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The Automotive Future (head)

Composite Bodies: A Critical Feature of Tomorrow's Automobiles (subhead)

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The search for a composite material to build automobile parts and even bodies has been going on for decades. In 1930s, scientists at Ford Motor Company, at the request of Henry Ford, began seeking ways to develop organic car parts. In 1940, the scientists hit on what seemed to be an ideal substance: soybean oil. The soybean material could be molded into a fiber-reinforced plastic that was incredibly strong—ten-times more resistant to shock than steel, according to the scientists. Henry himself demonstrated its strength by pounding on a soybean trunk lid with an ax. What seemed to be the key to a better automobile had two major flaws: the soybean material took too long to cure and it could not be molded easily.

Today the search for the perfect composite material continues, only now the focus is on man-made materials that can be molded and shaped into lightweight, aerodynamic bodies that are a critical component of future vehicles. In this installment of *The Automotive Future*, we will look at recent industry developments in advanced composites and address how they are already being used in today's automobiles.

The advanced composites being developed today are man-made polymer materials that, when combined, are stronger, tougher and more durable than each material separately. These new materials combine extremely strong carbon fibers and tough

Kevlar fibers with corrosion resistant plastic to create a single “composite” material that has far greater performance than materials like steel and aluminum. Yet, despite the high-tech slant, the principle behind advanced composites is not all that different from what Henry Ford was attempting in 1940.

Advanced composites are probably best known for their use in exotic military aircraft, but are also found in everyday objects, such as boat hulls, snowboards, fly rods, and tennis rackets. Structural composites, a class of composites with lower performance than advanced composites, have been developed for use in rooftops and door panels on today’s production vehicles. Generals Motor’s Saturn-brand vehicles well-known dent-resistant door panels are made from structural composites and, over the past decade, have proved that they stand up better to corrosion and dents than their steel counterparts.

Although Saturns and some other vehicles, such as the Dodge Viper and Chevrolet Corvette, use structural composite panels, these panels utilize a steel frame beneath the panels for strength. The more advanced composites that are being developed for tomorrow’s cars and trucks will go well beyond cosmetic uses and are even strong enough to form the entire vehicle structure.

Advanced composite bodies are used for racecars precisely because they are extremely lightweight, yet can withstand the great forces generated in racing, especially during collisions. Since the early eighties, advanced composite materials have been commonplace in the “survival cells” of Formula One racecars that are designed to protect the driver in 100+ mile-per-hour collisions. In fact, the official rules for safety structures in Formula One racecars *require* the survival cell be constructed of advanced composite panels.

The use of lightweight materials, like composites, is also seen as the key to greatly improving fuel economy—without reducing the roominess and performance most American consumers expect from their vehicles. Gas mileage, acceleration and handling can all be improved by reducing the overall weight of a vehicle. In 1991, General Motors built a prototype advanced composite car called the Ultralight. The Ultralight is roughly 50 percent lighter than an equivilently-sized, four-seat steel car, giving it excellent, 7.8 second 0-to-60 acceleration and gas mileage of 62 miles per gallon.

Since Henry Ford's experiment in the 1930's automakers have known composite auto parts are expensive to manufacture, and have only used them on special products like Chevrolet's Corvette, which has featured fiberglass body panels since 1953. However, manufacturing techniques have improved over the years, and now structural composites, which are less expensive than advanced composites, are becoming quite common in today's cars. New manufacturing techniques such as ultra-high-speed resin transfer molding, and, rapid e-beam curing, have lowered costs to the point where even advanced composites will soon be affordable in everyday production cars.

Domestic automakers Ford Motor Company, General Motors and DaimlerChrysler are all focusing research efforts on the development of composites for use in vehicles. Chrysler is a leader in the composites quest, launching a research program in 1994 that had a goal of developing a low-cost car that would be suitable for production in developing countries like China. The result of the program was the Composite Concept Vehicle, the CCV, which was unveiled at the Frankfurt Auto Show in 1997. While the concept was never produced, it proved that large parts could be molded from the composite material yet still have the strength to bear driving and

collision loads. The CCV's structural composite body was actually four sections formed of PET (polyethylene terephthalate), the same substance used to make beverage bottles, mixed with chopped glass reinforcing fibers. These days DaimlerChrysler's efforts are concentrated on mastering the process of building single pieces, such as hardtop roofs for Jeep Wranglers, with the vision of one day building a complete vehicle body from a single mold.

Cars made entirely from advanced composite materials are also on the near horizon. Volkswagen has recently announced a program to develop an ultra-efficient city-class car, about the size of a Geo Metro, made from advanced composite materials. This advanced composite version of the Volkswagen Lupo is destined to see production in 2004 and boasts fuel economy of 235 miles per gallon of diesel fuel. In a few short years we will begin to see the first mass-produced advanced composite cars on the road, and although they will look very similar to today's cars their mileage and performance are likely to be revolutionary.

To learn more about composite materials and other advanced vehicle technologies, visit www.rmi.org and select the Transportation link.

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