Composites, crossmembers, and competition

Intra-composite competition is rapidly spreading into a realm that extends beyond the intense rivalry between thermoset and thermoplastic matrices.

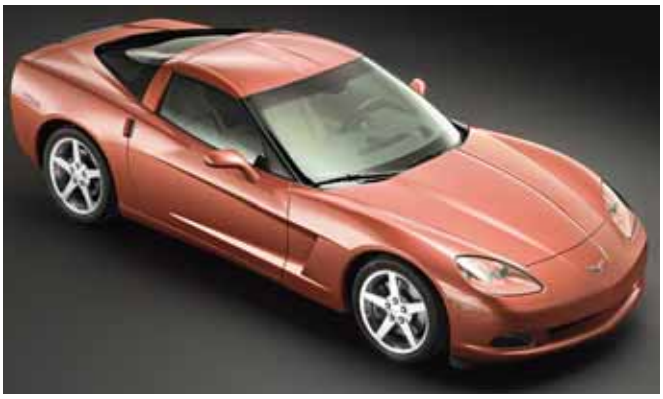
For instance, low-density reinforced thermoplastics (LD-RTPs) have taken aim at high-density RTPs in semi-structural applications. And the appearance of nano-composites brings added competition to a host of materials—long-glass-fiber-reinforced polypropylene for body side moldings and running boards, and mineral-reinforced thermoplastic olefins and engineering thermoplastics for bumper fascia and electronics component applications.

Likewise, the competition between composites and other materials—namely, advanced nonwovens, foams, hybrid metal-plastic, and unfilled plastics—is fierce. LD-RTPs, for instance, are now alternatives to multilayer nonwoven sandwiches and compression-molded sheet in wheel arch liners, and replacing glass-fiber-reinforced polyurethane foam headliners.

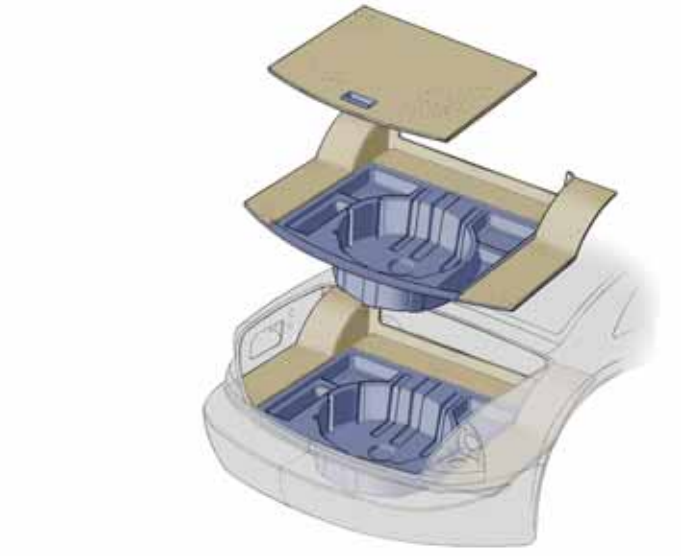
"You can evolve to a monomaterial construction if you're substituting the traditional headliner core with a polyester nonwoven from one of many companies, or a lightweight fiber composite—like those being developed by **Quadrant**, **Azdel**, **Owens Corning Automotive**, and several Japanese companies," said Robert Eller, President of **Robert Eller Associates**, consultants to the plastics and rubber industries, during a keynote speech at the 4th annual **Society of Plastics Engineers** (SPE) Automotive Composites Conference in Troy, MI.

Customers do influence supplier technologies, and that underscores one of the reasons different material compositions are being looked at as a replacement to the traditional glass-fiber-reinforced headliner. "Japanese automakers have given us a milestone date of 2007 for glass elimination in headliners because of damage caused to the incinerators during the recycling process," said Jesse Hipwell, Technical Manager of Interiors for Azdel. The company is working on a mineral-fiber solution. "We've got an incinerator-friendly, glass-free headliner product that is comparable in performance to our glass-fiber-reinforced headliner. It's about one and a half years from being put into production," Hipwell said.

Quadrant also is developing a glass-free headliner. "There are still challenges to meeting headliner requirements—sag in particular," said Marcia Kurcz, Business Development Manager in North America for Quadrant, which has more than 20 years experience using natural fibers in



The 2005 Chevrolet Corvette has composite body panels, a hydroformed steel frame, as well as aluminum and magnesium structural and chassis components.



