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Natural fibers in use

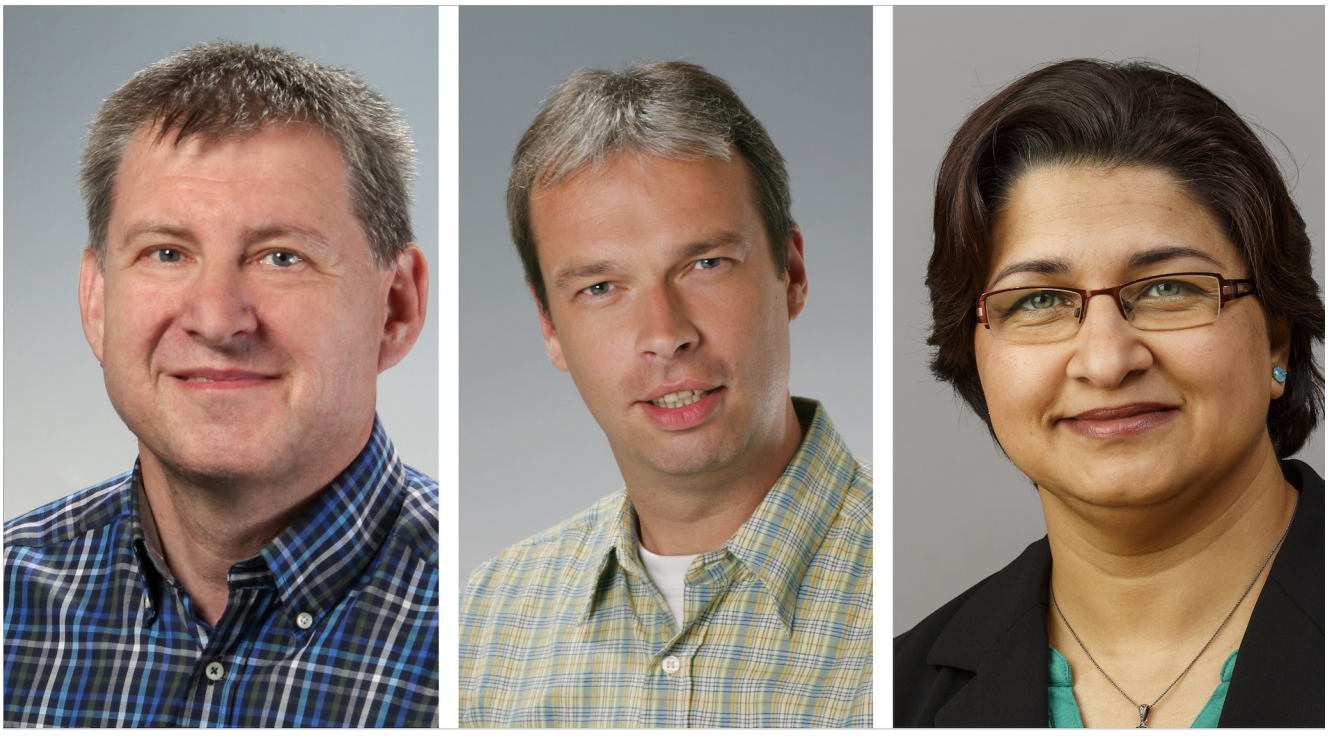
Sustainable reinforcement of e-bike battery cases

Ansmann AG from Assamstadt provides mobile energy solutions with a focus on sustainability. The BioBattery project, which was awarded the Baden-Württemberg Bioeconomy Innovation Prize, saw Ansmann AG working with the Fraunhofer LBF in Darmstadt to develop a natural fibre reinforced plastic composite for use in e-bike battery cases.

Rechargeable lithium-ion batteries (Li-ion batteries) have become an indispensable part of our everyday lives. Due to their high energy density, they are used in a wide range of portable devices, such as cell phones, cameras and notebooks, as well as tools such as cordless screwdrivers and garden power tools. Their advantage over nickel-cadmium or nickel-metal hydride batteries is their low self-discharge and their lack of memory effect: this means that they can be recharged again and again without loss of performance or capacity. However, they are sensitive to extreme temperatures. The optimum operating range for a long service life is between 5 °C and 45 °C.

