLA grade to form the matrix and an ultra-high stiffness and high melting temperature PLA grade to form the reinforcing fibres. The two PLA grades selected for Bio4self have a melting temperature difference of about 20° C, leaving a sufficient temperature processing window. Bio4self innovations overcome several challenges related to the production of PLA SRPC: formulation of a moisture/humidity-resistant PLA grade; melt extrusion of ultra-high stiffness PLA reinforcement fibres; development of (consolidation and thermoforming) manufacturing procedures to produce the highest performance SRPC material; and industrial scale-up of production.

As a result, the PLA SRPC developed in Bio4self matches the requirements of current commercial self-reinforced polypropylene (PP) composites. Self-reinforced PLA composites made of 0/90 fabric have a stiffness of 4 GPa, which is comparable to the stiffness achieved by self-reinforced PP, but the PLA SRPC has the advantage of using renewable materials with a better end-of-life perspective.

SPORTS & HEALTHCARE

FMC FOR THE KTM CARBON SKID PLATE

Nominated for a JEC Innovation Award: **KTM-Technologies GmbH (Austria)**

Associated partners: **KTM-Technologies GmbH (Austria), Mitsubishi Chemical Carbon Fiber and Composites GmbH (Germany)**

The first structural composite skid plate produced using an FMC/NCF/elastomer hybrid. This direct production line with a one-shot process enables the best product-market fit in series production in terms of properties and costs.

Key Benefits:

→New look with the best product-market fit in terms of properties and costs compared to current parts

→Creation of material cards for new hybrid material mixes

→Complex hybrid part manufactured with a time-saving one-shot process (< 4min)

→Reduced CO2 emissions due to direct production with less transport effort

→Reliable because calculated, tested, and proven in a real-life use case

A new hybridized carbon skid plate for motorcycles was successfully developed for serial production by KTM-Technologies, Mitsubishi Chemical and KTM in a short time and produced in a one-shot serial production process (cycle times <4 minutes). The composite look was created using a carbon-forged moulding compound (FMC) for the main part, non-crimp fibres (NCF) for local reinforcements and elastomers for local damping.

This new engineering process is pushing the boundaries within the composite market. Combining the materials in a single, fully-automated process step enables a new generation of sustainable composite structures offering huge design freedom. Joining is achieved by a direct chemical bond between different thermosets and elastomers without additional joining processes. This easy production also allows the manufacturing of most materials and parts in one location, thus saving transportation costs, emissions and time. This hybridized part with a refreshing carbon look leads to the best product-market fit compared to current skid plates made of aluminium, CFRP-fabrics or plastic materials. It is as light as a standard CFRP solution (lighter than plastic and aluminium) but 50% cheaper.

Testing and real-life operation showed that the mechanical properties are also better for this application. Based on this new material, data was created for the simulation and development of other structural parts on the market. The result is a structural, complex part that meets market needs by saving time, costs and efforts. This new circle of sustainability leads to structural components with new material cards, where the reduced use of unidirectional carbon fibre helps save energy drastically, e.g. no exact pattern needed. The carbon fibre used will be recycled into fleece or short fibre reinforcement for thermoplastic materials. This innovation combines new composite design, efficient solution package and breakthrough serial production technology.

JEC WORLD INNOVATION AWARDS
Celebrating the best composites breakthrough

SPORTS & HEALTHCARE

CARBON FIBRE HANDLE FOR GUIDE DOGS

Nominated for a JEC Innovation Award: **Refitech Composites (Netherlands)**

Associated partner: **NPK Design (Netherlands)**

A lightweight carbon fibre handle for guide dogs replacing the old metal version.

Key Benefits:

→50% lighter than the metal version

→Improved feeling and therefore better navigation through obstacles and traffic

→Improved handle stiffness and harness mounting

→Fits into place with a clearly audible “click”

→Easier to locate while it “floats” above the dog’s back

The handle is produced using a prepreg material in a closed-mould autoclave process with a vacuum bag. Its small size makes it challenging to produce. Inserts are glued in after the production process.

