Carbon composites and cars – technology watch 2012

Carbon fibre composites are well established in limited-edition cars. The development of materials and processes to enable their use in high volume vehicles is the challenge. In this article we review some of the developments announced in 2012.

According to the Frost & Sullivan report Supply Chain Analysis of the Automotive Carbon Fibre Composites Market (*www.reinforcedplastics.com/view/26941/study-forecasts-impressive-growth-for-carbon-composites-in-automotive-market*), the automotive carbon fibre composites market is likely to grow to US$95.5 million by 2017 at a compound annual growth rate (CAGR) of 30.6%. The market saw revenues of $14.7 million in 2010.

The report states that fuel efficiency and low carbon emission regulations are playing a major role in raising demand for lightweight automotive composite components to replace metal parts. Carbon composites are also being widely adopted in alternative vehicles such as electric/hybrid and fuel cell vehicles (*www.reinforcedplastics.com/view/8044/electric-cars-need-lightweight-composites*).

A design study of the McLaren P1 was unveiled at the 2012 Paris Motor Show. It features a carbon fibre monocoque and body panels. McLaren Automotive will reveal a production version in 2013, which it wants to put on sale within 12 months.

However, Frost & Sullivan notes that barriers to growth include the high cost of carbon fibre and existing production techniques that result in higher manufacturing cycle times (and low-volume production), and concerns over providing a waste disposal/recycling system for carbon composite parts. There is also a lack of general engineering experience among OEMs that are reluctant to move away from the metal-based assembly lines, which they have already heavily invested in, it says.

10 automotive composite developments in 2012

2012 saw numerous developments and collaborations in the automotive composites sector. Here are 10 key ones (*listed in chronological order*).

1. In March, carbon fibre producer **Zoltek** and **Magna Exteriors and Interiors**, a

Ford has developed a carbon fibre bonnet for the Ford Focus. It says production time for an individual carbon composite bonnet is fast enough to be employed on a production line. (Picture © Ford Motor Company.)

global supplier of automotive systems (including Class A composite panels) announced a partnership to develop low-cost carbon fibre sheet moulding compound (SMC) for the automotive industry (*www.reinforcedplastics.com/view/24847/zoltek-and-magna-join-forces-on-automotive-smc*).

2. In April, **Ford** and **Dow Automotive Systems** signed a joint development agreement to research the use of carbon fibre composites in high-volume vehicles. Cutting the weight of new cars by up to 340 kg by the end of the decade is key to Ford's strategy to improve fuel efficiency (*www.reinforcedplastics.com/view/25133/ford-and-dow-team-up-on-low-cost-high-volume-carbon-fibre-composites*). A couple of months later Dow announced plans to form a joint venture with Turkish company **AKSA** to manufact-ure carbon fibre.

3. In May, **Benteler-SGL & Co KG**, a joint venture between automotive supplier Benteler Automobiltechnik GmbH and carbon fibre manufacturer SGL Group, announced an investment of €36 million in a new plant in Austria to manufact-ure automotive components made of carbon composite. The plant will start series production in mid-2013 (*www.reinforcedplastics.com/view/25804/benteler-sgl-builds-production-plant-for-carbon-fibre-automotive-components*).

4. Showing that glass fibre is still very much in the mix, in July **SABIC Innovative Plastics** announced that it was "signifi-cantly boosting" capacity for its STAMAX long glass fibre reinforced polypropylene composite to meet growing demand from automotive customers. The new produc-tion line is scheduled to start up in the second half of 2013 (*www.reinforcedplastics.com/view/27186/sabic-increases-stamax-thermoplastic-composite-capacity-to-meet-automotive-demand*). STAMAX is used in front-end modules, door modules, and seating and tailgate structures.

5. In August, **Cytec**, an established supplier of advanced composite materials to the aerospace sector, announced a collaboration with UK-headquartered **Jaguar Land Rover** (part of India's Tata Motors) to develop designs, materials and manu-facturing concepts for the cost-effective use of composites materials in automo-tive structures (*www.reinforcedplastics.com/view/27573/cytec-collaborates-with-jaguar-land-rover-to-develop-automotive-composites*). In this venture Cytec will leverage the expertise of its recent acquisition **Umeco**, which has more than 30 years' experience in the manufacture of prepregs for the automotive sector.

6. In October, chemicals company **BASF** and **TenCate Advanced Compos-ites** announced a strategic alliance to co-operate on the development, produc-tion and commercialisation of thermo-plastic composite materials suitable for high-volume vehicle production (*www.reinforcedplastics.com/view/29011/basf-and-tencate-team-up-on-automotive-thermo-plastic-composites*). TenCate is one of the founding partners of the newly-established European Thermoplastic Automotive Composites consortium (eTAC), which aims to promote the use of thermoplastic composites in the automotive sector. (The other partners are Dutch Thermoplastic Components (DTC), Kok & Van Engelen, NLR (National Aerospace Laboratory of the Netherlands), and VIRO.)

