Making Demanding Applications Bio-Based

Functionalized Bioplastic Compounds for Healthcare and Engineering Applications

Biovox was founded in 2020 to enable more sustainability through renewable bioplastics even in difficult applications such as consumables in healthcare or machine parts. The founders, a team of three who studied Mechanical Engineering at Technical University Darmstadt, Germany, have a holistic approach: First, the requirements of application and production processes are thoroughly analyzed together with the customer. Then Biovox produces the most ecologically and economically sustainable material system from a wide range of polymers and additives and helps with implementation. Julian Lotz, Carmen Rommel and Vinzenz Nienhaus explain their motivation and growth strategy.

Biovox founders (left to right): Vinzenz Nienhaus, Julian Lotz, Carmen Rommel

CHEManager: There are various fields where bioplastics can replace fossil-based plastics, why did you pick tough applications like healthcare consumables?

Carmen Rommel: Currently, bioplastics are mostly used for packaging and low-tech consumer goods. In such applications recycling can often have more impact than switching to bio-based materials. However, approximately one quarter of hospital waste is plastics, and the vast majority of it is burned due to possible contaminations. These applications are not addressable for the recycling processes currently used. A huge amount of fossil carbon is emitted subsequently, over 3 million tons per year in Germany alone. Hospital plastic waste exceeds the amount of plastic waste from online retail by about 50%. Using 100% bio-based plastics in these applications reduces carbon emissions drastically.

We also have projects in application areas where huge amounts of microplastics are set free. With a bioplastic formulation that fully and quickly degrades in various ecosystems, we can eliminate permanent microplastic pollution.

What is your approach to developing a bio-based material for an industrial or medical application?

Julian Lotz: First, we are analyzing the requirements together with our customer, and we do it along the complete lifecycle. This is part of our consultation packages customers often book when they just started their journey from fossil-based to bio-based materials. After learning the requirements and the life cycle in detail, we are proposing feasible and sustainable material systems, including all masterbatches and additives needed. We are creating a roadmap for the transition together with the customer's operations department. On top, we provide scientifically proven sustainability benefits to the customer's marketing team. That prevents them from accidentally greenwash the product or handing out false claims. In especially demanding applications we usually start with the simplest product available to quickly create a success story for our customer.

And the challenges you are facing?

Vinzenz Nienhaus: Customers usually want to have an "out of the box" solution for their problem. But such solutions do not always exist. Since we are mostly working on applications with special requirements, there seldomly are samples of semi-finished products, like foils for thermoforming, readily available. The cost to make prototypes from a new material composition is sometimes high due to the need for significant production machinery. Customers do not always plan budget for that. In about half of the cases we can help by 3D-printing prototypes from the actual serial production material variants. Luckily, in this area I could gather plenty of experience in the past.

What are the next steps planned to grow your start-up?

V. Nienhaus: We are currently preparing our bio-based and biodegrad able antimicrobial additive for the biocide approval process. This will be a major step for its use, for example in machine parts in the food production industry. And we are always looking for new polymers and regional feedstock and are extending our production partner network for injection molding and processing to offer qualified production partners to our customers.

C. Rommel: Besides the production network we are also partnering with sustainability strategy consultants to support our customers even further in their transition process. For true sustainability you cannot "just swap the material", a holistic view on the company is needed to grant lasting effects.

J. Lotz: In addition to that, we are in the middle of a financing round to fund our further growth and the development of new materials. ■

Personal Profiles

Julian Lotz, CEO of Biovox, holds a PhD in Mechanical & Process Engineering from Technical University (TU) Darmstadt. His studies in the field of product development methodologies soon became the basis for the structured material counselling he provides now. He has been working with fiber-reinforced plastics for over a decade but shifted his focus from carbon fiber epoxy systems to sustainable thermoplastic compounds with second-generation biomass. Before founding Biovox, he managed a program team at Voith Turbo.

Carmen Rommel, COO of Biovox, holds a master's degree in mechanical engineering from TU Darmstadt with a focus on sustainability. During her studies she contributed to a research project developing cellulose-based building materials and improving sustainability assessment of production lines. After completing her studies, she worked on replacing fossil plastics with recycled plastics and bioplastics in automotive applications at Daimler. There she learned sustainability key factors as well as the pain points that companies face transitioning towards green materials.

Vinzenz Nienhaus, CTO of Biovox, is an expert for 3D printing with plastics. He studied mechanical engineering at Technical University Darmstadt, where wrote his dissertation about FFF printing, and he worked on the creation of biopolymer-based bone replacement materials. He loves production processes and metrology, two competencies he acquired in various industrial research projects. With this know-how he develops compounds and additives at Biovox and ensures a reliable material qualification.

Business Idea

Bioplastics for More Than Packaging

Biovox helps its customers making their demanding products more sustainable. Today, many complex or regulated applications of plastics are not covered by recycling. The start-up's mission is to contribute to a more livable world by reducing carbon and microplastic emissions from industrial and healthcare applications. The team uses an holistic approach, including support in sustainability assessment, product development, production process optimization and marketing support.