SPORTS & HEALTHCARE

TORAYCA® ET40 PREPREG WITH SUPERIOR FORMABILITY

Nominated for a JEC Innovation Award: **Toray Industries, Inc. (Japan)**

Associated partners: **Honma Golf Co., Ltd. (Japan), Suzuki Motor Corporation (Japan)**

The TORAYCA® ET40 prepreg achieves superior levels of formability with complex shapes while keeping mechanical properties equivalent to conventional continuous-fibre UD prepreg.

Key Benefits:

→Extensible and transformable

→Equivalent modulus and 80% the strength of UD prepreg

→One-shot moulding and quick cure

→Multiple rib formation from flat laminate in compression moulding

→Excellent drapeability similar to woven fabrics used in preforming processes

UD prepreg, as it integrates unidirectionally-aligned fibres with minimal amounts of resin, enhances the lightness, strength and rust resistance characteristics of carbon fibre. However, when manufacturing complex shapes, its limited formability can generate various defects such as wrinkling, voids and resin-rich areas due to the bridging of fibre at corners.

One way to enhance its formability is to use woven fabric. The disadvantage of woven fabric is that its mechanical properties and surface flatness are inferior to those offered by UD prepreg. Another technique consists in using carbon fibre pellets in injection moulding and Sheet Moulding Compounds. This method is capable of manufacturing complex shapes such as sharp convex and concave forms. However, the fibre volume fraction of parts manufactured using this technique is lower than that of UD prepreg and their mechanical properties are insufficient due to the use of pre-cut fibres.

The extensible and transformable TORAYCA® ET40 prepreg was developed to provide an innovative product that simultaneously combines high mechanical properties and excellent formability. It has the advantages of UD prepreg without the usual trade-off between mechanical properties and formability. TORAYCA® ET40 prepreg is made by introducing slits into a UD prepreg in a controlled manner, creating a type of unidirectional SMC material in which fibre bundles are regularly arrayed in the same direction. This allows for consistent and regular flow of the bundles during the moulding process and therefore results in the ability to be shaped into complex shapes, such as ribs and deep-drawing, while maintaining a homogenous laminate structure due to its extensible and transformable nature.

As a result of specific slitting patterns, ET40 can achieve equivalent surface appearance, modulus and over 80% of the strength of UD prepreg.

JEC WORLD INNOVATION AWARDS
Celebrating the best composites breakthrough

3D PRINTING

CFAM PRIME

Nominated for a JEC Innovation Award: **CEA (Netherlands)**

Associated partners: **European Commission (Belgium), Poly Products (Netherlands), Royal Roos (Netherlands), Siemens Nederland N.V. (Netherlands)**

An additive manufacturing machine that can produce fast (average throughput 15 kg/hr), large and complex fibre-reinforced thermoplastic objects (2x4x1.5) using continuous glass or carbon fibre.

Key Benefits:

→Increased product functionality, complex shapes

→Shorter lead times, reduction of process steps

→Reduced costs, less manual labour

The CFAM Prime 3D printer, where CFAM stands for Continuous Fibre Additive Manufacturing, is a new 3D printing technology that combines the extrusion of granules with pre-impregnated fibre filaments to print fibre-reinforced thermoplastic components. The extruder is designed to virtually process all thermoplastics (maximum temperature 400° C).

CEAD tested various thermoplastics such as PETG, PP, PPS, ABS, PC, PB, and PEEK, where some of these granules already consist of a percentage of short fibres. The continuous fibres are pre-impregnated with the thermoplastics used for the application. So, CEAD produce their own filament of continuous fibres impregnated with the required thermoplastic, much like currently-used UD tapes. The printing head can combine the melted thermoplastics with the continuous pre-impregnated fibres and print the composite material.

This procedure is unique and patented. The machine can run for 24 hours without an operator. It is fully enclosed, with a closed-loop temperature control system and a dedicated cooling system. This makes CFAM Prime a dedicated production machine and gives complete control over the quality of the printed object.

3D PRINTING

OPTIMISED 3D-PRINTED INTERNAL BEAM STRUCTURE

Nominated for a JEC Innovation Award: **Compo Tech Plus spol s r.o. (Czech Republic)**

Associated partner**: Czech Technical University in Prague (Czech Republic)**

Designed for automation and dynamic machine structures. Optimised with manufacturability in mind. 3D-printed internal structure tailored to improve the static and dynamic properties of CFRP beams.

