Introduction

Composite materials have contributed for more than 50 years to vehicle development, making many things possible in terms of design, durability, performance and lightweighting.

To support the fast-evolving mobility, composite materials now provide the automotive industry with new benefits and applications.

The development of new fuels and energies is also a new application sector for composites, since these materials offer key benefits, particularly for the battery pack housing and their integration in EVs and PHEVs, and also for the production of onboard storage tanks for hydrogen-powered vehicles.

Composites offer a broad range of applications for the different technologies along with the added value of high tech simulation, optimization and production techniques.

The more significant benefits and applications are:

- Lightweighting,
- Design Freedom, Aesthetics & Flexibility,
- Resistance & Resilience,
- Strength & Stiffness,
- Part Count Reduction & Functions Integration,
- Hybridization & Bonding with Other Materials,
- Fuel Storage of Hydrogen – & LPG – Powered Vehicles,
- Battery Housing & Integration on Electric/Hybrid Vehicles,
- Connectivity Integration.

To address the issues of an increasingly diverse and fast-evolving mobility, JEC Group, under the motto “Composite Mobility” highlights the different benefits, applications and the growing relevance of composite materials for the transportation industry.

JEC Group has observed the fast-evolving mobility notably while organizing annually the JEC Innovation Awards. Over the past 20 years, this program, part of all the JEC events, has identified, promoted and rewarded the most innovative composite projects worldwide.

In the following pages, we will introduce the benefits and applications offered by composite materials, using automotive parts to demonstrate them. To highlight and detail the latest innovations in the composite industries, we have selected illustrations amongst JEC Innovation Awards and other illustrations from the JEC Composites Magazine or Programs.

- In order to share JEC Group’s and partners expertise about composites in the fast-evolving mobility, we will showcase the various benefits offered by composite materials at major automotive motor shows under the motto “Composite Mobility”.

- We encourage you to discover the JEC Composites Magazine n° 123, with a major focus on Automotive including the release of a special “Composite in Automotive” research report from Deloitte – “Automotive and composite materials: current state and forecast”.

For further information:
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Summary

DESIGN FREEDOM, AESTHETICS & FLEXIBILITY

LIGHTWEIGHTING
RESISTANCE & RESILIENCE
STRENGTH & STIFFNESS
EASY COUNT REDUCTION & FUNCTION INTEGRATION
HYBRIDIZATION & BONDING WITH OTHER MATERIALS
FUEL STORAGE - HYDROGEN, ALCOHOL, GAS POWERED VEHICLES
BATTERY HOUSING & INTEGRATION ON ELECTRIC/HYBRID VEHICLES
CONNECTION INTEGRATION

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DESIGN FREEDOM, AESTHETICS & FLEXIBILITY

Flexibility of design is one of the major benefits made possible by composite materials. They allow to create more complex shapes and contours with a unique and consistent surface finish.

Automobili Lamborghini
Combination of C-SMC and patented application to automotive A-class components

Chopped composites will be widely used for aesthetic purposes in the automotive industry with this application. Lamborghini owns the patent to achieve A-grade surfaces using C-SMC materials.

KEY BENEFITS
- Large-scale scale applications.
- Lower price of components manufacturing.
- Use of R-CFRP for raw material base.
- Use of recycled carbon fibers.
- A variety of other potential industrial applications.
Composites create a virtuous circle allowing engines to become lighter due to lighter structures.

**KEY BENEFITS**

+ Compared to conventional steel constructions, the weight reduction is approximately 44%.
+ The spare wheel pan fulfills high functional requirements for stiffness, NVH, performance and structural integrity in the event of a crash.
+ The new materials offer a higher degree of freedom component design as well as the integration of load-oriented structures with very good specific material properties.
+ Carbon SMC is an efficient and economical route providing excellent cost ratios.

**Vehicle underbody protection**

The innovation is about a composite underbody protection that reduces the weight, designed with a new FEA – Finite Element Analysis – based preforming approach, with specific constraints such as complex shape, abrasion and impact.