Using a variety of industrial-scale biopolymers like PBS, PHB, PLA and drop-ins, Biovox creates functionalized material systems, mainly for industrial and healthcare applications.

Special features of Biovox' material systems:

Bio-based and fully biodegradable biocidal additive (submitted to registration): it keeps products clean from bacteria, molds and certain viruses while not accumulating in ecosystems.

Especially well compostable regiogradable compounds, up to 100% bio-based. Using regionally sourced secondary biomass from agro or food production waste for compounds grants best life cycle assessment. They also help to create unique designs and tell a story, too. The biomass can be chosen individually.

Color master batches, partly from natural pigments, are tailored for various base polymers and certified for composting and food contact safety.

Barrier coatings that prevent odors and flavors as well as oxygen and water passing through the bioplastics are used if the inherent barrier effects are not sufficient or if a compound with a high proportion of secondary biomass is used.

FDA-approval is an inherent feature of many of the material formulations. ISO 13485 will follow soon.

Transition & innovation support: Biovox helps customers to start and successfully implement the use of renewable resources instead of fossil-based plastics.

Together with our supplier network, we provide our solutions as regional as possible. Furthermore, we are also contributing to the UN Sustainable Development Goals (SDGs) 3, 12, 13, and 14.

■ Biovox GmbH, Darmstadt, Germany
www.biovox.systems

BIOVOX

Regiogradable compounds have an excellent footprint, outstanding sustainability, unique looks, and can tell an upcycling story.

Elevator Pitch

More Sustainability Now

With every kilogram of fossil-based plastic waste that is burned, over 3 kg of CO_2 are released into the atmosphere — over 3 million t/y just from Germany's hospitals' plastic waste. Non-biodegradable plastics are polluting the oceans, food and water — the average human consumes about 5 g of microplastics per week, equaling the plastic amount of 52 credit cards per year.

The team at Biovox wants to solve these pressing problems. There are many plastics applications that are not covered by recycling systems and that have complex requirements. Bioplastics are not commonly used in these applications yet. With expert knowledge in material formulation and choice, processing, LCA and regulatory affairs (medical device regulation, food safety) Biovox is a one-stop-shop for bioplastic systems.

The Darmstadt, Germany-based start-up develops new bioplastic compounds that have advanced functionality like inherent antimicrobial activity, barrier properties against oxygen and water vapor, or the release of bioactive substances. At the same time, they are environmentally friendly: bio-based, microplastic-free, biodegradable and with lower carbon emissions.

Milestones

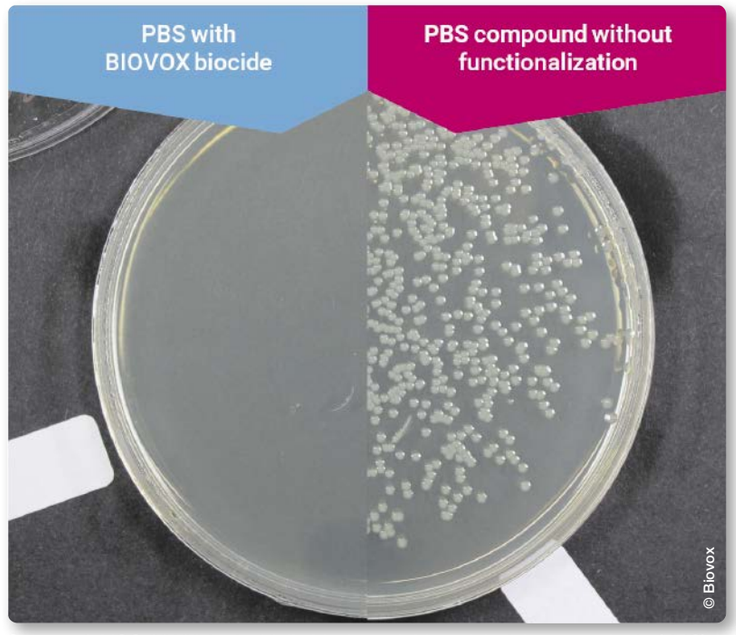
2020:
- Founding of Biovox

2021:
- Market entry of regionally sourced, well compostable bioplastic series Regiogradable
- Prototyping process (3D-printing) for injection-molding and extrusion materials set-up
- Fully compostable and food safe color masterbatches certified and market-ready
- First medical device development projects started

Roadmap

2022:
- Authorization of Biovox antimicrobial additive
- Seed round funding completed
- Onboard Biovox-certified injection-molding and extrusion contract manufacturers
- ISO 13485 certification

2023:
- Release of first Biovox-developed material system for class-II-a medical devices
- Further business expansion



Successful ISO 22196 test of fully biodegradable polybutylene succinate (PBS) functionalized with Biovox biocide against E.coli.