Key Benefits:

→Improving the dynamic performance of machine structures

→Globally optimal least-weight design of the internal structure

→Limiting the wall instability of thin-walled layered composites

→Reducing the need for human interventions during design and fabrication

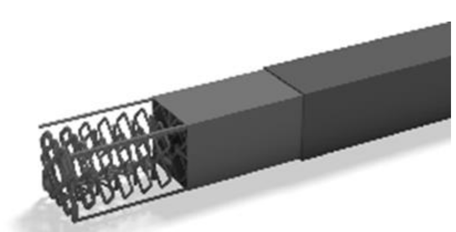
→Increased cost competitiveness

Composite machine tool and automation frame structures are thin-walled filament-wound carbon laminates with axially-placed graphite fibres. Designed for a maximum bending stiffness and high natural frequency while maintaining a low weight, they suffer from wall instability under shear and buckling conditions. Limiting this instability by additional laminae leads to significantly increased structural weight. Internal carbon structures with a high-density foam support, for manufacturing and section shape, are also used. This is labour intensive and involves high processing time and cost. A better design solution is needed for more efficient and lightweight structures.

To solve this problem, a topology optimisation approach was adopted in order to develop the optimal distribution and cross-sections of a lattice-like internal beam structure. The optimisation output of non-uniformly distributed modular lattice elements was then automatically exported for production using additive manufacturing. The structures are currently 3D printed by layer deposition of ABS (acrylonitrile butadiene styrene). The final objective is to produce the internal 3D structure from continuous carbon fibres saturated with a thermoplastic epoxy resin.

The internal structure is primarily designed to improve the mechanical response to operational loads. It also has to withstand the production process. This internal structure provides a rigid connection with a steel mandrel that is removed after curing. This is important as the torsion and bending forces during the fibre laying process can affect the accuracy of the section tolerance and run out in the final precision-pressing stage. This can then reduce machining and cost. The internal structure is also designed to withstand a set of loads and stresses created during the compression moulding process within a set deflection requirement.

During the pressing step, the resin is cured before release from the press when post-curing occurs.



3D PRINTING

CONTINUOUS-FIBRE 3D PRINTING

Nominated for a JEC Innovation Award: **Continuous Composites (USA)**

Associated partners: **Air Force Research Lab (USA), FCA / Comau (USA), Lockheed Martin (USA), Siemens (USA)**

Continuous Fibre 3D Printing (CF3D™) combines composite materials with a 3D printing process, creating a mouldless out-of-autoclave process. The result is a drastic reduction in cost and lead times.

Key Benefits:

→Eliminates expensive capital equipment such as moulds, autoclaves and ovens

→Automates fibre laying and removes costly manual labour

→Leverages low-cost, high-performance dry fibre impregnated in-situ

→Enables on-the-fly design changes and complex designs with composites

→CF3D™ can directly print functionality into composite parts

The CF3D™ patented technology is a revolutionary composites manufacturing process. Rather than using costly prepreg fibre, high-performance dry continuous fibres (AS4, IM7, T1100, etc.) are impregnated with a rapid-curing thermoset inside the print head. The head is attached to an industrial robot controlled by the company's CF3D™ software. The fully-impregnated fibre is pulled through the print head where, upon discharge, a high-intensity energy source (e.g. UV, heat, etc.) is directed at the wet fibre, curing the fibre(s) instantaneously and resulting in a true 3D composite part. As a result of the fibre being cured immediately after discharge, the CF3D™ technology does not require moulds or other support materials.

This enables on-the-fly design changes, reduced lead times, and complex designs to be printed with strong and light composite materials. CF3D™ is not limited to stacking 2D laminates and can print fibres out of the XY plane into the Z direction. This opens design possibilities and enables load path optimization by discretely printing fibres in the direction of principal stresses and strains. Multiple parts can now become single parts, reducing fasteners and making parts lighter and more efficient.

