

**CARBON WITH MULTIPLE LIVES:
BRINGING INNOVATIONS IN CARBON FIBER RECYCLING TO MARKET**



ZUSE-GEMEINSCHAFT
FORSCHUNG, DIE ANKOMMT.

When it comes to the future of motorized mobility, everyone talks about the power drive: How much e-car, how much combustion engine can the environment tolerate and how much do people need? At the same time, new powertrains place increased demands not only on the engine, but also on its housing and the car body: Carbon fibers are often used for such demanding applications. Like the powertrain of the future, the materials on the vehicle should also be environmentally friendly. That is why recycling of carbon fibers is required. Institutes of the Zuse Community have developed solutions for this.



Carbon fibers consist almost completely of pure carbon. It is extracted from the plastic polyacrylonitrile at 1,300 degrees Celsius, using a lot of energy. The advantages of carbon fibers: They have almost no dead weight, are enormously break-resistant and sturdy. These properties are needed, for example, in the battery box of electric vehicles in structural components of a car body.

The Saxon Textile Research Institute (STFI), for instance, is currently working with industrial partners on combining the static-mechanical strengths of carbon fibers with vibration damping properties to improve the housings of electric motors in cars. The project, which is funded by the German Federal Ministry for Economic Affairs and Energy, is aimed at developing hybrid nonwovens that contain other fibers, in addition to carbon fiber, as a reinforcement. "We want to combine the advantages of different fiber materials and thereby develop a product that is optimally tailored to the requirements", explains Marcel Hofmann, head of department of Textile Lightweight Construction at STFI.

The Chemnitz researchers would therefore complement previous nonwoven solutions. They look back on 15 years of working with recycled carbon fibers. The global annual demand for the high-value fibers has almost quadrupled in the past decade, according to the AVK Industry Association to around 142,000 t most recently. "Increasing demand has brought recycling more and more into focus", says Hofmann. According to him, carbon fiber waste is available for about one-tenth to one-fifth of the price of primary fibers, but they still need to be processed. The key issue for the research success of recycled fibers is competitive applications. STFI has found these not only in cars, but also in the sports and leisure sector as well as in medical technology, for example



in components for computer tomography. "While metals or glass fibers cast shadows as potential competing products, carbon does not interfere with the image display and can fully exploit its advantages", explains Hofmann.



Using Paper Know-How

If recycled carbon fibers can pass through the product cycle again, this significantly improves their carbon footprint. At the same time it applies: The shorter the carbon fibers, the less attractive they are for further recycling. With this in mind, the Cetex Research Institute and the Papiertechnische Stiftung (PTS), both members of the Zuse Community, developed a new process as part of a research project that gives recycled carbon fibers, which previously seemed unsuitable, a second product life. "While classic textile processes use dry processing for the already very brittle recycled carbon fibers in fiber lengths of at least 80 mm, we dealt with a process from the paper industry that processes the materials wet. At the end of the process, in very simplified terms, we obtained a laminar mat made of recycled carbon fibers and chemical fibers", says Cetex project engineer Johannes Tietze, explaining the process by which even 40 mm short carbon fibers can be recycled into appealing intermediates.



The resulting product created in a hot pressing process serves as the base material for heavy-duty structural components. In addition, the mechanical properties of the semi-finished products were improved by combining them with continuous fiber-reinforced tapes. The researchers expect the recycled product to compete with glass-fiber-reinforced plastics, for example in applications in rail and vehicle construction. The results are now being incorporated into further research and development in the cooperation network of Ressourcetex, a funded association with 18 partners from industry and science.

Successful Implementation in the Automotive Industry

Industrial solutions for the recycling of carbon fiber production waste are being developed at the Thuringian Institute of Textile and Plastics Research (TITK). Several of these developments were industrially implemented with partners at the company SGL Composites in Wackersdorf, Germany. The processing of the so-called dry waste, mainly from production, is carried out in a separate procedure. "Here, we add the opened fibers to various processes for nonwoven production", says the responsible head of the department at TITK, Dr. Renate Lützkendorf¹. In addition to developments for applications e.g. in the BMW i3 in the roof or rear seat shell, special nonwovens and processes for the production of Sheet Molding Compounds (SMC) were established at TITK. These are thermoset materials consisting of reaction resins and reinforcing fibers, which are used to press fiber-plastic composites. This was used, for example, in a component for the C-pillar of the BMW 7 Series. "In its projects, TITK is primarily focusing on the development of more efficient processes and combined procedures to give carbon fiber recycling materials better opportunities in lightweight construction applications, also in terms of costs", says Lützkendorf. The focus is currently on the use of CF recycled fibers in thermoplastic processes for sheet and profile extrusion. "The goal is to combine short- and continuous-fiber reinforcement in a single, high-performance process step."

Source: Zuse Community

¹ On February 1, 2021, Dr. Thomas Reußmann succeeded Dr. Renate Lützkendorf, who retired on January 31.