JEC WORLD INNOVATION AWARDS 2018

VOTE FOR ME

AEROSPACE PROCESS

M.TORRES DISEÑOS INDUSTRIALES SAU

Mould-less monocoque manufacturing process

New manufacturing process for large monocoque composite structures with fully-integrated reinforcements and without the need for complete moulds.

KEY BENEFITS

- DRAMATIC TOOLING REDUCTION, UP TO 70%
- GLOBAL MANUFACTURING COSTS REDUCTION, UP TO 40%
- WEIGHT REDUCTION DUE TO THE ELIMINATION OF FASTENERS
- TOPOLOGICAL OPTIMIZATION OF THE REINFORCEMENTS
- PROCESS FLEXIBILITY BREAKTHROUGH

MTorres developed a new manufacturing process for large composite structures with fully-integrated reinforcements in a final single part. The process introduces a new mould-less approach, where elementary composite components are pre-fabricated and joined together to create an initial structure geometry that acts as a mould for the external structural skin. The initial structure then remains inside the final product as an additional structural component. This allows for a co-curing process for both the skin and the initial components, creating a single final structure.

Initially focused on the manufacturing of fuselages, the process offers relevant weight savings for the final structure due to:

- The elimination of fasteners inside the structure;
- More flexible geometry and reinforcements configuration;
- A critical reduction in the manufacturing costs, suppressing most of the assembly tooling needed for such a structure.

Finally, an out-of-autoclave manufacturing process was chosen for all the components used: an infusion-based production that avoids the need for autoclave curing while using MTorres internally-developed low-cost dry carbon fibre tows for the automated fibre placement process, even further increasing the cost reductions for the global component.

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AEROSPACE PROCESS

AIRBUS

PARTNERS: BMW GROUP, TECHNICAL UNIVERSITY OF MUNICH (TUM), NEUE MATERIALIEN BAYREUTH GMBH, WERKZEUGBAU SIEGFRIED HOFMANN GMBH, BASF SE, FOLDCORE, NEENAH FILTRATION, SGL CARBON GMBH

Complex structural applications of MAI sandwich technology

Production of a cost-effective, complex 2.5D thermoplastic composite sandwich structure with a very short cycle time of less than 5 minutes for aerospace materials and 2.5 minutes for automotive materials.

KEY BENEFITS

- NET-SHAPED 2.5D COMPLEX STRUCTURAL SANDWICH PART
- HIGH FUNCTIONALITY THROUGH INJECTION DIRECTLY ON SKIN
- PREVENTION OF VOIDS IN THE OUTER LAYER DUE TO THE PROCESS
- VERY ECONOMIC DUE TO SHORT CYCLE TIMES IN ONE DEVICE
- CROSS-INDUSTRY MID- AND LARGE-SCALE PRODUCTION

Based on the concept design from the early stage of the project, a cross-industry net-shaped 2.5D sandwich demonstration part was created, including an injection-moulded surface feature. The project team, with partners along the process chain, responded to the demand to produce this challenging part for structural applications based on carbon fibre-reinforced thermoplastic materials.

The first trials showed that even unidirectional non-woven skin layers loft during the process when the material is in the molten state, which is needed to achieve the required drapeability and bonding with the core layer.

To prevent these unacceptable voids from occuring in a structural part, the following process was designed.

In a first step, the two outer layers are thermoformed as well-known monolithic parts. These can be easily overmoulded to increase the integration of additional structural and/or functional requirements within the part.

In the next process step, the core layer (foam, fold core or injected core) is positioned between the two outer skin layers in a press, after the contact surfaces of the inner and outer layers are preheated to allow bonding by thermal diffusion welding.

In the final process step, injection moulding of a long fibre-reinforced thermoplastic material around the edges allows a net-shape design as well as local edge reinforcement.

For the team, it was obvious that – driven by the strategic goal of the MAI Carbon cluster – a breakthrough for CFRP sandwich technology into large-scale production must be achieved. This resulted in a dramatic cycle time reduction from hours to less than 5 minutes (aeronautic materials) and 2.5 minutes (automotive materials) by using only one mould, which is the result of a well-designed process composed of robust and fully-automated process steps.

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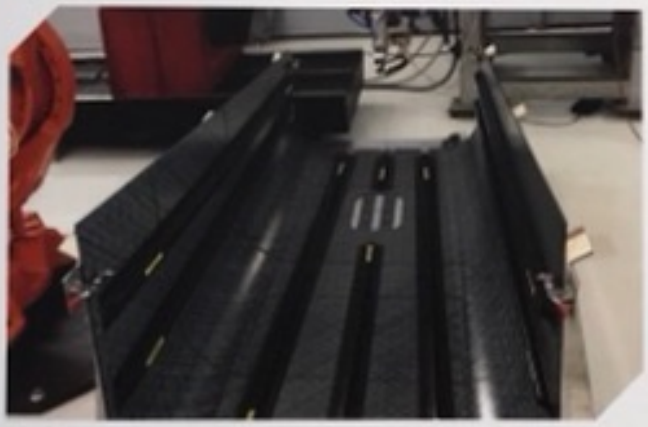
AEROSPACE PROCESS

STELIA AEROSPACE

PARTNERS: PORCHER INDUSTRIES, SINTEX NP, COMPOSE TOOL, CETIM, AVIACOMP SA, INSTITUT DE SOUDURE / COMPOSITE INTEGRITY

Full-OOA TP welded primary airframe

Full-OOA thermoplastic airframe with industrial dynamic induction welding demonstration using carbon tape for future fuselage applications and multi-functional parts produced by an overmoulding process.



KEY BENEFITS

- INDUCTION WELDING DEMONSTRATION FOR FUSELAGE PANELS
- 100% OOA THERMOPLASTIC STRUCTURE
- NEW DESIGN OPPORTUNITY WITH AN OVERMOULDING PROCESS
- FULLY-AUTOMATED, COST-EFFECTIVE PROCESS
- 100% RECYCLABLE AIRFRAME (TP)

The airframe's skin is produced by fully-automated deposition of materials by automated fibre placement (AFP) of new PEKK carbon slit tape and copper slit foil (innovative lightning strike protection material). STELIA Aerospace developed optimized AFP process parameters for the carbon slit tape and copper slit foil (heating laws, speed, compaction pressure) to allow an efficient out-of-autoclave (reduced investment) thermal consolidation cycle and ensure good material quality.

The omega stringers and frames are produced with a fast stamp forming process with a robotic loading system well-suited to automated high-volume production. Process simulation software was used to define the right stamping design tools in order to quickly achieve accurate sizing tolerance on the parts. This method makes it possible to avoid numerous and expensive tooling adjustment steps. This collaborative works was conducted by French subcontractors: CETIM in Nantes for the frames, Aviacomp in Toulouse for the stringers and Compose for the tooling. A new 12K woven carbon/PEKK laminate was specifically developed for the stamp forming process in order to achieve a cost-effective solution (vs. 3K).

The automated assembly process used for the stringers is based on robotic dynamic induction welding. The innovation focuses on the development of induction welding on a carbon UD tape with a metal protection on the surface and skin thickness variations. A test campaign was performed with a high number of specimens to set up the key induction welding process parameters.