The CF3D™ process reduces intensive manual labour and removes the need for expensive capital equipment such as autoclaves and ovens, further reducing the costs and barriers to entry for the manufacture of composite parts. CF3D™ parts are also printed net shape, which eliminates material waste and reduces costs even further. Since CF3D™ utilizes dry fibres and impregnates in-situ, the cost of the materials used in the process is exponentially (+50x) lower than prepregs, which are commonly used in traditional composite manufacturing techniques. CF3D™ can print both structural fibres (e.g. carbon, Kevlar, etc.) and functional fibres (e.g. fibre optics, metallic wire, etc).

LAND TRANSPORTATION

TRAIN SEAT SUPPORT FROM A BIO-BASED PREPREG

Nominated for a JEC Innovation Award: **Composites Evolution Ltd. (UK**)

Associated partners: **Bercella SRL (Italy), Composites Evolution Ltd. (UK)**, **Element Materials Technology (UK)**

A lightweight, fire-resistant cantilevered train seat support produced from a carbon fibre-reinforced bioresin prepreg composite.

Key Benefits:

→Lightweight – the two-seat support weighs less than 5 kg

→Fire-resistant – meets Hazard Level (HL) 3 of rail fire standard EN45545

→Wall-mounted (cantilevered) for easy access to carriage floors

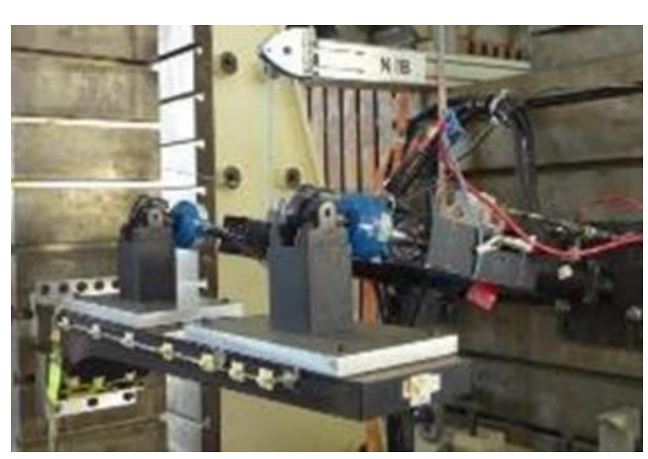
→Eco-friendly – PFA resin is water-based and 100% bio-derived

→Low toxicity – no hazardous volatile organic compounds

Composites Evolution, Bercella and Element Materials Technology successfully completed the development and testing of a lightweight composite cantilevered support for rail passenger seating. Cantilevered seat supports, which are mounted on the wall of a train carriage, offer a number of advantages over conventional floor-mounted passenger seating, including improved access for floor cleaning and under-seat luggage storage.

The lightweight composite structure also provides benefits in terms of reduced train energy consumption and lower axle loads (less track damage). The component accommodates the mounting of two seats side-by-side. The seat support, which is 1 meter long but weighs less than 5 kg, passed a wide range of tests performed by Element. The evaluation included static loadings, fatigue cycles and fire testing to EN 45545 according to the requirements of Bercella's customers. With respect to fire performance, the seat support met the most stringent requirement, Hazard Level (HL) 3, of EN 45545. It was manufactured by Bercella using Composites Evolution's Evopreg PFC prepreg with a high-strength carbon fibre reinforcement.

Evopreg PFC was specified for this application because of its excellent fire performance, low toxicity and outstanding environmental credentials. The base polyfurfuryl alcohol resin is 100% bio-derived, thereby providing a safer and more sustainable alternative to traditional phenolics for equivalent cost and performance. Producing composites that are both structural and highly fire-resistant is often challenging. In this application, Composites Evolution's bioresin prepreg enabled Bercella to offer its customers the best of both worlds.



LAND TRANSPORTATION

MOULDED STRUCTURAL COMPOSITE REFRIGERATED TRAILER

Nominated for a JEC Innovation Award: **Saertex GmbH & CO KG (Germany)**

Associated partners: **Nippon Electric Glass Co., Ltd. (Japan), Structural Composites, Inc. (USA), Wabash National Corporation (USA)**

A moulded structural composite refrigerated trailer, offering 20% weight saving and 28% improved thermal performance, manufactured in serial production.