**KEY BENEFITS**

+ This innovation replaces the current steel underbody protection, enabling a weight reduction of 53%, with equivalent performance.
+ The composite material definition meets specific criteria such as abrasion and impact behavior combined with a high level of stiffness.
+ A combination of aramid, carbon, and glass fibre designed for complex shape preforming and to achieve maximum material and process cost optimization.

**Daimler AG**

Partners:
Mercedes-AMG GmbH
EACC GmbH

**Faurecia**

Partner:
Hexion
Composite materials exhibit extraordinary resistance against corrosion, fatigue, impact, heat and friction.

While producing the swingarm – the motorbike’s most complex component – Riba Composites had to take two important aspects into consideration: the weight (target 4.2 kg) and passing the Ducati endurance tests.

**Ducati 1299 Superleggera**

**Carbon swingarm for road motorbike**

While producing the swingarm – the motorbike’s most complex component – Riba Composites had to take two important aspects into consideration: the weight (target 4.2 kg) and passing the Ducati endurance tests.

**KEY BENEFITS**
- Structural strength.
- Fatigue and corrosion resistance.
- Aesthetic surface.
- Without compromise on strength and endurance.
- Aluminium / carbon interfaces.

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**RESISTANCE & RESILIENCE**

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**KEY BENEFITS**
- Very good resistance in aggressive environments.
- The transverse leaf spring incorporated into the rear suspension saves a significant 4.5 kg compared to steel coil springs normally used in cars.
- The leaf spring also helps provide a smoother ride and improved NVH (Noise, Vibration, Harshness) behavior.
- Furthermore, by eliminating coil springs that would otherwise protrude into the trunk area, the transverse leaf spring leaves more space for luggage.
- Short cycle times with RTM process.

**Henkel, Benteler-SGL, Volvo**

**Composite leaf springs on Volvo models**

Henkel’s flagship two-component polyurethane composite matrix resin system Loctite MAX 2 has proved fundamental in enabling the development of this innovative leaf spring, produced by Benteler-SGL using high-speed resin transfer molding (RTM).

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Composite materials offer higher specific strength and stiffness than other conventional materials. Readily available carbon fiber composites will match the stiffness and strength of high-grade aluminum in all directions, at less than two-thirds of the density. Specialist grades can double the strength and stiffness of steel in the fiber direction at a fifth of the density. The relative lightness of composite materials enables the use of bigger sections that are inherently stiffer and stronger for bending and torsion. This is a considerable advantage for engineered structures.

Polestar Volvo Car group

A CFRP body for the Volvo Polestar 1

Practically all parts of the Polestar 1 upper body, including the doors, bonnet and boot lid, are made of carbon fibre-reinforced polymer (CFRP) for maximum stiffness, torsional rigidity and lightness. This stiff and rigid body contributes to great handling with consistently precise characteristics.

KEY BENEFITS

+ The lightweight material gives the car three significant advantages:
  - a substantial body weight reduction of 230kg,
  - a 45% increase in torsional stiffness,
  - and finally, weight reduction of the upper body panels lowering the gravity centre allowing better handling, performance and drivability on an open and flowing road.

+ The use of composites dramatically influenced the car’s design. The roof cross-section are slim, light and stiff carbon fibre profiles, enabling a low, elegant roof line and a beautiful design.

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Composite materials offer the ability to add new functions to a part and reduce the number of sub-parts as well as the overall mass. Composites allow the integration of mechanical but also electronic features, lighting or identification. This features’ integration takes place at a level where steel does not have the ability to do so. The integration of functions is always conducted during the manufacturing operations and during the parts’ completion.

Hanwha Advanced Materials
Lightweight seat back frame for SUV second row
Development of the world’s first SUV second-row seat back frame using a new rib and channel hybrid design using composite materials.