The multi-functional one-part access door is produced by an overmoulding process. By combining two processes: injection (short fibre) and stamping (continuous fibre), additional features (inserts, ribs and hinge) were included in the access door to obtain a single lightweight part.

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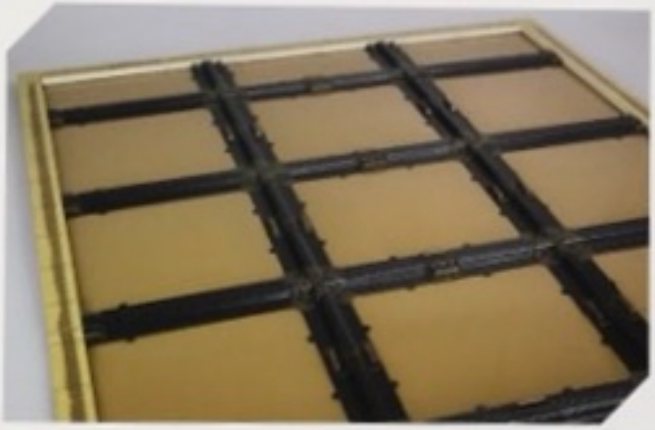
AEROSPACE APPLICATION

FRAUNHOFER ICT

PARTNERS: AIRBUS OPERATIONS GMBH, LASER ZENTRUM HANNOVER E.V., TENCATE ADVANCED COMPOSITES B.V., ELRING KLINGER AG, KMS AUTOMATION GMBH

Modular thermoplastic stiffening panels

Modular thermoplastic stiffening panels for aerospace applications. The panels lead to weight and cost savings, in addition to easy adaptation. They are recyclable and exhibit outstanding flame resistance.



KEY BENEFITS

- WEIGHT SAVINGS FOR NEW GENERATIONS OF AIRCRAFT
- MODULAR DESIGN ALLOWS EASY ADAPTATION TO USE CASE
- EASY INTEGRATION BY LASER TRANSMISSION WELDING
- INTEGRATED FUNCTIONALITY VIA HYBRID MOULDING
- ECONOMICAL MANUFACTURING FOR HIGH VOLUMES

The innovation relates to a new generation of modular stiffening panels for aerospace applications based on thermoplastic fibre-reinforced composites. The aim was to reduce the overall system weight and the manufacturing costs for high-volume production. Additionally, recyclability aspects as well as rising flame-retardancy requirements were addressed. Based on a polyetherimide (PEI) thermoplastic material, a new design concept and processing approach were developed. The main component of the innovation is a hybrid sub-structure manufactured from continuous carbon fibre-reinforced PEI fabrics (PEI/CF) and short glass fibre-reinforced PEI. The PEI fabrics are stampformed into simple-shaped omega profiles. Using over-injection moulding, these profiles are intrinsically assembled to a cruciform sub-structure. In the same process, connectors for post-assembly are integrated (PEI/GF). By connecting the sub-structures, a grid-shaped stiffening structure can be quickly assembled. The modular design of the structure allows flexible change of the overall dimensions, and thus airplane type and use case adaptation. The stiffener is integrated into a supporting frame and can be laser-transmission-welded to a lining or skin based on fibre-reinforced thermoplastics (PEI/GF).

The new generation of stiffening panels lead to overall weight savings. Additionally, they can be recycled, show highly reduced smoke and toxicity in case of fire, and withstand Airbus certified tests. The tests performed include fire safety requirements according to the applicable airworthiness regulations. Consequently, these panels might be used for a new generation of lining modules replacing thermoset sandwich structures.

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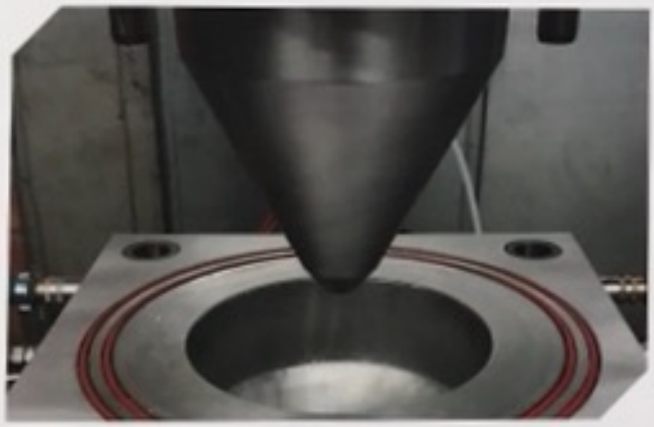
AEROSPACE APPLICATION

UNIVERSITY OF APPLIED SCIENCES RAPPERSWIL

PARTNERS: FACC, RÜHL PUROMER GMBH, ISOTHERM AG, WPT, TU DORTMUND

Polyurethane-RTM nose cone for jet engines

Using the high-pressure polyurethane-RTM process, jet engine nose cones with optimized properties can be manufactured in a fraction of the time commonly needed today.



KEY BENEFITS

- BETTER IMPACT AND ABRASION PROPERTIES
- DRAMATICALLY REDUCED PRODUCTION TIME AND COSTS
- OPTIMIZED AND EASIER PROCESSING
- PROLONGED OPERATING TIME
- LOWER MATERIAL COSTS

The innovation enables the production of composite components based on a polyurethane matrix using a high-pressure RTM process (HP-RTM). This combination allows the production of aeronautic components prone to abrasion and impacts in a very cost-efficient and fast process. The strength and stiffness properties of the resulting parts are comparable to components produced by established technologies and processes.

The combination of a fibre reinforcement, polyurethane resin and high-pressure RTM is particularly interesting – the low-viscosity, highly-reactive PU enables a fast processing route; in combination with a cavity pressure of 30bar or more, a low void content can be achieved. Additionally, PU offers outstanding abrasion resistance, as well as excellent impact toughness in a wide temperature range.

The PUR-RTM process was implemented to manufacture a jet engine nose cone – a typical aeronautic component exposed to prolonged abrasion and impacts. Today's manufacturing technologies for this type of part, mainly based on prepreg systems, have significant shortcomings such as the need for a complex coating or the use of toughened systems leading to higher injection viscosity. It was shown that with the newly developed process, high-quality polyurethane composite components are feasible. Simultaneously, processing times and efforts are reduced dramatically.

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VOTE FOR ME

AEROSPACE APPLICATION

AEROCOMPOSIT, JSC

PARTNER: SOLVAY

Infusion technology for an aircraft wing

Using infusion technology to manufacture primary structural elements for an aircraft wing, making it possible to build integral composite structures with high elongation and a complex aerodynamic form.

KEY BENEFITS

- LIGHTER AIRCRAFT STRUCTURES
- LOWER COST OF EQUIPMENT
- REDUCED TOTAL TIME AND POWER SPENDINGS
- MORE FLEXIBILITY IN PRODUCTION
- LOWER POROSITY, BETTER QUALITY OF PARTS

The advanced infusion technology developed by JSC Aero Composit's specialists (Russia) is used to manufacture primary structural elements for an aircraft wing. This technology makes it possible to build integral composite structures with high elongation and a complex aerodynamic form that cannot be made of metal.