Stricter standards for battery transport

Since Li-ion batteries are highly flammable when overheated or damaged, they are subject to dangerous goods legislation that regulates the transport of hazardous substances worldwide. Battery cases are therefore certified using the UN 38.3 test, which simulates a wide range of transport conditions such as temperature fluctuations or differences in altitude and assesses resistance to pressure, crushing, vibrations and impact from a height. Since January 2020, these standards have been further tightened, meaning that many common plastic cases no longer meet the specifications for mechanical properties and must be adapted. One possibility is switching to metal (mainly aluminium) as the predominant material. However, in most cases this increases the weight and the costs.



Ansmann AG's Alfred Bergold (left) and Gerhard Baumbusch (centre) worked together with Shilpa Khare (right) from the Fraunhofer LBF in the BioBattery project.

A company called Ansmann AG from Assamstadt is taking a different approach: "We're looking to modify our plastic battery cases so we can keep the same design possibilities while still meeting the new standards," explains Alfred Bergold, who is in charge of the research projects in the company's innovation and technology management department. Ansmann is a global market leader in the field of high-quality charging technologies. It has a large production site in Germany and subsidiaries in Great Britain, France, Sweden, Hong Kong and China. The company sells products such as power banks, chargers and torches directly to consumers, as well as individual industrial solutions for larger devices for the home and garden and in the field of medical technology. "Since we are not a mass manufacturer and tend to produce smaller quantities, we mainly manufacture plastic cases using injection moulding technology. This allows us to react flexibly to changing requirements," says the technical business economist, describing the advantages of the medium-sized company.

Natural fibre reinforced plastic for stabilisation

Thin organo sheets (B) are made from flax fabric (A) and polypropylene, which are used to reinforce the panels of an e-bike battery case.
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Improvements in the mechanical stability of plastics are currently mainly achieved by incorporating carbon fibres. In the BioBattery project, which was successfully concluded in August 2021, Ansmann worked in close cooperation with the Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt to develop a sustainable alternative to these fossil-based materials. In the project funded by the German Federal Ministry of Food and Agriculture (BMEL) via the Agency of Renewable Resources (FNR), the cooperation partners studied the suitability of natural fibres for reinforcing plastic. The lightweight cases for e-bike Li-ion batteries were used as a model system. After initial investigations, it was decided to use flax, as it is better able to withstand processing temperatures than hemp, sisal or even ramie. Moreover, the fibre fabrics are also available in consistent quality in the longer term.

Led by engineer Shilpa Khare, the existing technical processes at the Fraunhofer LBF were adapted and expanded to enable the flax fabric to be impregnated in a continuous process using polyolefin hot-melt adhesives and processed into thin (< 1 mm) plastic composite sheets. Ansmann then used these so-called organo sheets to make inserts that were integrated into the polypropylene (PP) battery case panels produced by a company called Dürr Kunststofftechnik from Schöntal. However, during these procedures, light deformations of the components occurred, which will be further optimised by changing the process parameters or geometry of the inserts. The sample parts produced were fitted into e-bike battery cases.

Tests at the Fraunhofer LBF showed that the mechanical properties of the natural fibre reinforced plastic panels are approximately 30 percent better than those of the pure PP component. The panels therefore meet the new standards. In addition, they are almost 15 percent lighter than the ABS (acrylonitrile-butadiene-styrene copolymer) panels currently used.

This is a positive aspect, especially for mobile applications. Compared to carbon fibres, the CO_2 footprint of the incorporated natural fibre is 75 percent lower and recycling in the form of thermal recovery (incineration) is easier.

Prize-winning development

In May 2021, Ansmann AG received the Main-Tauber district Innovation Prize for the developments made in the BioBattery project and was awarded the Baden-Württemberg Bioeconomy Innovation Prize in November 2021. "However, the battery case is not yet market-ready and the plant for manufacturing the organic sheets at the Fraunhofer LBF would have to be adapted for industrial series production," says Bergold, putting the results into perspective. "The connection of the insert to the PP component also still needs to be optimised to preclude deformations." However, the process can now be used for new designs where no distortion is expected. In addition, further material and battery case developments based on biobased plastic composites are being planned.

Article

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Further information

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