Carbon fiber cars could put US on highway to efficiency

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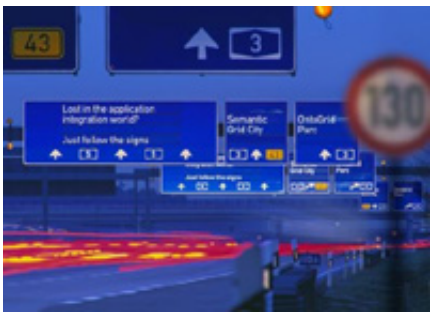

Highways of tomorrow might be filled with lighter, cleaner and more fuel-efficient automobiles made in part from recycled plastics, lignin from wood pulp and cellulose.

First, however, researchers at the Department of Energy's Oak Ridge National Laboratory, working as part of a consortium with Ford, General Motors and DaimlerChrysler, must figure out how to lower the cost of carbon fiber composites. If they are successful in developing high-volume renewable sources of carbon fiber feedstocks, ORNL's Bob Norris believes they will be on the road to success.

"Whereas today the cost to purchase commercial-grade carbon fiber is between $8 and $10 per pound, the goal is to reduce that figure to between $3 and $5 per pound," said Norris, leader of ORNL's Polymer

Matrix Composites Group. At that price, it would become feasible for automakers to use more than a million tons of composites – approximately 300 pounds of composites per vehicle – annually in the manufacturing of cars.

The big advantage of carbon fiber is that it is one-fifth the weight of steel yet just as strong and stiff, which makes it ideal for structural or semi-structural components in automobiles. Replacing half the ferrous metals in current automobiles could reduce a vehicle's weight by 60 percent and fuel consumption by 30 percent, according to some studies. The resulting gains in fuel efficiency, made in part because smaller engines could be used with lighter vehicles, would also reduce greenhouse gas and other emissions by 10 percent to 20 percent.

All of this would come with no sacrifice in safety, as preliminary results of computer crash simulations show that cars made from carbon fiber would be just as safe – perhaps even safer – than today's automobiles. Today's Formula 1 racers are required by mandate to be made from carbon fiber to meet safety requirements.

Progress in developing affordable carbon fiber composites has been steady as ORNL researchers with the support of the University of Tennessee work to optimize raw materials and spinning processes for alternative forms of carbon fiber precursors from renewable sources.

Another focus is on developing an efficient carbon fiber oxidation process, which would significantly increase production and lower cost of this raw material. One promising possibility is plasma processing technology to rapidly oxidize precursor fibers. In this area, ORNL is working with Atmospheric Glow Technologies, a high-tech company spun off from UT that has expertise in atmospheric pressure plasma processing. This is a technique to generate and use plasmas in a non-traditional way – in the open atmosphere instead of in a carefully

controlled environment such as in inert gases and at very low pressures.

ORNL is also establishing a modular carbon fiber research pilot line to evaluate these revolutionary new processes on a comparable basis against conventional industrial processes.

"The goal is to demonstrate and transfer the technology to producers of carbon fiber, which could be existing carbon fiber producers or perhaps companies in the forest product industries," Norris said.

Researchers also are working to develop techniques to allow high-volume cost-effective processing of carbon fiber, hybrid glass-carbon fiber and reinforced thermoplastic material forms. In addition, ORNL recently installed an advanced preforming machine that features a robotically actuated arm that chops and sprays fiber and a binder in powder form to create fiber preforms. After being set at elevated temperature, the preforms are injected with resin in a mold and consolidated under pressure to create the final part.

"The preforming process is the first step in creating polymer composite structural and semi-structural auto parts that are lightweight and cost-competitive with metal parts they would replace," Norris said.

Source: Oak Ridge National Laboratory