The distinguishing feature of this technology is the capability of forming a composite structure from a dry carbon preform laid up by an automated (AFP) machine using carbon-fibre tape.

The process starts with the automated layup of preforms using a 6.35mm-wide dry carbon-fibre tape, resulting in dry carbon workpieces (preforms) with a specified typical form, in particular skins as well as angled or channel sections. Then, the preforms are placed into the tooling used for the infusion process, assembled and fixed according to the required design shape. Vacuum bagging of the tool with the preform ensures a proper manufacturing environment, with the resin supply line connections and the air bleed vents provided by the vacuum bag engineering design. Forming in an oven at 180°C follows. This manufacturing stage includes heating the workpiece (preform) together with the tool, resin injection and infusion, and curing. The process is called vacuum infusion. After the resin has hardened and the part is cured, the excess material is trimmed mechanically and the part is prepared for further assembly.

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VOTE FOR ME

CONSTRUCTION & INFRASTRUCTURE

KOMATSU SEIREN CO., LTD.

PARTNERS: KANAZAWA INSTITUTE OF TECHNOLOGY, NAGASE CHEMTEX CORPORATION

Cabkoma CFRTP strand rod

Komatsu Seiren developed a CFRTP strand rod capable of ultra-high speed moulding at low cost by in-situ polymerizing of a thermoplastic epoxy resin.

KEY BENEFITS

- HIGH PRODUCTIVITY AT LOW COST
- HIGH DURABILITY AND HIGH STRENGTH
- NON-FERROUS, RUSTPROOF MATERIAL
- LIGHTWEIGHT AND WINDABLE
- GOOD PROCESSABILITY, CAN BE APPLIED ON-SITE

The Cabkoma CFRTP strand rod is a strong and flexible rope-shaped composite material that combines traditional Japanese braiding technology with modern carbon fibre technology. This product has a huge potential to change the lives of people all over the world.

One of the product's innovations is its original covering technology using a braiding technique. Compared to the conventional covering method (winding), it combines high durability and high strength and allows high production rates at low cost.

Another innovation is the in-situ polymerized thermoplastic epoxy resin. Even though it is an epoxy resin, this innovative resin polymerizes linearly, so polymerization (after cure) shows the physical properties of thermoplastics. This resin combines the good adhesion performance of epoxy and the toughness of a linear polymer. Moreover, it offers high fibre impregnation since its in-situ polymerization capability enables low-viscosity impregnation before polymerization. In addition, because this resin can be polymerized in the atmospheric air, ultra-high speed production can be achieved with low-cost equipment.

With this GF-covered CFRTP strand rod, Komatsu Seiren pioneered new applications for the seismic reinforcement of buildings. This rod is lightweight, windable and the best seismic reinforcement material for old wooden Japanese buildings. Since it is non-ferrous, and thus rustproof, it can be used in important cultural landmarks.

This rod uses a thermoplastic resin, so that it can be easily bent or spliced under heat. When used in infrastructure, a secondary process is possible on the work site, thus meeting a great potential need in the building and construction industry.

Komatsu Seiren filed several patents applications for the strand rod itself and its use as a seismic reinforcement material.

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VOTE FOR ME

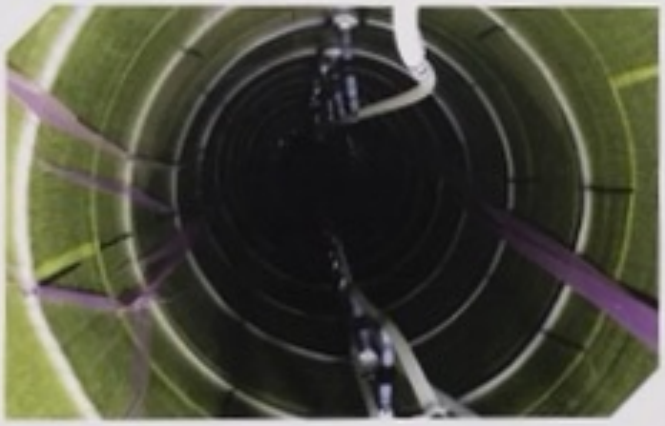
CONSTRUCTION & INFRASTRUCTURE

GRUPO NAVEC

PARTNERS: SAERTEX GMBH, HENKEL

Below the line: concrete pipe repair with carbon fibre.

In-situ manufacturing of a carbon fibre pipeline by means of an epoxy resin infusion process and subsequent vacuum consolidation, using the existing reinforced concrete pipe as a lost mould.



KEY BENEFITS

- RELIABILITY: CALCULATED, TESTED, AND PROVEN IN REAL-LIFE USE CASE
- DURABILITY: ESTIMATED LIFETIME 40 YEARS
- SAFE CONSTRUCTION AND INSTALLATION PHASES
- QUICKNESS: EXECUTION IN HALF THE TIME
- ECONOMIC: MUCH LOWER COST THAN TRADITIONAL SOLUTIONS

This innovation involves the in-situ manufacturing of a carbon fibre pipeline by means of an epoxy resin infusion process and subsequent vacuum consolidation, using the existing reinforced concrete pipe of the cooling system of a nuclear power plant reactor in poor conditions as a lost mould.

The pipe is 1,525 metres in length, 800 mm in diameter and is buried between 4 and 9 metres deep. Due to the very complex pipe system with crossings, vertical sections and manholes, it was not possible to use a liner technology.

SAERfix self-adhesive carbon non-crimp fabrics from Saertex were used. These tacky fabrics helped the workers in the lay-up, especially in the vertical parts of the existing pipe – which was used as the mould.

20,000 m2 of carbon fabrics and 25,000 kg of epoxy resin were used, together with 13,200 valves, 28,150 m of vacuum tubing and 5,300 m^3 of vacuum infusion bags for the vacuum infusion process. All for just one project that could be applied to the many industrial facilities in oil & gas, chemical industries, electricity plants or water treatment facilities that face wash-out pipe systems from sea water.

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VOTE FOR ME

CONSTRUCTION & INFRASTRUCTURE

SOLUTIONS COMPOSITES

PARTNER: TOP GLASS

Innovative pultruded deck for station platforms

Innovative pultruded deck for station platforms to improve and provide safer accessibility to trains.

KEY BENEFITS

- LIGHTWEIGHT MATERIAL, EASE OF USE
- HIGH MECHANICAL PERFORMANCE, ROBUSTNESS
- MATERIAL SAVINGS RESULTING IN COST SAVINGS
- GREAT FIRE PROPERTIES
- LONG-LASTING SOLUTION

To solve accessibility problems, Solutions Composites developed an innovative deck that enhances safe access to trains, reducing the wide gap between the train and the platform. The pultruded deck offers high mechanical performance. The lightweight fibreglass profiles make for an easy and rapid installation on site. The formulation provides great fire resistance (M1-F0 class), thermal and electrical insulation. The deck requires very low maintenance and includes composite tactile strips to prevent slips and falls.