This design concept from Quadrant shows a GMT floor pan with tire basin, in-mold carpet, and extended trim surface.

applications such as door panels and sunshades. "We're continuing to look at new material matrices and technologies to control the moisture into the part."

In application zones once dominated by metal, nonmetal competitors have shaken the status quo. For instance, glass mat thermoplastic (GMT) and inline compounding have made front-end module material usage inroads, but long-fiber-reinforced thermoplastics are joining the fray.

"A lot of times in this industry you'll get a 'metal replacement' plastic, but once that happens the penetrating technology doesn't always keep the application," said Creig Bowland, U.S. General Manager for **Polyram**, which introduced its Polytron long-glass-fiber-reinforced thermoplastic (LGF-TP) product line to the U.S. market via the SPE Automotive Conference. "I think it's a big enough industry that there's really a niche for all the competitors. It's a matter of checking the cost and performance curves."

Production volume of the Dodge SRT-4 exceeded 10,000 units in the 2004 model year (shown is the 2005 Dodge SRT-4).

Although metals have established dominance in many structural zones of a vehicle, there is no immunity from nonmetal contenders. Consider the ongoing work being done to develop a thermoset polyester glass-reinforced sheet-molded compound (SMC) transmission crossmember that is 2 in (51 mm) thick. A three-piece steel crossmember with a mass of 19.5 lb (8.8 kg) that is used on **General Motors** full-size truck frames is the SMC part's target.

"This is the first time that General Motors has seriously considered going to a structural composite for a full-size truck frame application," said Adam Myers, Performance Integration Engineer for GM at the Vehicle Performance Center in Warren, MI. The two-piece unsaturated polyester composite—connected via an epoxy adhesive—uses aluminum pads and spacers. The steel crossmember uses a steel connection and bushings. The composite crossmember is 11 lb (5.0 kg) lighter. "That's quite substantial for one specific part," said Myers, noting that most GM truck frame reductions are about 1-2 lb (0.5-0.9 kg) per component.

The hood of the 2005 Dodge SRT-4 is steel.

Compared to the steel counterpart, the composite crossmember's lower and upper section wall thickness went from about 3 mm (0.1 in) to about 10 mm (0.4 in). Unlike the steel crossmember, the composite one does not need a stiffener plate. "Hopefully, we will be able to implement a composite crossmember in the near future," said Myers.

Getting production approval depends on confirmation of the part's durability and vibration behavior. On the latter aspect, a vertical vibration at 12 Hz has been noted during testing. The GM frame team and **Continental Structural Plastics** are working on vibration refinement. "Our refinement process includes using directional fibers [as opposed to randomly oriented glass fibers] where necessary to improve structural behavior," said Myers.

Like all materials, composites have pluses and minuses. "At low volumes, composites are generally more cost-effective because of lower tooling investment," said Douglas Denton, **DaimlerChrysler** Corp. Senior Specialist with Advanced Materials and Processes for Street and Racing Technology. The SRT-4, a high-performance version of the **Dodge** Neon, features a hood with an air scoop, unique from the rest of the Neon lineup. Although engineers considered SMC for the low-volume hood, the assembly plant did not want that material because of surface quality concerns. "For the **Chrysler** Group, the use of powder primers presents a challenge to SMC and other polymeric materials that absorb moisture," Denton said.

All Neons, including the SRT-4 version, feature a steel hood. "In the case of the SRT-4, we were able to get a steel hood at a comparable cost to composites," said Denton. "So, there is a lot of competition among materials—even at low production volumes."

Polytron, a long-glass-fiber thermoplastic product line from Polyram, is used for various applications, including the hinged battery tray on an Opel European platform.

In the end, the new **Chevrolet** C6 Corvette retained composite body panels, but a material change was contemplated. "It was a closer call than you might think to stay with composites," said David Mattis, Director of GM's Materials & Appearance Engineering Center.

The notion that composites could lose existing applications to metal has not gone unnoticed. "As an industry, we need to focus more on displacing metals by developing materials and processes that target steel applications, for example, instead of competing against each other's business," said Joe Walewski, Market Development Manager for **Hexcel**, an advanced composites company that provides multiple forms of honeycomb and fiber-reinforced thermoplastics and thermosets.

According to Walewski, there is a disparity in composites usage around the world. "There's more advanced use of composites in Europe, partly due to legislation and better consumer awareness of thermoplastic and thermoset benefits."

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