7. Also in October, **Ford** announced it had developed a prototype carbon fibre composite bonnet for the Ford Focus which weighs more than 50% less than a standard steel version. It reports that production times are also significantly reduced *(www.reinforcedplastics.com/view/28778/ford-develops-prototype-carbon-composite-bonnet*). The composite bonnet is a sandwich construction comprising a foam core material between two layers of carbon fibre reinforced plastic (CFRP) and was developed as part of the European Hightech.NRW research project.

Boeing and BMW collaborate on carbon fibre recycling

In December, BMW announced the signing of an agreement with aircraft maker Boeing to participate in joint research on carbon fibre recycling. Boeing and BMW are both using of carbon fibre composite in their latest products. The construction of Boeing's 787 Dreamliner is 50% carbon composite and BMW will introduce two vehicles with passenger compartments made of carbon composite in 2013 (the BMW i3 and i8). As part of the collaboration, Boeing and BMW will also share information on carbon fibre manufacturing process simulations and manufacturing automation.

8. In the same month, **BASF** and the **SGL Group** announced plans to develop a composite material based on carbon fibre and a reactive polyamide system intended for the mass production of automotive components (*www.reinforcedplastics.com/view/28629/basf-and-sgl-to-develop-carbon-fibre-thermoplastics-for-automotive-applications*). The composite is intended for use in the thermoplastic resin transfer moulding (RTM) process as well as the reactive injection moulding process. This will permit considerably shorter processing cycles than the conventional thermosetting RTM process, the companies say.

9. In November, in a further step to increase its composites expertise, automotive supplier **Faurecia** signed a framework agreement with German research institute **Fraunhofer ICT** concerning the joint R&D of industrial processes for composites for automotive applications (*www.reinforcedplastics.com/view/29410/faurecia-and-fraunhofer-ict-research-industrial-processes-for-automotive-composites*). In July, Faurecia acquired **Sora Composites**' automotive business, which produces both carbon and glass fibre composite parts.

10. In December, carbon fibre manufacturer **Teijin** announced the start up of its pilot plant in Japan for carbon fibre thermoplastic automotive parts. This uses Teijin's proprietary manufacturing technology, which is reported to reduce cycle times required for moulding composite parts to less than 1 minute (*www.reinforcedplastics.com/view/16457/teijin-establishes-mass-production-technologies-for-carbon-fibre-composite*). In December 2011, Teijn and **General Motors** (GM) announced plans to co-develop carbon fibre composite technologies for potential use in high-volume GM vehicles.

New cars sport carbon fibre

In April, **BMW** unveiled a third i brand model – the BMW i8 Spyder two-seat sports car. As with the i3 and i8 models this features a CFRP passenger cell. Like the i8 coupe, the i8 Spyder is a plug-in hybrid vehicle (*www.reinforcedplastics.com/view/25069/bmw-unveils-i8-spyder*).

In June, **Aston Martin** unveiled its new luxury sports car – the Vanquish – which features carbon fibre body panels. First deliveries of the £189,995 car began in Europe late in 2012 (*www.reinforcedplastics.com/view/26427/aston-martin-unveils-new-vanquish*).

McLaren Automotive launched its 12C Spider sports car in July, 12 months since its MP4-12C model went on sale (*www.reinforcedplastics.com/view/26760/mclaren-automotive-launches-12c-spider*). Both cars are based on McLaren's one-piece Monocell carbon composite chassis. In September, the company introduced the McLaren P1 'supercar', that features a carbon fibre monocoque and roof structure safety cage concept called MonoCage, a development of the MonoCell. All the P1's body panels are carbon fibre composite to reduce weight (*www.reinforcedplastics.com/view/28494/mclaren-p1-debuts-at-paris-motor-show*).

In October, **Ferrari** unveiled a carbon composite chassis for its first hybrid car, a limited-edition model scheduled for launch "in the near future." The chassis is hand-laminated and autoclave cured (*www.reinforcedplastics.com/view/28605/ferrari-unveils-carbon-composite-chassis-for-hybrid-model*).