Solutions Composites designed a robust, long-lasting and safe deck system for station platforms. The innovative pultruded deck was already installed in six RER train stations of the Paris railway network (four in 2017). The new deck system covers about 1900 square metres of Parisian station platforms.

Other stations will soon be equiped as this solution has proved its efficiency and meets French National Railway specifications.

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RAILWAY

ELG CARBON FIBRE LTD.

PARTNERS: ALSTOM TRANSPORT UK, MAGMA STRUCTURES, UNIVERSITY OF BIRMINGHAM, UNIVERSITY OF HUDDERSFIELD

Optimised lightweight carbon fibre bogie frame

This is the first project to develop a carbon fibre bogie frame including recycled material that addresses the barriers that have prevented commercial adoption.

KEY BENEFITS

- WEIGHT REDUCTION OF AT LEAST 50%
- REDUCED TRACK WEAR AND MAINTENANCE
- REDUCED GLOBAL WARMING POTENTIAL
- HIGH VOLUME MANUFACTURING TECHNIQUE
- REDUCED CAPITAL COST OF THE COMPOSITE SOLUTION

This project, which received a £1.25 million grant from the RSSB, will deliver a composite bogie frame concept addressing the barriers that have prevented commercial adoption. It will be the first project to develop a carbon fibre bogie frame and the first to include recycled material.

The project aimed to deliver at least 50% weight saving over metal frames through the use of carbon fibre materials: the current design delivers at least 70% weight saving. The mechanical properties of the materials are tailored to provide integrated suspension and steering functionality, reducing the lateral forces on rail tracks by up to 40%, and also providing a 20% reduction in overall train fuel consumption. This tailoring is achieved by using a combination of approximately 80% recycled carbon fibre and 20% prime carbon fibre. By achieving this tailored flexibility using a lightweight composite construction, vertical loading will be reduced as a consequence of lower axle weight, which will further reduce track damage.

The potential affordability issues associated with the use of composites are addressed through the utilisation of low-cost recycled carbon fibre materials and a cost-effective processing technique suitable for the manufacture of components of this size and complexity. The project team is now manufacturing and testing critical design details and manufacturing processes. Output from these tasks will be used to optimise the design after which full scale prototypes will be built and tested. In addition, an integral structural performance monitoring system was developed to measure the performance of the demonstrators during testing, which will also have the capability to be deployed as an in-service health monitoring system. This condition monitoring system will be an important aspect of satisfying the rail regulator regarding the use of composite materials and provide rail operators with valuable in-service data previously unavailable.

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RAILWAY

PENSO

Composite rail door

Penso designed and manufactured a composite rail door leaf assembly suitable for London Underground, improving the reliability and maintenance of the original aluminium component.

KEY BENEFITS

- OVERALL WEIGHT SAVING
- NEW WINDOW CASSETTE DESIGN
- IMPROVED DURABILITY
- CLOSED-CELL CORE TO PREVENT WATER INGRESS
- COMPLIANT WITH BS 6853 CATEGORY 1A

Penso designed and manufactured a composite rail door leaf assembly suitable for London Underground, improving the reliability and maintenance of the original aluminium component. The door was designed for the Jubilee Line, and also fits the Northern Line.

This unique train door design offers a total weight saving of more than 10kg, providing a number of benefits to the overall train, and has an extended life service of up to 40 years. The lightweight rail door enables faster opening and closing times, resulting in more people able to be transported per hour. The weight saving per door will create an overall lighter train, leading to less track and wheel wear and lowering the running costs and energy usage.

The door is designed to have a new window cassette that can be fitted in less than one hour. An additional benefit of the window design is that if it becomes damaged, the window can be replaced from inside the carriage and does not require removal of the whole door. Penso's press forming technology also reduces the manufacturing cycle time significantly to just 45 minutes, making the door more economically viable to produce in volume.

Penso decided to use a foam core in the train door design: this will not only reduce noise ingress through the door aperture, but also significantly reduce the risk of water penetration. Other materials selected include carbon fibre and glass fibre, contributing to the mass weight saving and a better structural performance. The use of phenolic materials also enabled the door to successfully pass fire, smoke and toxicity (FST) testing to meet the stringent deep tunnel requirements of BS 6853 Category 1A.

The door is engineered to have better dimensional stability. As the door leaf is a completely enclosed part manufactured in one pressing process, it has a greater dimensional accuracy than the existing aluminium honeycomb sandwich assemblies.

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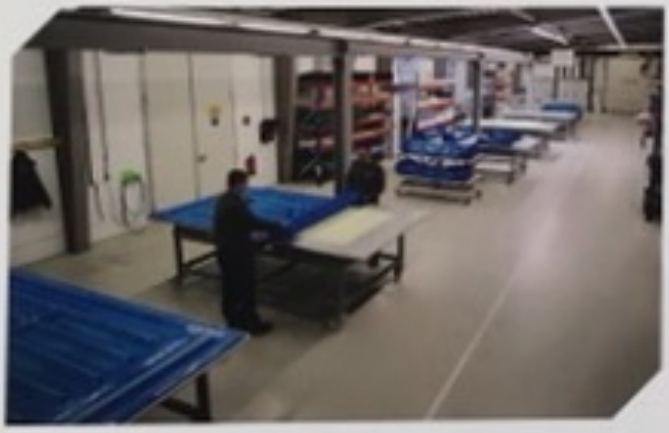
RAILWAY

SAERTEX GMBH & CO

PARTNERS: FORSTER SYSTEM-MONTAGE-TECHNIK GMBH, ALAN HARPER COMPOSITES

Breakthrough in railways: renovating the ICE train

Replacing plywood floor panels with Saertex Leo® GFRP panels in 66 of the prestigous ICE3 fast trains of Deutsche Bahn.



KEY BENEFITS

- PASSENGER SAFETY: COMPLIANCE WITH NEW EN 45545-2 STANDARD
- 50% WEIGHT REDUCTION
- INCREASED LIFETIME, HIGH TENSILE STRENGTH
- NON-TOXIC SOLUTION
- EASE OF USE: VACUUM INFUSION

The ICE is the prestigious fastest train of the Deutsche Bahn fleet. The company presented the new version 4 last year. Over 66 trains of the version 3 are still in use as the main passenger railway transportation system in Germany. This fleet was introduced in the year 2000 and its passenger wagons are now being renovated. In order to meet modern comfort standards, the interior will be upgraded, for instance regarding passenger entertainment and air conditioning. The additional weight of the new equipment had to be compensated by sophisticated lightweight solutions. With this development, a lightweight flooring system was created to keep the weight input at a minimum. Importantly, the novel system needs to fulfill the EN 45545-2 fire safety regulations, which will be valid from 2018 on.

The entire floor system, with an average panel size of 2400 x 1200 mm, will be renewed to replace heavy plywood with lightweight GFRP panels based on Saertex Leo® materials. This non-crimp fabric-based material system with integrated coating made it possible to manufacture all the sandwich panels in a vacuum infusion process using vinylester resin. Importantly, the production process incorporates reusable silicon membrane technologies as offered by Alan Harper Composites. This technique was implemented and adjusted by SMT to allow an enhanced process with increased output, to gain higher reproducibility and quality value, but also to save material costs. This resulted in the competitive production of high-end composites with minimum material waste. The use of this composite material inside the new floor of the ICE3 achieved the highest fire safety standards with 98% less flame progress, 57x less smoke generation and 12x higher tensile strength compared to the hand lay-up solutions in competition.

