



# Recycling carbon fibre

HIRECAR High Value Composite Materials from Recycled Carbon Fibre - researchers on this collaborative R&D project are finding ways to recycle carbon fibre composite materials for use in car manufacture and other applications

## Key benefits

- reducing the environmental impact
- new ways to restrict noise and fuel emissions
- finding sustainable solutions to problems that affect all major uses of carbon fibre

Current annual worldwide carbon fibre consumption is 30,000 tonnes. The principal markets are aircraft, racing cars and sporting goods. At present there is no way to recycle carbon fibre materials – more than 100 tonnes of highly valuable material, either end-of-life goods or scrap from manufacture, goes into landfill every year in the UK alone.

The high stiffness and strength and low density of carbon fibre composites could be used in new designs to reduce the weight and increase the safety of family cars, resulting in significant reductions in emissions and fuel consumption. A research project funded by the technology programme is working on ways to extract the

high value carbon fibre from end-of-life components and from manufacturing scrap, typically offcuts of woven 'prepreg' - materials impregnated with epoxy resin which are typically used in military aircraft and racing cars.

Project leader Dr Nick Warrior of the University of Nottingham says: "Much of the tonnage sent to UK landfill every year is simply offcuts from the manufacturing process, but at present there is no way of reusing it."

"These materials can cost as much as £120 a kilo. So it is a valuable commodity, which at present is all going to waste. We're hoping to extract the carbon fibre from these materials and use it to create other carbon fibre composites, which themselves can be recycled."

The University of Nottingham is the lead partner in the project, which also involves: Advanced Composites Group, Dow Automotive, Ford Motor Company, Technical Fibre Products and Toho Tenax GmbH.

The project started in March 2005 and runs for three years. The Technology Programme is providing £341,637 towards the total cost of the project, which is £926,637.

## Objectives

The aim of the project is to find ways to recycle scrap carbon fibre materials and convert them into useful materials. This will provide a sustainable lifecycle for carbon fibre for use in automotive applications and enable a step-change in design and performance of vehicle structures.

Dr Warrior says: "It will help automotive manufacturers meet EU end-of-life directives for



the next generation of vehicles. These state that 80% of the materials used in a new car have to be genuinely recyclable. At present, this limits the amount of carbon fibre that can be used in vehicles – because there is no viable way to reuse it.”

Use of carbon fibre in cars will reduce the weight of vehicles, and so lower fuel consumption. “It will also increase car safety, because the carbon fibre materials are extremely strong and can absorb much higher levels of impact energy,” says Dr Warrior.

## Solutions

The team has developed two methods for recovering the carbon fibre materials: The preferred route for end-of-life components is a fluidised bed technology where the fibres and resin are separated at high temperatures, energy is extracted from the polymer and the fibres are left in a clean condition, but with slightly reduced properties. The use of supercritical fluids on scrap new materials has been studied for the first time.

Co-investigator Dr Steve Pickering says: “The real blue-sky aspect of this research is based on the use of supercritical fluids to extract both valuable components: the carbon fibre and the polymer.

Finding the optimum balance of Supercritical fluids, pressure and temperature to achieve the best results with different types of carbon fibre is a major aim of the research project.

The project is looking at three ways of using the recycled carbon fibres: in bulk moulding compounds for smaller, non load-bearing components; as a sheet-moulding compound, where carbon fibre is rolled together with sheets of polymer; and as recycled materials in load-bearing, 3D shell structures, such as the floorpan of the vehicle.

## Results

Dr Warrior says: “Recycled carbon fibres have been made into bulk and sheet moulding compound forms and have been successfully moulded into laboratory-scale samples. “We’re developing this process on a laboratory scale. The results so far have been very promising. We have extracted useful polymer from the compounds and we are all really excited about the progress that is being made.”

The team intends to characterise the issues around supercritical fluid type, temperature,

pressure, and yield for the typical epoxy-based resins used in composite material manufacturing processes.

According to Dr Ebby Shahidi, Technical Director of Advanced Composites Group (ACG), “although the cost aspects and potential properties are yet to be proven, when scaled up, the outcome of the research should provide the composite industry with a potentially low cost fibre source that can be used to produce DMC and SMC products, replacing the current chopped carbon fibres reinforcements”. He goes on to confirm that, “If the material can be spun into continuous yarn with competitive properties and costs to carbon fibres, it will significantly expand the opportunity for increasing the application of composites to structures such as vehicles, where the weight reduction will have a significant positive impact on the industry, both environmentally and commercially. Typical applications, for example, will be for light-weight body panels, chassis structures, etc. in the automotive sector, numerous components in marine and, potentially, the aerospace industries”.

### Project contacts

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