First commercial application of DOE-funded automotive composites R&D

OAAT ACCOMPLISHMENTS

Programmable Powdered Preforming Process, P4

Challenge

Substituting lighter weight materials for steel in a vehicle is one way to improve vehicle fuel efficiency. The lighter materials must provide comparable or better service, be easily integrated into existing manufacturing processes, and result in similar costs.

Technology Description

Since 1994, the U.S. Department of Energy (DOE) has worked with the U.S. Council for Automotive Research's (USCAR's) Automotive Composites Consortium (DaimlerChrysler Corporation, Ford Motor Company, and General Motors Corporation) to prove that fiber-reinforced polymer matrix composites could meet the above criteria. As part of this overall effort, the Programmable Powdered Preforming Process, or P4, invented by a subsidiary of Owens Corning Fiberglass, was further developed to produce the skeletal "preform" of a composite part at rates and volumes typical of the auto industry.

Chopped reinforcement fibers and small amounts of a thermoplastic (meltable) powder are simultaneously sprayed onto a heated mandrel by programmed robots that control the placement, depth, and orientation of the fibers. The mandrel is a reverse image shape of the part to be produced. The heat melts the powder causing the fibers to stick together enough for the preform to be removed whole from the mandrel. The preform is placed in a mold where it is infused with more resin, compressed, and heat-cured to form the final product in the widely practiced, conventional process known as structural reaction injection molding (SRIM).

Commercialization

In late 2000, General Motors (GM) introduced a new truck bed for its Model Year 2001 Chevrolet Silverado. The bed was manufactured using a proprietary variant of the P4-SRIM process. Compared to its steel counterpart, the Silverado box is 50 pounds lighter and its tailgate is 15 pounds lighter. The bed is bonded with adhesives to the pickup truck frame, instead of welded as is steel.

Composite truck bed installed in Chevrolet Silverado (photo courtesy of General Motors Corporation).

Ford has responded with a similar product based on its alternative approach. In its Model Year 2001 Explorer Sport Trac sport utility vehicle, Ford will introduce an all-composite, one-piece truck bed that is 30% lighter than its steel counterpart.

Accomplishments

The GM and Ford products are commercial verifications that large composite automotive structures can most likely be made at rates and volumes required by the cost-competitive auto market.

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Durability-driven composite design guidelines were developed during the DOE/automaker effort; these were used to guide the development of both the GM and Ford products.

Awards

In 2000, the commercial application of P4-SRIM was named one of the Ten Best Innovations of the Year by *Popular Science* magazine.

Benefits

P4-SRIM production is highly automated, resulting in finished parts with good dimensional stability, high strength, and increased corrosion and wear resistance. The process is much faster than most composite preform processes. Because P4 reduces tooling and assembly costs, vehicle manufacturers could realize significant cost savings and/or increased profits.

Vehicle owners will benefit from the new composite structures, as the Silverado will not need a separate truck bed liner. The composite bed is more resistant to dents and scratches and, because the color is permanently impregnated into the material during the manufacturing process, the bed will not need repainting.

It is expected that approximately 6-8 gallons of fuel per year will be saved per truck due to the lighter weight of the truck bed.

Future Activities

The U.S. Department of Energy will introduce further improvements to the P4-SRIM process, such as the use of carbon fibers instead of glass to achieve an even greater weight reduction of 40-60%.

Manufacturers may expand the use of the P4-SRIM technology to replace a broader range of heavy steel parts in vehicle and other industry sector applications.

Vehicle manufacturers may extend the use of P4-SRIM technology to a wider range of vehicle models and classes.

Partners in Success

- Applicator System AB
- National Composites Center
- Oak Ridge National Laboratory
- Owens Corning Fiberglass
- Textron Automotive
- USCAR Automotive Composites Consortium