Key Benefits:

→Lightweight properties reduce weight by up to 20%

→Structural strength eliminates the need for metal or wood

→2X puncture resistance over traditional options

→Extended product life

→Boosts thermal performance by up to 28%

Conventional trailer walls are built using a foam in-place structure with an aluminium outer skin riveted to aluminium posts with wood inserts and a thermoplastic liner. The new moulded structural composite approach addresses equipment challenges that these refrigerated carriers have been facing for years: thermal efficiency, strength, weight and longevity.

The moulded structural composite is made with a high-efficiency foam core, encapsulated in a shell of polymer-impregnated high-performance non-crimp fabrics and covered with a protective gelcoat. This unique chemistry offers a solution that can deliver new levels of efficiency and a higher return on investment.

LAND TRANSPORTATION

ACCUM: UNIVERSAL COMPOSITE CATENARY CANTILEVER

Nominated for a JEC Innovation Award: **Stratiforme Industries (France)**

Associated partners: **Armines Douai, (France), CEF Centre d'essais ferroviaires (France), SNCF Réseau (France)**

ACCUM is a universal composite catenary cantilever validated from 750V to 25kV and suitable for all standard and specific railtrack profiles, designed for easy supply, installation and maintenance.

Key Benefits:

→Dramatically reduced installation and maintenance times

→Can be used with 750 to 25 kV lines, on all standard and specific points

→Increases the system reliability by eliminating glass and ceramic insulators

→Pre-assembled by Stratiforme Industries and delivered ready to mount

→Number of components dropped down to 10+ parts versus 100+

Stratiforme Industries improved the inner dielectric and mechanical properties of the composite material to bring it to a level never reached before with an SMC component, through specific testing, coating and a clever universal design. The SMC part was thoroughly tested in collaboration with SNCF (electrical) and ARMINES (mechanical) during 10 years in order to prove its relevance for use as a stand-alone insulator on multi-voltage catenary systems (750 to 25 kV).

The part design evolved through this 10-year project, starting from RTM and infusion parts to a high-productivity SMC process for the final version, benefiting from a universal design (the SMC part is common to all the ACCUM versions).

Different environmental protection coatings were developed and tested on tracks with the support of the CEF testing centre. More than 100 prototypes are currently on test tracks in France.

INDUSTRY & EQUIPEMENT

DIGITAL COMPOSITE MANUFACTURING LINE

Nominated for a JEC Innovation Award: **Airborne (Netherlands)**

Associated partners: **Airborne (Netherlands), Kuka (Belgium), Sabic (Netherlands) Siemens (Netherlands)**

The digital composites manufacturing line is a breakthrough technology for mass production, converting thermoplastic composite tapes into lightweight laminates at high speed at radically lower cost.

Key Benefits:

→Low-cost: up to 50% lower conversion cost

→Flexible: can produce different designs, other functionalities can be added

→High quality: leads to lower scrap and higher manufacturing yields downstream

→Fully digital: adaptive process control by data analytics and advanced models

→Low scrap: net-shape lamination reduces waste and cost

Thermoplastic composites hold great promise for automated and faster manufacturing. Process steps such as lay-up, consolidation and trimming are typically automated individually. However, to truly capitalize on the technology's potential, an end-to-end automated manufacturing line in which all steps are integrated was developed through a partnership between Airborne (composite automation) and SABIC (material science), powered by Siemens (digital factory technology) and KUKA (high-speed robotics).

The technology is based on three major systems:

1. A front-end, where UD tapes are fully inspected, laminated and welded.

2. A press system, based on three zones for high-speed consolidation with fully-automated product transfer and handling of press plates and release films.

3. A back-end, where the laminates are automatically separated from the press plates, trimmed and 100% inspected. The front-end features a unique and patented high-speed feeding system, including tape quality inspection (width, thickness and surface defects), that can handle fragile UD tapes. Products are made net-shaped, thus minimizing scrap. Tapes can be spliced on-the-fly, avoiding stand-still between roll changes. Defects that are detected are automatically cut out at full speed. The product-transporting system provides maximum flexibility to add, for example, local patches, embedded sensors or other hybrid materials. The laminates are automatically welded to facilitate robust handling. The back-end retrieves the laminates from the press plates and release films, which are recycled back to the front-end. The laminates are inspected automatically for dimensional stability and surface defects and then trimmed. The line control is fully digital, with an adaptive process control based on direct feedback of the online QA/QC systems. A complete digital twin of the line is being built, which combines data analytics, machine learning and advanced process models to provide online advice to increase output.

