Reducing raw materials cost enables affordable automotive parts

OAAT ACCOMPLISHMENTS

Lower-Cost Carbon Fiber Composite Materials

Challenge

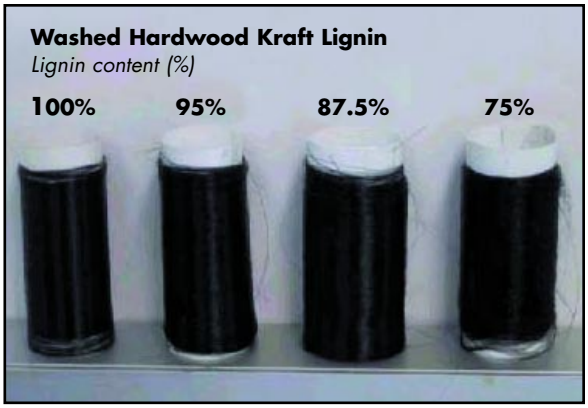
Raw materials account for 45-60% of the total production cost of carbon fiber composites (CFCs). Use of lower-cost feedstocks and recycling of advanced automotive parts containing CFCs could reduce raw materials cost.

Technology Description

Low-cost feedstocks for carbon fibers can be obtained from renewable or recycled sources. Renewable sources include lignins (paper pulping waste), reconstituted cellulosics (agricultural waste), and fiber blends of those materials. Recycled sources of petro-chemical polymers include beverage bottles and composite automotive parts. The feedstock program evaluated ways of spinning high-quality carbon fiber from lignin-polyolefin blends. Conventional techniques of improving fiber quality, such as hot stretching, were also explored.

Another program separated carbon fibers from polymer-matrix composite (PMC) materials typical of the advanced ultra-lightweight materials used in the Partnership for a New Generation of Vehicles (PNGV). This program evaluated three methods of extraction: thermal treatment, chemical degradation and thermal shock.

Results obtained from these two programs can be folded into the USCAR Automotive Composites Consortium (ACC) efforts to design, analyze, and build a composite-intensive body structure.



Lignin is a low-cost, renewable feedstock for carbon fibers.

Accomplishments

The low-cost feedstock program prepared and melt-spun several lignin-polyolefin blends identified as promising candidates to yield high-quality, low-cost carbon fibers. Polyethylene-lignin blends developed the fine-grained microstructure conducive to production of fine, strong carbon fiber.

The program extracting carbon fibers from scrap PMC found that the thermal treatment method recovered fibers from urethane-based PMCs with essentially the same density and electrical properties as fibers made from polyacrylonitrile (PAN), the standard industry feedstock. The process was also successful in recovering carbon fibers from epoxy-based PMCs.

The ACC composite-intensive body structure program is employing computer-aided design (CAD) and finite element analysis (FEA) to evaluate a variety of candidates, including carbon fiber, for the composite structures.

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Benefits

- Low-cost materials enable the development of ultra-lightweight, affordable automotive parts that will improve fuel economy and reduce emissions while maintaining safety.
- Early use of the next generation of advanced materials will establish U.S. automotive industry leadership and secure future jobs.
- Use of low-cost materials could reduce the cost of feedstocks to $0.20-$1.20 per pound, making carbon fibers affordable for the domestic automotive industry.
- Methods to use carbon fiber from recycled automotive PMC will help achieve the PNGV goal to recycle 85% of automotive parts.

Future Activities

The feedstock program will expand the variety of fiber blends spun and tested. Process improvements for oxidizing, hot stretching, and carbonizing the blends will be added. The process will be scaled up to permit evaluation of the mechanical properties of renewable and recyclable feedstocks.

The program for recycled automotive PMC will optimize the thermal treatment reactor for operating temperature, size of PMC scrap pieces, and reactor gases. Ultimately, a conceptual pilot plant design will be developed.

The ACC composite-intensive body structure program will contribute design, durability, joining, and safety research to explore the full potential of the renewable and recycled materials.

Partners in Success

- Argonne National Laboratory
- North Carolina State University
- Oak Ridge National Laboratory
- USCAR's Automotive Composites Consortium
  (Ford Motor Company, General Motors Corporation, DaimlerChrysler Corporation)