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MARINE

ULJANIK JSC

Composite cargo decks for a 7000-car car carrier vessel

SIEM Cicero car carrier vessel using a large number of GRP composite structures for cargo decks, saving considerable weight, reducing fuel consumption and CO_2 emissions.

KEY BENEFITS

- REDUCED FUEL CONSUMPTION: 4.5% OR 2.1 T/DAY
- INCREASED PAYLOAD: 800 TONS
- REDUCED PRODUCTION LEAD TIME
- IMPROVED CREW AND CARGO SAFETY IN CASE OF A FIRE
- SAME PRODUCTION COST AS CONVENTIONAL DESIGN

In July 2017, Uljanik Group delivered the SIEM Cicerocar carrier vessel featuring a high number of composite structures in the cargo decks. The major novelty is that the three uppermost decks, in a 13-deck vessel, are constructed from GRP sandwich panels, saving considerable weight high up in the ship and reducing fuel consumption and CO2 emissions.

Compared to traditional steel decks, the weight savings for the Uljanik-designed decks is 25% or 200 tons, at equal production cost. Pure car/truck carriers (PCTCs) of this type usually incorporate ballast to counteract their high centre of gravity in order to fulfil stability requirements. So, reducing structural weight high up in the ship provides a double benefit. The result is a 4.5% lower fuel consumption or an increased payload (up to 800 tons).

The Uljanik-designed vessel has the lowest fuel consumption per car-equivalent unit (CEU) of any PCTC in its class.

In a conventional steel design, a cargo deck has a steel deck plating stiffened by transversal web frames and longitudinal stiffeners. In the innovative deck structure design, the composite structure is used for decks 10, 11 and 12, covering a total area of 12,600 m². The structure arrangement consists of steel supporting grillage and 1043 composite sandwich panels (vacuum-infused GRP panels with a PVC core). The laminates are made of glass fibre-reinforced polyester with a fibre content of about 74% by weight. The core consists of two densities of PVC. Each panel has 22 lashing holes to secure the cargo during operation at sea. The composite panels are fastened to the supporting structure by a flexible bolt connection.

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VOTE FOR ME

MARINE

SAERTEX GMBH

PARTNER: MEYER WERFT (NEPTUN)

From steel to composites in a 110m-long river cruise ship

From steel to composites: Neptun and Saertex created a composite deck for a 110m-long river ship certified by the CCNR European authorities.

KEY BENEFITS

- CCNR APPROVAL
- 5CM LESS DRAUGHT: LONGER SEASON
- PASSENGER SAFETY IN CASE OF A FIRE ON BOARD
- 45% WEIGHT SAVINGS
- DESIGN FREEDOM FOR THE SHIP ENGINEERS

In this project, Saertex and its partner Meyer Group managed to replace steel with composites using Saertex LEO sandwich materials in the design of a new river cruise ship of 110m length and 11.4m width. The whole sundeck, including walls and floor, was changed to composites, resulting in 45% weight savings for the sundeck and the walls, and a draught reduction of roughly 5cm.

The main challenge was not only to manage the technical challenges related to the mechanical properties of the upper and lower decks and the high fire safety standards for shipbuilding. It was also to convince people and authorities that composites can perform like steel and show an equivalence to steel. In connection with the design of a mock-up of the superstructure, the proof of safety in terms of strength, buckling, etc. was carried out according to the class rules.

This project started in 2014 with the first contact between Meyer and Saertex. On its way to realization, the innovation managers at Meyer and the Saertex LEO engineers had to convince ship buyers, the class society and the Central Commission for the Navigation of the Rhine (CCNR) in Strasbourg about this innovative material as an alternative to traditional steel materials. The CCNR works on matters that concern not only the Rhine but all inland waterways in Europe as a whole and, therefore, it was a necessary requirement to get the official permission and a recommendation for the usage of this material.

To convince people, a series of trials, fire safety tests, mechanical tests and the creation of a complete upper deck mock-up of 10.6m x 11.4m were necessary. Several visits at the authorities involved in the certification of river ships were needed to manage the project. Additionally, a FEM structural analysis and fire tests were performed in a fire laboratory to get the material approved by the European CCNR river ship authority.

JEC WORLD INNOVATION AWARDS 2018

VOTE FOR ME

MARINE

MULTIPLAST GROUPE CARBOMAN

PARTNER: GROUPE BÉNÉTEAU

New process for manufacturing hydrofoils

Multiplast transferred wind blade building knowledge from one of its branches to create a mass production process for the manufacture of foils (one set a week).

KEY BENEFITS

- REDUCED PRODUCTION COST
- IMPROVED ERGONOMICS FOR BETTER WORK PERFORMANCE
- WASTE REDUCTION

A new building concept was needed for the manufacture of hydrofoils in large volumes. The main parameters for this project were as follows: reaching an ambitious target price (4 to 5 times less expensive than a "classic" process), ensuring a perfect shape of the foil section, guaranteeing identical weight for all the appendages, and producing one set of foils per week over one year.

The Multiplast R&D department built 15 sample foils over four months to determine the influence of each parameter of the infu-jection process: resin injection pressure, injection temperature, number of carbon layers needed to reach the ideal resin/fibre ratio, ideal resin viscosity, diameter of the injection channels, influence of the foil tip...

The idea was to produce the first set of foils using an optimized lean process. Kitting the carbon and glass layers, CNC machining the foam inserts, minimizing the movements required for the foil builders at their workstation and optimizing their position and posture are only a few examples of the tasks achieved by the project manager, the team leader and the operators themselves. Weekly team meetings around a PDCA (Plan Do Check Act) support constantly pushed the process towards the necessary optimization of the production time while reducing the production risks and costs.

The second set of foils was dedicated to destructive tests. In the presence of the designers, the calculator and the Bénéteau Project manager, two foils were tested to breaking load, one in roll up and the second one, in unroll, the latter being the worst configuration from a composite engineer point of view. Indeed, in the unroll case, each ply of the carbon beam tends to separate from the next one and the weak part of the structural chain is the resistance of the resin itself. Calculation and construction were correct as the actual breaking loads matched the theorical breaking loads at more than 4 tons.

JEC WORLD INNOVATION AWARDS 2018

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VOTE FOR ME

SUSTAINABILITY

ARKEMA INC.

PARTNERS: CHOMARAT, IACMI – THE COMPOSITES INSTITUTE, JOHNS MANVILLE, HUNTSMAN POLYURETHANES, SIKA AXSON, TPI COMPOSITES

Innovative thermoplastic-matrix wind turbine blade

The nine-metre demonstrator blade highlights new technologies to drive down the LCOE. Technologies are available for use in current wind blade manufacturing plants.