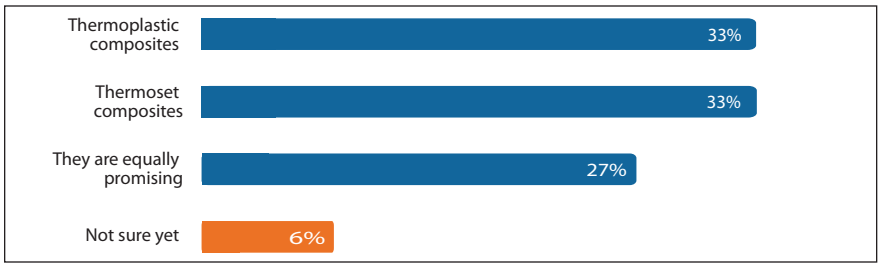
Chrysler's 2013 SRT Viper® was named the winner of 2012 Vehicle Engineering Team Award by the Automotive Division of the Society of Plastics Engineers (SPE) in November. The car features carbon

Chrysler's award-winning 2013 SRT Viper® features a number of composite parts.

Top 5 *Reinforced Plastics* automotive stories of 2012

The following automotive articles were the most read on the *Reinforced Plastics* website during 2012.

1. **Automotive composites – reducing weight to meet fuel economy demands** (*www.reinforcedplastics.com/view/23696/automotive-composites-reducing-weight-to-meet-fuel-economy-demands*).
2. **Automotive composites offer lighter solutions** (*www.reinforcedplastics.com/view/7473/automotive-composites-offer-lighter-solutions*).
3. **Blog: 10 composite innovations in the automotive industry** (*www.reinforcedplastics.com/blog/2012/5/10/10-composite-innovations-in-the-automotive-industry/549.aspx*).
4. **Australia's first carbon fibre monocoque sports car cockpit chassis** (*www.reinforcedplastics.com/view/25776/australias-first-carbon-fibre-monocoque-sports-car-cockpit-chassis*).
5. **Rebounding automotive industry is welcome news for FRP sector** (*www.reinforcedplastics.com/view/14833/rebounding-automotive-industry-is-welcome-news-for-frp-sector*).



Here are the results of our survey on composites for high volume automotive applications. We asked: What is the most promising material – thermoplastic composite or thermoset composite? (Source: Reinforced Plastics LinkedIn Group. Results as of 7 December 2012.)

composite body panels. The Class A hood assembly is reported to be the largest Class A carbon composite part provided to a mainstream OEM at volumes of up to 3000 vehicle sets/year (*www.reinforcedplastics.com/view/29236/composites-intensive-chrysler-srt-viper-wins-spe-award*). It was produced using a vacuum bag/autoclave cure process.

Thermoset or thermoplastic?

The dynamic automotive composites sector is continuing to attract investment from materials suppliers and vehicle manufacturers alike.

This year we've seen aerospace materials specialists Cytec and TenCate setting their sights on the automotive automotive market. Chemicals giant BASF, already a big supplier of plastics to the automotive industry, is putting an increased focus on composites. The carbon fibre makers have also been active. Teijin is continuing to develop its thermoplastics process, while SGL, a key partner in BMW's composites efforts, is also investigating thermoplastics in partnership with BASF. Dow, a new entry to the carbon fibre market, has secured a partnership with Ford.

As can be seen from the developments listed here, a variety of materials and processes are being researched. According to our recent survey on the *Reinforced Plastics* LinkedIn Group (*www.linkedin.com/groups/Reinforced-Plastics-magazine-2351928*) thermoplastic composites and thermoset composites are seen as equally promising materials (see chart above). This survey created a lot of debate, and here are just a few of the comments posted:

- "I think thermoplastics will be used in small and complex parts while thermosets should be used for body panels."
- "Speed of process is the important factor currently favouring thermoplastics rather than recyclability, as there are now EU compliant solutions for recycling both thermoplastic and thermosets."
- "Speed of production will be a driving force in mass production. But we also have to analyse the actual usage of each material. Exterior parts that see high loading may not be appropriate for a material that has creep as one of its functions over time. While easy bonding or welding processes of thermoplastics will also have certain advantages."
- "In my opinion the resin matrix will have to be a thermoset; actually I believe it must be nearly exactly the same as what Boeing, Airbus and the many other aerospace giants are now using to build the new generation ultralight aircraft. They chose toughened epoxy for a really good reason ... it can survive all of the above for the life of the aircraft. Zero concerns about creep, stress corrosion, fatigue, galvanic corrosion. The major hurtle is development of cost effective methods for producing automotive production volumes. Boeing and Airbus are developing manufacturing technology capable of producing a few aircraft per month. A typical automotive assembly plant is producing on-average one thousand vehicles per day."
- "The part and volume will dictate what material/materials are chosen. Many look at the market as all TS or all TP, but as is common both have a place, especially when material cost, tooling cost, energy, labour, volume, etc., comes into play."

You can review all the comments, and join the debate, on the Reinforced Plastics LinkedIn Group. ■