Green innovation: where wood is used to make structural foam

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Researchers in Leuna are using tall oil in the production of bioplastics

The bio-economy is creating solutions for future challenges, such as the scarcity of raw materials. In the shape of the "EffiMat" project, one example of bio-based innovations from Saxony-Anhalt is provided by the "Fraunhofer Center for Chemical-Biotechnological Processes CBP" in Leuna, in which tall oil is extracted from wood before being converted into innovative products.

Digitalisation, robotics, artificial intelligence – all are important topics for the worlds of industry and commerce. However, the bio-economy is also providing important impetus for the future. Green innovations are being driven forwards in Saxony-Anhalt: together with Saxony, the federal state is the focus region of the BioEconomy cluster of excellence in Central Germany, which promotes joint projects such as the "EffiMat". "One of the key principles of the bio-economy is the efficient use of bio-based residues and waste materials," explains Kerstin Thiele, Project Manager for Chemical Processes at the Fraunhofer Centre for Chemical-Biotechnological Processes CBP. "An unbelievable amount of everyday products are made from oil, a raw material which is also a finite resource. To meet future industrial needs while protecting the climate, it is necessary for us to find alternatives that are based on renewable raw materials."

Production based on crude oil-— another way is possible

The cluster project, which was funded by the Federal Ministry of Education and Research, had a clear brief: for comprehensive use to be made of the raw material of wood. Six project partners – the *Fraunhofer Institute for* Microstructure of Materials and Systems *IMWS* in Halle (Saale), the CBP in Leuna, the companies "Miltitz Aromatics", "Hennecke Polyurethane Technology", "ö_Konzept" and "BARiT Kunstharz und Belagstechnik" – worked together to develop plastics from biomass for floor coverings and foams, including the processing technologies which are adapted to them. "Until now, these products have only been produced on the basis of crude oil. We have shown that things can be different," explains Kerstin Thiele.

Energy-efficient production and an additional use of the raw material of wood

The "EffiMat" researchers focused on the by-product of tall oil, which arises during the production of cellulose, i.e. during the processing of wood. As explained by Kerstin Thiele: "Until now, this vegetable oil was only used in the production of energy. We succeeded in producing high-quality reactive resin systems with this product over several processing stages." In combination with what is known as a cross-linking component, biopolymers were hardened into solid plastic materials. According to the project manager, these structural foams could be used for packaging or in the construction of buildings. The bio-based innovative synthetic resin systems also have other advantages. "Structural foams which are based on vegetable oil harden more quickly when processed at low temperatures than any petroleum-based foam. The manufacturing process is also energy-efficient," explains Kerstin Thiele. She then highlights the increased added value which results from the fact that the by-product of tall oil can be reintroduced to the production cycle, and thereby make an "additional option for the material use of wood" possible.

Research conducted into the use of bioresin-bonded floor coverings

It was also possible for technologies and processes to be tested during the project. "We tested a specialist high-pressure foaming process," explains the project manager. "In this respect, we initially developed high-quality resin mixtures and suitable hardeners, and tested material and hardener combinations for their characteristics." The outcome: a variety of moulding compounds and structural foams. "It was very exciting," explains Kerstin Thiele, "our researchers didn't just put the foaming of the resin mixtures to the test on an industrial scale, but also their use in the form of bioresin-bonded floor coverings. In addition, synthetic resin systems "have been developed for a variety of applications" which "can be modified according to the requirements and the processing."

Promising applications in the area of home and furniture construction

A next step for the practical implementation of the research results could now be long-term tests, on chemical resistance, for example. Furthermore, Thiele explains that manufacturers of epoxy resin could also mix and offer resin and hardener components separately. "Users such as coating specialists and flooring fitters could also purchase and mix the individual components. We envisage there to be especially promising areas of application in the areas of home and furniture construction." The scientists in Leuna and their collaborative partners are constantly driving such possibilities forwards. Some of the then six partners in the project are continuing to work together on other projects after the "Effimat" funding has expired. In this context, the Fraunhofer Centre for Chemical Biotechnological Processes CBP is maintaining close contact with companies interested in additional bio-based epoxy resin systems.

Further research is on the way

The green innovations that originate from Saxony-Anhalt are in demand. "There is still so much that needs to be researched in order to advance bio-economy," says Kerstin Thiele. Another promising project is now under way in Leuna with the Fraunhofer Institute for Material and Beam Technology IWS, in which material for bio-based thermosetting plastics is to be jointly developed. The key buzzwords here are: multifunctional substances for insulating foams and adhesive systems – but that's a story from the local bio-economy for another day.

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