KEY BENEFITS

- MORE ENVIRONMENTALLY FRIENDLY MATERIALS/PROCESSING
- RECYCLABLE THERMOPLASTIC BLADE SHELL AND SHEAR WEB
- FIRST USE OF TEXTILE PAN CARBON FIBRE IN WIND APPLICATIONS
- OVERALL LOWER COST OF BLADE MANUFACTURE
- 100% POST-CONSUMER PET FOAM USAGE

A novel demonstration blade, nine metres in length, features design elements of multi-megawatt scale blades exceeding 50 metres, including a large root diameter, inboard flatback airfoils, outboard high-performance airfoils and carbon fibre spar caps. The use of this design allows for validation of the manufacturing concepts and increases confidence the technology can be scalable as it matures.

The wind energy market competes with other forms of electricity generation, including coal, natural gas, solar and hydropower. The Levelized Cost of Energy (LCOE) has steadily declined as blade lengths have increased. Further breakthroughs are needed to shorten manufacturing times and bring lower-cost carbon fibre into blade manufacture to reduce weight and increase lengths further. The incorporation of textile PAN-based carbon fibre developed by Oak Ridge National Laboratories, pultruded into a tough polyurethane matrix, will enable a significant reduction in carbon fibre costs for wind blades. The use of a room-temperature-infused reactive thermoplastic improves the impact strength of the shells and eliminates the need for post-cure during manufacture compared to epoxy. The materials used in the blade enhance sustainability – the textile PAN carbon fibre requires 60% less energy to manufacture, the reactive thermoplastic can be infused at room temperature (versus heated tools for epoxy) and does not require post-cure, and the thermoplastic shells can be recycled at end of life. The foam core is made from post-consumer PET plastic, and has 33% less embodied energy.

Many of the above materials are recent to the marketplace, so IACMI and industrial partners elected to raise their visibility and promise to address key needs of the wind turbine marketplace.

JEC WORLD INNOVATION AWARDS 2018

VOTE FOR ME

SUSTAINABILITY

CETIM-CERMAT

PARTNER: CETIM

3-in-1 line for recycled composites manufacturing

Modular line using an innovative thermomechanical process to manufacture large-scale panels from composite or plastic waste and for hot-stamping parts from these panels.

KEY BENEFITS

- MODULAR, FLEXIBLE PRODUCTION LINE
- PRODUCTION OF HIGH-PERFORMANCE RECYCLED COMPOSITES
- COST EFFECTIVENESS
- TECHNOLOGIES ADAPTED TO SMEs

The innovation is a recycling line for both thermoplastics and thermoplastic composite materials that is unique in Europe. It is the only line that can use waste to produce large-scale panels with maximized mechanical performance in-between short-fibre injection-moulded plastics and continuous fibre-reinforced thermoplastic composite materials.
The innovation is based on a thermomechanical "step-by-step" process that makes it possible to recover either:
- composite waste (Thermosaic® route): recovery of production scrap and/or end-of-life waste, sorted and crushed beforehand, and then shredded. The shreds are bound by thermocompression into the shape of structural panels; or - recycled plastic materials combined with fibre reinforcements (ThermoPRIME® route): using recycled plastics to produce new materials with a higher technical and economic value.

The line is composed of:
- a fixed central element incorporating a heating module and a press with tooling, fed by a conveyor system;
- interchangeable feeding modules depending on the type of waste to recover (Thermosaic® shred feeding modules, ThermoPRIME® modules to unwind films and reinforcements);
- a cutting tool to divide the panels at the required length after consolidation (the panels are produced in continuous lengths).

The line can also be equipped with a specific module to produce stamped parts from the composite panels obtained with both the Thermosaic® and the ThermoPRIME® processes. This pilot line, which prefigures the industrial lines that will be available in a few years, was installed and commissioned on a new R&D platform at CETIM-CERMAT in Mulhouse (France).

JEC WORLD INNOVATION AWARDS

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VOTE FOR ME

SUSTAINABILITY

GS4C SRL

PARTNERS: ENTROPY RESINS, ISOMATEX, COMPSULT, DIAB, GIVIDI FABRICS, CORMATEX

Loop 650: a sustainable cradle-to-cradle composite sailing boat

Sustainable, zero-landfill cradle-to-cradle industrial composite manufacturing technology demonstrator.

KEY BENEFITS

- INDUSTRIAL READY
- CRADLE-TO-CRADLE RECYCLING
- ZERO-LANDFILL MANUFACTURING
- LOW EMBODIED ENERGY

The Loop 650 project was devised as an example of industrial circular economy for the composite industry. The aim of the project was to minimize the overall embodied energy and to identify solutions and technologies that would allow zero-landfill manufacturing, including a sustainable and cradle-to-cradle end-of-life recycling system. It uses a bio-based epoxy resin with very low emissions during manufacturing and very low embodied energy. For this first prototype, the resin will not be recycled and will be burnt through a pyrolysis process at end of life to allow the recovery of clean fibre. This process was verified at the lab scale. The fibre recovered was successfully re-melted into the same original raw mineral, ready to be stretched into new virgin fibre. All the manufacturing waste was recovered and recycled into new chopped strand mats to be re-used for new moulds and non-structural parts, maintaining the cradle-to-cradle recyclability of the fibre. In the lifecycle of the material combination identified for the task, the recycled fibre cleaned from the matrix feeds back into the original material value chain with no downgrade. Thanks to the specific manufacturing process of the mineral reinforcement fibre used for the composite, the recovered material is exactly the same as the material manufactured from virgin raw materials.

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VOTE FOR ME

SMART CITIES

EXEL COMPOSITES OYJ

PARTNERS: NOKIA BELL LABS, VAISALA OYJ, TELESTE OY, INDAGON OY

5G smart LED lighting pole

Smart LED lighting pole with integrated functions. A real-world use-case product that enables the development of a smart city.

KEY BENEFITS

- INTEGRATED FUNCTIONS – ENABLES NEW BUSINESS MODELS
- EASE OF ASSEMBLY, LIGHTWEIGHT POLE
- LONGER LIFETIME COMPARED TO STEEL AND WOOD
- AESTHETICALLY CAMOUFLAGED ANTENNAS

A full-composite lighting pole with integrated small cell 5G antennas (5-90Ghz) inside the pole structure, making it an urban 5G era antenna base station. The pole works as a mast, architectural casing, weather cover and radome for the antenna(s)/radio(s) (transmitter and/or receiver). The laminate structure of the pole wall is designed with optimized attenuation properties enabling the millimeter-length radio waves to penetrate the wall structure without dampening the signal too much. The poles are also equipped with a weather station, an air quality sensor, a surveillance camera and/or positioning solutions when applicable. The tubes for the pole are mainly made of glass fibre and Desmocomp innovative polyurethane resin from Covestro, using the pultrusion process. The poles are aimed for areas, mainly large cities, that will need a dense network to support all the digital services provided in the future (e.g. autonomous cars). DALI control enables remote control of the LED lights. The lighting head is equipped with integrated PV modules to enable the use of solar energy in geographical areas where this is feasible.

