



With its new, 100% wood-based Renewable Functional Fillers (RFF), UPM aims to revolutionise the rubber and plastic industry. But how exactly? And what makes the new material so superior? Christian Hübsch, director Sales & Marketing at UPM Biochemicals, explains the details.

RFF will be a real game-changer

Today, hundreds of millions of tons of fossil-based raw materials are still being used in everyday industrial products. For example, about 15 million tons of highly CO₂ intensive carbon black and silica are used annually to reinforce rubbers and plastics in tires, hoses, sealing systems and other rubber and plastic applications. With the growing impact of climate change, industries are intensively looking for more sustainable business alternatives.

For them, UPM Biochemicals now comes up with a new-to-the-world solution that claims to have the potential to revolutionise an entire industry. The newly developed Renewable Functional Fillers (RFF) combine superior environmental and technical performance with substantially lower weight and higher purity cost-effectively. In the biorefinery currently under construction at Leuna, Germany, these

100% wood-based fillers will soon be produced and enter the market to significantly reduce the carbon footprint in a wide variety of rubber and plastic products.

Christian Hübsch has been involved in developing RFF at UPM since the beginning. Now, he is overseeing the implementation of the concept at full scale and the go-to-market approach of the new product as Director Sales & Marketing at UPM Biochemicals. Here, he explains how RFF helps to reduce fossil-based content and carbon footprint in rubber products. And how they contribute directly to the urgently needed transformation towards a far more sustainable raw material use worldwide.

UPM announces RFF has the potential to revolutionise the rubber and plastics industry. What is RFF – and what can it do?

UPM BioMotion™ RFF are a patent-protected material that is genuinely new to the world.

More precisely: a truly sustainable functional filler that simultaneously gives rubber compounds more excellent elasticity and strength. As a 100% wood-based product, it can achieve the same performance level as fossil-based fillers. With a density of only 1.35 g/cm³ it's also up to 25% lighter than traditional filler systems. It's renewable and long-term biodegradable, thermally stable and meets the highest purity requirements (in terms of Sulphur content). It's free of carcinogenic PAH (polycyclic aromatic hydrocarbons), making it a safe solution to produce products in contact with human skin. But its biggest U.S.P. is: It combines a unique performance profile with an outstandingly low environmental footprint.

What makes its footprint so exceptional?

RFF are more than just a product – this new filler marks a solution for urgent industry needs. It can be a real game-changer, as it will enable a radical step forward in the sustainability performance of rubber and plastic products in various end-uses. The two materials that RFF can replace best are carbon black and precipitated silica. Both are highly CO₂-intensive in production, non-renewable and challenging to recycle. According to our calculations, RFF have a more than 90% better CO₂-footprint than industrial carbon black – we will provide exact figures in the coming months once our Life Cycle Assessment (LCA) is validated. RFF help to reduce the content of both carbon black and silica drastically. They enable renewable contents in up to 85% in final compounds combined with bio-based rubbers and plasticisers. The mentioned weight savings are an additional solid value add, especially for the automotive industry, where lower weight means better mileage, lower costs, and a further reduction of CO₂-emissions.

In which industries can RFF be used?

RFF are suitable for use in a broad range of elastomers, thermoplastic compounds, and thermoplastic elastomers (TPE) in automotive, construction, flooring, footwear, or entertainment industries. For example, in the automotive industry, carbon black is applied in sealing profiles, hoses, and fittings, not to mention the tires, around one-third of which are made of industrial carbon black. Profiles even consist of around 50% industrial carbon black. Here, RFF can improve the CO₂ balance by almost half.

Does the carbon footprint apply to the entire value chain?

Our LCA covers the RFF lifecycle from cradle-to-gate, respectively, from resource extraction until transportation to the customer. The end-usage cases for RFF are pretty diverse, which makes reliable data for usage and end-of-life footprints quite tricky. But there will be significant progress also in these phases, due to weight-savings, amongst others.

Will sustainability benefits compromise the performance profile and mechanical properties?

On the contrary! In addition to its exceptionally low footprint breakthrough, RFF combine several exceptional outstanding properties.

For example, the product offers an exceptionally high surface area per weight and thus very high mechanical strength with the same elasticity. It's 100% electrically non-conductive (<2000 μS/cm) and effectively prevents electrochemical corrosion when applied in rubber formulations that are in direct contact with light metals like magnesium and aluminium. This will result in longer rubber product lifetimes, enabling further weight savings, especially in automotive applications. But of course, RFF cannot be a drop-in alternative. For industrial use, the composition of each rubber compound must be carefully optimised, sometimes with novel or even counter-intuitive approaches. We can confidently state that with high probability, we can develop an RFF-based compound for each application area that meets even stringent performance requirements.

UPM develops the specific RFF applications to support our customers' product development. What are the advantages?

For us, it is imperative to directly support our customers in making their compound development as fast and straightforward as possible. For this, we closely collaborate with all our clients in our recently opened Rubber Lab in Leuna. Together, we use our compounding and testing lab to share our resources and experiences, exchange ideas, and learn ourselves. After all, the aim is to perfect our new product quickly and effectively. With all customers, we go through three stages. We test in small quantities in the laboratory phase, later an industrial scale with trial batches and with pilot tests. Then we go into pre-production and finally start regular production.

What about market readiness and initial interim results of the collaboration?

At the end of 2021, we completed the pre-series phase with several customers. We are working with leading manufacturers in the automotive industry and companies from mechanical rubber goods, flooring, and footwear sectors. We are developing customised solutions that inspire a new generation of sustainable consumer products.

To what extent can RFF help such manufacturers solve acute problems?

Many industries have ambitious sustainability targets and urgently seek solutions based on renewable materi-

als with optimised environmental performance. We can provide them with a future-fit alternative to fossil-based materials. With RFF, our partners will take a step-change to transform their products into truly sustainable.

How about the price?

Our objective is to keep raw material costs per article similar to state-of-the-art products. However, we are offering very significant added value, making the whole package, comprising the physical product and a broad range of services, highly attractive.

Where will RFF be produced?

UPM is building a highly modern, first-of-its-kind biorefinery at Leuna, Saxony-Anhalt, at €550 million. RFF production start is scheduled for 2023. Many chemical companies are located at the site, which offers an optimal infrastructure and, due to its central location, favourable transport routes and proximity to raw materials and customers alike. Our UPM Leuna woody biomass refinery is also the first to use remarkable on-site processing method technologies, such as beechwood from regional forests and residues from sawing industry. The annual capacity is expected to be around 220,000 metric tons.

UPM has so far been known as one of the world's leading pulp and paper manufacturers. Why are you investing in novel products such as biochemicals?

We have seen that our core competence in sourcing and processing wood, proven over 150 years, turns out to be an excellent advantage for the production of new forest-based materials and chemicals. At the same time, we are seeing a growing demand for renewable materials to help mitigate the dramatic consequences of climate change. Our activities are another strong manifestation of UPM's transformation to reach out beyond pulp and paper and extend our value chains into new innovative businesses – such as biochemicals, fully in line with our corporate mission "we create a future beyond fossils". The market size for RFF alone is enormous – carbon black is one of the top-10 petro-based products globally, with annual production of around 15 million tons. And even if we start with similar small production in Leuna, RFF can substantially transform this market to better respond to the need for climate protection. In that sense, RFF as part of our growing Biochemicals portfolio shows how UPM will develop going forward.