**KEY BENEFITS**
- Secure both strength and stiffness.
- The frame is 20% lighter than steel, offering high fuel efficiency.
- Short cycle times with fewer sub-parts – number of sub-parts reduced by 22% due to the integrated design.
- Eco-friendly technology using a corrosion-resistant, recyclable PP-based thermoplastic material.

Faurecia
One-shot composite process for visible parts
Thermoplastic woven organo-sheet blanks are pre-cut into the final shape to minimize waste and eliminate the need for machining after thermoforming followed by overmolding.

**KEY BENEFITS**
- Weight is saved by integrating functions that are usually spread out over three parts into a single part, but also by improving interface between the reinforcement and the overmolding material.
- Minimization of waste.
- A final net-shape part.
Advantageous multi-material solutions are made possible by joining composite materials to metals: developing hybrid structures in the form of toughened composites with better balanced mechanical properties is key.

**Hybrid roof bow**

The innovation helps reduce process costs while maintaining the part’s performance by reducing material costs and shortening process times through the integration of several process steps.

**KEY BENEFITS**

+ Cost reduction.
+ Increased process speed.
+ Fewer steps.
+ No additional materials such as adhesives.
+ Recyclability.

Cost-competitive, lightweight decklid concept

Developed as part of a multi-material approach, making it possible to save weight and reduce cycle times.

**KEY BENEFITS**

+ Multi-material approach resulting in weight-saving superior to aluminium.
+ Rapid prototyping to reduce production time.
+ Significantly reduced cycle times thanks to RTM process.

**Partners:**

Weber Fibertech
Werkzeugbau Siegfried Hofmann
Fraunhofer LBF
ScanLab

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**Continental Structural Plastics**

**Partners:**

Owens Corning, Composite Tooling Expert, Altair Engineering, PPE / Composite Integrity by Institut de Soudure Groupe, Hexion, Brandolph
FUEL STORAGE OF HYDROGEN - & LPG - POWERED VEHICLES

The use of alternative fuels, such as hydrogen, is becoming an increasingly sought-out solution to improve energy efficiency and reduce CO₂ emissions, especially in the automotive industry.

Hexagon Composites

Compressed hydrogen tanks for serial production of fuel-cell electric vehicles

Use of hydrogen in combination with fuel-cell technology as a low-carbon alternative fuel for mobility applications.

KEY BENEFITS
- Light-duty hydrogen tanks.
- Long-term potential.
- Clean and safe energy carrier.
- Large-scale storage.
- Improved life cycle.

BATTERY HOUSING & INTEGRATION ON ELECTRIC/ HYBRID VEHICLES

The main issue encountered by electric vehicles is their capacity to stay charged. The lighter the vehicle, the longer it can run. The weight of battery cases in particular can be reduced by using composite materials, while still maintaining safety and crash-resistance.

Energica Motorcycles

Partner: CRP Technology

Redesign of battery housing via 3D printing

Creation of a functional 3D printed prototype via Laser Sintering technology using Windform® LX 2.0 composite material.

KEY BENEFITS
- Large part manufacturing by 3D printing.
- High-level temperature resistance, not electrically conductive.
- State-of-the-art process chains for the manufacturing of FRP parts with either thermoset or thermoplastic resin systems.
In a context where clean and safe mobility has become a widespread goal, connected-car systems are rapidly developing thanks to the improved use of the right materials. Optimized safety and self-driving capacities are two of the major challenges facing the automotive industry.

Magna Exteriors

Composite innovations enabling future mobility
Towards a full range of Advanced Driver Assistance Systems (ADAS) component, such as lane departure, adaptive cruise control, etc… Composites bring these components to exteriors with sensor integration.

KEY BENEFITS
+ Development of thin wall materials to add sensors without increasing weight.
+ Development of materials allowing signal transmission.

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The world's leading composites magazine
with a circulation of 45,695 copies*

The automotive sector is growing steadily worldwide. This new book, written by Deloitte for JEC Group, will tackle the concerns of regulations, technical innovation and the evolution of consumer expectations for composite materials in the automotive industry.

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