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VOTE FOR ME

SMART CITIES

MC MATERIALES COMPUESTOS

PARTNERS: PLAQUIMET, PURCOM, IS GROUPE – COMPOSITE INTEGRITY, G12 INNOVATION

Wet Core Pod composite housing module

The Wet Core Pod is a composite housing module that, through industrialization, facilitates the most complex, expensive and time-consuming stage of a construction project.

KEY BENEFITS

- REDUCE CONSTRUCTION TIME, INCREASE PRODUCTIVITY
- TOTAL QUALITY CONTROL
- ENERGY SAVE AND ENVIRONMENT FRIENDLY

The Wet Core Pod is a module integrating a bathroom, a kitchen and a laundry that was developed with the aim of accelerating installation time and simplifying the construction of social housing. The system is manufactured with a basic design that connects the three sanitary facilities, but it can have variations according to the project and adapt to all types of terminations for single-family homes in general. The module was developed for industrial production using composite materials. These materials were selected for their low weight, as the module is transported mounted to the construction site, their durability, since the module will be exposed to humidity and bad weather, and their low maintenance and high performance. Composite materials offer improved thermal and acoustic comfort with low energy consumption, combined with ease of cleaning and sanitizing. The module was designed using four production processes: integrated RTM, continuous rolling, pultrusion and PIR injection.

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VOTE FOR ME

SMART CITIES

SICOMIN

PARTNER: DECISION SA

InfuGreen 810 bio-resin for the SeaBubble water taxi

The InfuGreen 810 bio-based infusion resin offers the highest level of sustainable content on the market, the same performance as conventional epoxies and high-volume manufacturing capability.

KEY BENEFITS

- HIGHEST LEVEL OF SUSTAINABLE CONTENT ON THE MARKET
- SAME PERFORMANCE AS CONVENTIONAL EPOXIES
- ENABLES HIGH-VOLUME MANUFACTURING
- DNV/GL CERTIFICATION
- FIRST INDUSTRIAL-VOLUME BIO-EPOXY INFUSION RESIN

SeaBubble is a new on-demand urban transportation network that uses the waterways of major cities. Passengers will ride in composite SeaBubble water taxis that "fly" silently above the water powered by a clean-charging electric drive system. The SeaBubble does not generate any air pollutants or CO2 emissions.

A lightweight composite construction means the craft's range between charging is maximised. Composites also offer the strength, durability and corrosion resistance required for this marine application.

The SeaBubble specifications called for a bio-based resin with equivalent performance to a conventional resin. The resin also had to enable a high-volume manufacturing technique. These two factors are generally difficult to achieve. It was a challenge for Sicomin's chemists to formulate a low-viscosity system with such a high bio-based carbon content, but the company succeeded in creating the first bio-epoxy infusion-specific resin available in industrial volumes to support production on the scale of the Seabubble project plans. The InfuGreen 810 bio-based epoxy resin formulated by Sicomin contains 38% bio-carbon derived from plant-based sources. The resin's bio-based carbon content is certified by an independent laboratory using Carbon 14 measurements (ASTM D6866 or XP CEN/TS 16640).

The resin has an extremely low viscosity at ambient temperature and is specifically formulated for the mass production of parts using injection or infusion techniques. It is extremely easy to manage during the infusion process with a very low exotherm, even when infusing laminates up to 150 mm in thickness. It was also awarded the DNV GL marine industry certification. This was a significant factor in its selection for this project, providing quality assurance and enabling decision to make rapid progress during the initial stages of the build.

JEC WORLD INNOVATION AWARDS 2018

VOTE FOR ME

SPORTS & LEISURE

BMW GROUP

PARTNERS: EDAG ENGINEERING GMBH, KRAUSSMAFFEI TECHNOLOGIES GMBH, CHR. KARL SIEBENWURST GMBH & CO. KG, TUM-LCC, AUTOMATION W+R GMBH, FHG-IGCV

Modular construction system for a motorcycle rear swingarm

Modular system for a complex-shaped carbon fibre-reinforced swingarm to individually adjust the mechanical properties at competitive cost and weight compared to metallic solutions.

KEY BENEFITS

- PERFORMANCE-ADAPTED PARTS WITHIN ONE MOULD
- ADAPTED LOAD PATH, CARBON UD TAPE REINFORCEMENT
- ECONOMIC LARGE-SCALE PRODUCTION POSSIBLE
- HIGH DESIGN FLEXIBILITY BY INJECTION MOULDING
- GOOD COHERENCE WITH SIMULATION AND TESTING RESULTS

A complex-shaped structural module – a motorcycle rear swingarm produced with a carbon fibre-reinforced thermoplastic – was realized and successfully tested. There was a very good coherence between the predicted results of the simulation and the hardware test.

One of the most important results is the extraordinary process concept that allows to produce parts with various mechanical properties using a single injection mould. With this modular construction system, the mechanical properties of the part can be aligned with the demand of the structure, in accordance with different cost requirements, only by modifying the endless carbon-reinforced insert or by welding additional structural covers.

During the development of the part, many problems had to be solved, e.g. how to place the tape on a curved surface and how to achieve good adhesion between the tape and the metallic inserts.

Besides the automated injection moulding process, the inserts were produced with endless thermoplastics tapes in a fully automated and controlled process.

Key benefits:

- Modular system to individually adjust the mechanical properties of the injection-moulded part.
- Cost, weight and performance competitive with metallic solutions.
- Good coherence between the simulation and the part testing results (UD tape reinforcement and matrix material).

JEC WORLD INNOVATION AWARDS 2018

VOTE FOR ME

SPORTS & LEISURE

SCHAPPE TECHNIQUES

PARTNERS: VISCERAL PERFORMANCE INC. GROUPE CTT COMPSULT MAT-COMP

First-ever carbon/PEI hockey stick

An advanced hockey stick (made of continuous carbon-fibre-reinforced thermoplastic materials) that delivers superior toughness/durability and on-ice performance, while being fully recyclable.

KEY BENEFITS

- SUPERIOR TOUGHNESS/DURABILITY OF THE COMPOSITE
- SHORT CONSOLIDATION CYCLE
- FULLY RECYCLABLE (HOLLOW PART)

Current hockey sticks are mostly made with thermoset composites, given the performance-enhancing properties offered by this type of material. The disadvantage is that they are relatively brittle, leading to potential breakage at the worst possible moments during game action and considerable costs (for multiple replacements during a season).

Visceral Performance's Lethal stick is the first carbon/PEI hockey stick. It is made from Schappe Techniques' TPFL® carbon/PEI that allows for the production of porosity-free composites. The TPFL® made of stretch-broken carbon fibres also allows for perfect conformability to the complex geometry of the tool that was developed. These features, combined with net-shape preforming technologies developed by Group CTT, offer superior characteristics. The preforms are then processed using Visceral Performance's proprietary processing technology to create hollow parts.

The end-result is a stick that offers superior toughness, allowing for an advanced optimization of weight-to-stiffness properties, thus producing unprecedented performance when shooting a hockey puck. The thermoplastic composites also offer superior surface finish and are fully recyclable.

