

# Story: Mountain bike



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CFRTP composites from Covestro make mountain bikes safer

## Going through hell to get to heaven

**Lightweight, highly resilient and ideally also attractive to look at: These are the demands that enthusiastic cyclists make on the components of their bikes today. The challenge: the synthetic resin-carbon fiber composites that are in great demand in this scene may be light and chic – but the risk of breakage is always present. With its brand-new, lightweight CFRTP composites (continuous fiber-reinforced thermoplastic), Covestro opens up a new chapter: they can be processed in a novel process in just one step.**

Previous restrictions on synthetic resin composites, such as the mass production capability and intrinsic brittleness of the material, could soon be a thing of the past thanks to CFRTPs. The impact-resistant matrix material polycarbonate further increases safety – and the popular carbon look is also included. Last but not least, CFRTP composites also increase the cost-effectiveness of production. Time for a change of guard in the bicycle sector!

### Tours with adrenaline factor

When are mountain bike tours most beautiful? Of course: on the ups and downs! It goes without saying that not only all the driver's senses are challenged as much as possible: The material also has to withstand enormous forces and shocks when shooting over roots and rocks, in tight hairpin curves and in hard landings after a jump.

This is reason enough for experienced developers such as Dr. Niccolo Pini, founder and managing director of next composites GmbH in Otelfingen, Switzerland (a company of Ensinger GmbH), to keep up with the latest materials that the market offers in order to achieve the best there is for the bikers. His latest highlight: a pedal crank made of CFRTP, the new high-performance



composites in Covestro's portfolio. The part is not only extremely light and robust, but also looks great due to the coveted carbon fiber optic. Thanks to the new manufacturing possibilities of next composites, it can be reproducibly and automatically produced – with all the advantages for component quality.

### **True engineering work**

Get on your bike, get out of the exhaust fumes of city traffic, head down fast downhill over winding paths: For engineers, some mountain bike tours mean that the rider is in the sky while the material goes through hell. Of course, no one needs a breakdown when shooting at 50 km/h, for example due to broken handlebars, frames or cranks.

"The development of components for mountain bikes is true engineering work," explains Niccolo Pini of next composites. He is also a passionate cyclist who has been thrown out of the saddle several times while pursuing his hobby. A man who knows his way around – from several perspectives.

### **Genuine engineering work for shooting over rough and rocky surfaces**

Material failure often has a very simple reason for Pini: poor workmanship due to manual labor. "Even for simple components such as a crank, you need sixty to seventy carbon fiber blanks in classic synthetic resin processing, which have to be aligned manually in the correct order and position. This is exhausting work that requires a lot of concentration. No wonder there are quality problems." From the outside you can hardly see the black carbon part. But when it comes down to it, the break is there – and the driver goes over the handlebars.

The solution for Dr. Pini is Covestro CFRTPs – continuous carbon fibers impregnated with the high-performance plastic polycarbonate. This new composite material offers enormous strengths thanks to the fiber reinforcement, but thanks to its thermoplastic matrix, it can be processed mechanically and significantly faster than epoxy-based systems. "Machines make mistakes less often," says Pini. This means that problems with incorrectly laid carbon fiber sheets, which can lead to fractures later on, are remedied from the very beginning.

"In fact, the great strength of our CFRTP tapes is that they are not only able to absorb high forces thanks to the continuous carbon fibers," adds Dr. Michael Schmidt, who is one of two Co-CEOs of Covestro CFRTP, together with David Hartmann, "but that with their help, several conventional steps in the processing of previous carbon fiber thermoset composites can be combined in a single, fast process." The tapes are automatically cut at precisely the required angle according to the mechanical requirements. They are then placed into a tool before the preform manufactured in this process is pressed in the next step.



### **High impact strength protects against fractures**

In addition, there are considerable economic advantages in terms of post-treatment: traditionally manufactured composites made of synthetic resin and carbon fiber usually have to be laboriously treated with fillers, reground and polished in order to satisfy the aesthetic demands of the customers.

According to Pini, a "classic" carbon frame passes through up to 70 pairs of hands in the course of its manufacture. Approximately 120 working hours are required to bring the component so that it can be hung on the wall in the shop – and half of this time is needed for rework. With Covestro CFRTP, on the other hand, the component with a high-quality surface finish comes out of the machine practically ready for sale. And with a weight of 150 grams, the new crank is still incredibly light despite its load-bearing capacity – this is an important argument for the new material, according to Niccolo Pini, especially when it comes to moving parts in bicycle construction.

The matrix material polycarbonate also offers clear advantages. "Thanks to its high fracture toughness, this plastic is ideal for such applications," says Dr. Pini. According to the composite expert, thermoset materials such as those often used in the manufacture of carbon fiber composites, on the other hand, tend to break brittle quickly in the event of blows – this is just not enough for the stresses and strains that mountain bikes are subject to in the fields and forests. Polycarbonate, on the other hand, is also able to withstand violent blows.

### **CFRTPs from Covestro are "Composites 2.0"**

Another advantage: The toughness of the plastic material means that metal inlays, which are commonplace with synthetic resin composites, can be largely dispensed with when processing Covestro's CFRTP tapes. Dr. Pini and his colleagues simply cut their threads into the molded crank – ready. At present, they only need a single inlay – and that too should soon be a thing of the past. "We are gradually approaching the goal of doing without aluminum inlays altogether," says the manager, "in order to make the crank even lighter at the end."

CFRTP is a new material whose maximum performance potential has yet to be explored by the engineers. In this way, Pini also takes the wind out of the sails of critics who did not have the best experiences with thermoplastic materials in bicycle construction in the 1990s: "With CFRTP, Covestro has practically reinvented carbon fiber composites!" The specialists of the plastics company are happy to pass on their knowledge: "We have received a competent answer to every question," says the Swiss engineer.



Covestro is also proud of the project. "This was one of our first orders and the best opportunity for us to bring our unidirectional CFRTP tapes into a fascinating application," says Dr. Michael Schmidt.

"Covestro is also a very reliable consulting partner – and I have been working in this industry for 15 years," says Dr. Pini. No wonder that the committed bike fan is already thinking about further projects with the new material from the high-end materials factory in Leverkusen. Covestro also sees a whole range of new opportunities for CFRTP tapes – in addition to the sports sector, there are also opportunities in the automotive sector, electronics, medical technology and other sectors. The chances are good, because the demand for lightweight yet stable, cost-effective plastic components is growing worldwide.

**About Covestro:**

With 2017 sales of EUR 14.1 billion, Covestro is among the world's largest polymer companies. Business activities are focused on the manufacture of high-tech polymer materials and the development of innovative solutions for products used in many areas of daily life. The main segments served are the automotive, construction, wood processing and furniture, and electrical and electronics industries. Other sectors include sports and leisure, cosmetics, health and the chemical industry itself. Covestro has 30 production sites worldwide and employs approximately 16,200 people (calculated as full-time equivalents) at the end of 2017.

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