Leibniz-Institut für Verbundwerkstoffe GmbH (IVW)

The Leibniz-Institut für Verbundwerkstoffe GmbH (IVW) is a nonprofit research institution of the state of Rhineland-Palatinate and the Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau.

It researches fundamentals for future applications of composite materials, which are of great importance for the mobility of the future, the fields of energy, climate and environment, production technology as well as for health care. New materials, construction methods and manufacturing processes are investigated and tailor-made for the respective requirements. The focus is on the entire process chain, from basic materials to characterization and simulation, from construction methods and production technology to component testing and recycling.

To address specific questions on renewable and recycled materials the competence field “Material Cycles” is focusing on the characterization and novel application scenarios of these materials.

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Interview

with **Dr Barbara Güttler**
Manager Material Cycles
Leibniz-Institut für Verbundwerkstoffe (IVW)

Dr. Barbara Güttler successfully graduated in 2007 at the University of Applied Science Berlin (Germany) in the program Biotechnology with an emphasis in bioprocess engineering. In 2012 she successfully graduated from her PhD program in the Department of Chemical Engineering at the University of Waterloo, Ontario (Canada) in the field of biocomposites. She joined the Institute of Composite Materials in April 2014 where she is the manager of the competence field "Material Cycles" in the department of materials science. At IVW she is also the contact person for the topics “Biocomposites” and “Carbon Fiber Recycling”.

How can composites based on renewable carbon contribute to climate protection, enhanced health and forward-looking energy and mobility transitions?

The field of composite materials has an immense potential for lightweight applications especially in the mobility sector. This translates directly in reduced fuels consumption and unwanted emissions, which is most beneficial in the aviation sector. In addition, the energy sector benefits from composite materials since they provide superior properties when used for example in wind blades and turbines and for hydrogen storage.

In the medical field, fiber-reinforced orthoses or implants can substitute heavy and highly rigid metallic components with high weight and adjustable stiffness. We like to say "the right material at the right place". This overall approach contributes to a more sustainable product throughout the lifetime of a material or component.

The integration of renewable carbon as a source for polymers, fibers and additives is only a logical consequence that follows this approach towards an optimal composite component including a truly closed material loop.

Many renewable and bio-based materials have the same properties or are even identical with fossil materials. What is your strategy for increasingly integrating bio-based materials into your applications?

We regularly report on our successful research results with sustainable materials in peer-reviewed and widely read journals as well as at international conferences and also on our own homepage. This contributes to a broadening of knowledge also among potential users.

We also work on research projects that focus on the implementation of bio-based materials. This is often in collaboration with industry partners, which participate in these projects to create new products that give them an advantage over competing products.

More and more we have companies coming to us that have specific questions regarding sustainable products and circularity. This is sometimes due to their own vision or strategy but more often due to changed regulations regarding the circularity and environmental footprint of parts for mobility applications.

Which exactly are advantages of integrating bio-based materials into your composites? Can you give examples, in which you achieved an advanced composite when you switched from fossil material to a bio-based alternative?

The obvious advantage is the reduced environmental footprint due to the lower embodied energy and the stored carbon in the final products. However, natural fibers and fillers often have a great advantage due to their low density, which results in significant mass savings that is key in mobility applications.

This in combination with the appropriate design for composite materials can save up to 70 % of the original metal component. One example is the Bio-SMC that was developed in our institute and was substantially lighter than conventional SMC at the same performance.

What are barriers and variables that can aggravate the implementation of renewable alternatives – even if they are identical with fossil-based materials? How can those barriers be overcome?

Obstacles we see in two main areas: 1. Costs and availability 2. Existing equipment and processes. Especially the automotive industry is highly cost-driven, which makes it sometimes very difficult

when materials increase just by a few cent. The biopolymers are often more than double in price and due to the much lower demand, there seems to be a higher risk of supply shortage, also because of some seasonal influences. When switching from one to another material the process with its many variables need to be adjusted and optimized which is also related with to high risks and costs.

Many people still believe in the saying "never change a running system" and this is where digitalization as well as simulations can help reducing risks by predicting the processing and performance behaviors.

The recycling of composites can be challenging. Which solutions are offered by the Leibniz Institution tackling these challenges?

We have research groups that focus on specific challenges along the value chain. For recycling, special emphasis is placed on technologies enabling carbon fiber reuse, in order to permanently maintain the carbon for structural applications and to avoid further CO_2 emission by energetic valorization. The staple fiber technology is seen as a very promising approach in order to avoid "downcycling" in the future.

Is there an advantage of using bio-based composites for the recycling process?

The source or origin of the material is not as important as its performance and processing behavior. According to our expectations, renewable sources should be the sole origin of materials in today's times and the material cycle should be kept in a closed loop, which does not necessarily mean that the carbon should only cycle within the same application but rather within the renewable carbon loop.

What was your motivation to lay focus on renewable carbon in your composite research and why did you join RCI?

Being always active in the field of sustainable material application, it was a logical conclusion to join the RCI and be part of the activities, esp. in the material sector. Since our institute depends on the polymers and fibers that are available on the market, we see this membership as a great opportunity to connect to the chemical industry that is synthesizing the next generation of polymers and fibers.

How can RCI profit from the membership of the Leibniz Institute?

Our researchers are working on the cutting edge in the development of high performance composite materials. When selecting suitable polymers, fibers and additives we are always interested to integrate renewable resources. Other members of the RCI developing some of these basic materials that can be applied in our processes and integrated in our projects. This will discover new fields of applications and increase the market share of the products.

We are a reliable research partner with a great interest to lead together with partners the composite materials community towards holistic sustainable material cycles.