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VOTE FOR ME

SPORTS & LEISURE

ADHEREND INNOVATIONS, LLC

PARTNER: COMPOSITES UNIVERSAL GROUP

Project Cedrus: advanced carbon hydrofoil for kites

Using a patent-pending design and manufacturing technique based on optimized composite materials, Project Cedrus is the lightest, safest, most compatible, and environmentally friendly hydrofoil ever introduced.

KEY BENEFITS

- REDUCED ENVIRONMENTAL IMPACT
- SAFETY
- LOW WEIGHT
- LOW COST
- COMPATIBILITY

Project Cedrus introduces the most advanced manufacturing processes from aerospace, automotive, and consumer products to the world of sporting goods. The first mass-produced hollow carbon hydrofoil for kite, windsurf, SUP, and surf boards offers reduced weight and cost while improving the safety and environmental impact of the activities. The hydrofoil was entirely designed and optimized using CAD and finite element analysis, and a single prototype and set of moulds was all that was needed for validation, dramatically reducing development costs, schedule, and waste. To achieve the lightest weight of any commercially available hydrofoil, the structural box of the mast is produced in two pieces using low-cost open moulding techniques, and bonded together using an advanced adhesive system. This eliminates the need for expensive bladder moulds or high-pressure tooling, and allows for freedom and constant optimization of the layup tailored to the rider's style and weight. Non-structural leading and trailing edges extruded from soft thermoplastic polymers such as TPU or flexible PVC are then adhesively bonded to the front and rear spars, producing a hybrid structure offering the necessary strength and stiffness, with reduced weight, cost, and improved safety and durability. The design is material and process agnostic, and easily scaled for higher rate manufacturing using stamping, CCM (continuous compression moulding), or even HP RTM. In addition to lower weight and cost, the design and assembly process allows for the integration of metallic fittings and adapters to interface with any foil board for any sport. The innovative technology will be available on foils produced for Bay Area Kiteboarding as the launch customer, followed shortly by the surfboard foil market. The technology is also available for license, in the interest of improving the safety and performance of equipment in all forms of hydrofoil sports, and to reduce the environmental impact of these activities.

JEC WORLD INNOVATION AWARDS 2018

VOTE FOR ME

AUTOMOTIVE APPLICATION

FORD WERKE GMBH

PARTNERS: GESTAMP, GRM CONSULTING, UNIVERSITY OF WARWICK

Composite lightweight automotive suspension system

A structural composite suspension component producing significant weight savings using an industry-first patented prepreg/SMC/steel overmoulded manufacturing process, designed applying newly developed computer-aided engineering (CAE) technology.

KEY BENEFITS

- WEIGHT REDUCTION WITH AN ASSOCIATED REDUCTION OF CO_2 EMISSIONS
- COMPLEX COMPOSITE PART MANUFACTURED IN ONE SHOT
- REDUCED ENGINEERING/DEVELOPMENT TIME TO MARKET
- CAE TOOLS FOR THE OPTIMIZATION OF MULTI-MATERIAL PARTS
- INDUSTRY-FIRST PREPREG/SMC/STEEL OVERMOULDING

The Composite Lightweight Automotive Suspension System (CLASS) project, which was conceived in support of Ford's (or automotive OEMs') lightweight chassis development strategy for further reduction of vehicle CO2 emissions, successfully delivered a new tieblade-knuckle design, 35% lighter than the multi-piece steel design it replaced. The new design was tested in accordance with the series production component and system verification process with test results being used to successfully correlate the results predicted in CAE.

The opportunity was taken to develop an innovative design, which incorporates multiple composite materials (continuous carbon fibre bi-axial and unidirectional epoxy prepregs with discontinuous carbon fibre/vinyl ester SMC) in combination with a steel insert. The CAE analysis tools created specifically to support the development of this innovative design were used to optimize material usage (composite and steel) in one step, based on component strength, stiffness and durability. The compliance with these requirements was verified and later correlated in testing.

The development of a production process capable of manufacturing a multi-material component in a single moulding cycle required innovative process and mould design solutions to ensure consistent part quality and to prevent mould damage. Extensive in-mould instrumentation was used to generate critical parametric data that was fed into the multi-loop post-processing analysis necessary to optimize the moulding cycle time.

JEC WORLD INNOVATION AWARDS 2018

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VOTE FOR ME

AUTOMOTIVE APPLICATION

HANWHA ADVANCED MATERIALS

Lightweight seat back frame for SUV second row

Development of the world's first SUV second-row seat back frame using composite materials.

KEY BENEFITS

- LOW WEIGHT
- SHORT CYCLE TIME AND REDUCED NUMBER OF PARTS
- RECYCLABLE

This innovation concerns the development of the world's first SUV seat frame using a new rib and channel hybrid design using composite materials to secure both strength and stiffness. The channel structure makes it possible to keep the fibre orientation as designed during the compression moulding process.

A new grade of GMT material and CFRTPC is used. The new GMT has a 200% higher tensile strength than the former classical Hanwha GMT product. The CFRTPC is a PP-based continuous fibre-reinforced thermoplastic composite that shows over 600MPa of tensile strength in unidirectional tests.

The frame is 20% lighter than steel, offering high fuel efficiency, an improved work environment for the assembly line (easy to handle), short cycle times with less sub-parts (number of sub-parts reduced by 22% due to the integrated design) and an eco-friendly technology using a corrosion-resistant, recyclable PP-based thermoplastic material.

JEC WORLD INNOVATION AWARDS

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VOTE FOR ME

AUTOMOTIVE APPLICATION

KANGDE COMPOSITES CO.

PARTNERS: KDX-RODING EUROPE AUTOMOBILE, FASTSTAR NEW ENERGY AUTOMOBILE

Development and manufacturing of a full-CFRP car body

Lightweight CFRP hypercar body.

KEY BENEFITS

- USING THE MECHANICAL ADVANTAGES OF CARBON FIBRE
- REDUCED PART NUMBER AND PROCESSING DIFFICULTY
- IMPROVED ENDURANCE, LOWER EMISSIONS AND HIGH NOISE & VIBRATION CHARACTERISTICS
- TECHNICAL RESERVE FOR FUTURE MASS PRODUCTION

Kangde Composites developed a functional prototype for Chongqing Kuaixing's pure electric hypercar, and also developed and manufactured a full-CFRP car body structure intended for mass production.

The main structure is composed of 34 CFRP parts using high-performance T700 carbon fibre as a reinforcement material. The company's NCF, fabric, prepreg and other products were selected for this project according to the variety of shapes and load requirements. In the prototype phase, the parts were manufactured with VARI and prepreg moulding processes. The main structural components were assembled with the Dow 2850L high-performance, high-toughness adhesive.

In the R&D phase, due to the precise structural design and manufacturing process control, including the development and quality control of the precision mould and fixtures, Kangde Composites achieved high dimensional accuracy and stability of the CFRP parts (adhesive layer thickness ≤ 2mm). The metal attachments and the concentrated load areas were connected by rivet nut sets, allowing for high assembly precision at the installation points. Compared to the conventional body weight of 200~300kg, the total weight of the prototype is 100kg, and the carbon fibre main structure is only 75kg.