INDUSTRY & EQUIPEMENT

ULTRA-FAST CONSOLIDATOR MACHINE SYSTEM

Nominated for a JEC Innovation Award: **AZL AACHEN GMBH (Germany)**

Associated partners: **AZL Institute of RWTH Aachen University (Germany), Conbility GmbH (Germany), Covestro Deutschland AG (Germany), Engel Austria GmbH (Austria), Evonik Industries AG (Germany), Fagor Arrasate S. Coop. (Spain), Faurecia Composite Technologies (France), Fraunhofer IPT (Germany), Laserline GmbH (Germany), Mitsui Chemicals Europe GmbH (Germany), Mubea Carbo Tech GmbH (Austria), Philips Photonics (Germany), SSDT Shanghai Superior Die Technology Co., Ltd. (China), Toyota Motor Europe NV/SA (Belgium)**

Modular production system for the mass-production of individual tailored blanks based on a piece flow approach in combination with laser-assisted thermoplastic tape placement with in-situ consolidation.

Key Benefits:

→Mass production of thermoplastic tailored laminates: >500 kg/hour

→Cycle time <5 seconds (state of the art: several minutes)

→Using in-situ consolidation: fast, flexible and energy efficient

→Laser-safe configurable, flexible production system with piece-flow principle

→Enabling new business models such as stiffening structures for injection moulding

The latest laminate production technologies using thermoplastic tapes are limited in terms of productivity because the table-based processing principle uses a moving table or a robot system in combination with a tape placement applicator system. This offers a very high flexibility but is not suitable for mass production.

The new ultra-fast consolidator machine offers both high flexibility and mass production. Fully-consolidated multi-layer laminates with different fibre directions and minimized waste (tailored blanks) can be produced in cycle times under 5 seconds for the first time, whereas the most recent machines need several minutes. This is accomplished by a new piece-flow principle which is state of the art in the printing industry but has not been used in composite production.

The production principle is based on moving carrier plates (for the transportation of the laminates), which are moved by a conveyor system and fed through several applicator stations. Each applicator station is equipped with innovative narrow applicator cassettes for laser-assisted tape placement with on-the-fly cut-and-add. The applicator cassettes are 50 mm wide and can process a tape width of 25 mm. Larger tape widths are also possible as the applicator cassettes are scalable.

The cassettes in each station can be relocated in the Y direction right before the moving carriers are fed through the applicator station in the X direction. Before each station, the carrier can be turned at a precise angle so that each applicator station can process one tape direction (fibre angle). The new machine system is modularly scalable: multiple application stations can be added (e.g. for each layer one application station for mass production) or the machine can be configured with one or two applicator stations with a conveyor carrousel where the carriers are moved multiple times through the application stations.

INDUSTRY & EQUIPEMENT

MILLING TOOL AND TOOL HOLDER MADE FROM A COMPOSITE MATERIAL

Nominated for a JEC Innovation Award: **Compo Tech Plus SPOL, s r.o. (Czech Republic)**

Associated partners: **Hofmeister s.r.o. (Czech Republic)**

Milling tool and tool holder made from a hybrid composite-steel material, reducing weight and increasing machining speed and accuracy.

Key Benefits:

→Up to 40% mass reduction

→Reduced high-frequency noise

→Energy saving

→Increased machining stability, accuracy and speed

→Improved surface roughness

The milling head consists of carbon and graphite fibre wound onto a steel part. The specially designed tooling and winding process allows the fibre to be placed on the complex steel part, which acts as a mandrel. Modelling the fibre winding pattern on the part allows the fibres to be placed with the thickness and direction required according to the optimal design.

The steel part is not removed but used in the final assembly for coupling, i.e. connecting the tool to the tool holder or the tool holder to the spindle itself. It also provides attachment to the milling teeth. In some cases, an extra damping material can be added for the desired optimal solution. After winding, curing takes place at room temperature to reduce any thermally-induced stress in the composite part.

During the final machining step, the composite-steel part is machined to its final shape and tolerance.