

Finding BioInspiration

Working with an eco-inspired company to create a flexible filament from compostable raw materials for 3D printers

green dot[®]

Entrepreneurs and disruptors the world over are waking up to the fact that for some of our most pressing environmental problems, Mother Nature can show us solutions. If only we pay attention.

That's the thinking behind <u>BioInspiration</u>, a company that set out to "follow nature's lead." Brian Crotty, CEO and co-founder of the Berlin-based company, sees it as nothing less than the harbinger of an organic material revolution, where the things we make, the things we use, and the things we throw away enhance and compliment nature, not degrade and destroy it. His company is committed to replacing, anywhere possible, the artificial materials that make up the goods we buy—and that fill our landfills—with compostable or upcyclable materials.



Turning inspiration into change

Where does a company with such grand ambitions begin? For BioInspiration, it began with probing the market for gaps in material offerings that were both environmentally friendly, unique and highly useful. Biopolymers were



selected as the first concentration, particularly for the new and extremely promising arena of filaments for 3D printing.

Flexible filaments had been seen as an area of opportunity since shortly after the advent of 3D printing technology itself. So naturally, there were plenty of the materials already on the market including flexible filaments. What did not exist, however, was a material that was both flexible and made from compostable raw materials.

BioInspiration had found their first product offering. Next, they searched the market for biopolymer suppliers that could help them make their idea a reality. After scouring the Web, Thorsten Perl, CVO came across a company that had previously worked on an iPhone case made from a composite plastic material designed to biodegrade over time. The base qualifications of the material used looked like it could be adapted for 3D printing. BioInspiration reached out to the company to see if they thought it was possible. The reception from Green Dot was warm, as they had already explored entering the 3D print arena but without finding an interested partner. After learning more about Green Dot's line of Terratek plastics, a partnership was formed.





Welcome, WillowFlex

Once Crotty and BioInspiration had a viable material supplier, it was time to team up with another German company, a plastics manufacturer with considerable 3D printing and filament extrusion experience. That company, <u>3dk.berlin</u>, owned a testing facility with seven different types of printers and extensive experience with quality and endurance testing. Florian Deurer, who runs the filament laboratory at 3dk.berlin, was immediately impressed with the material and its properties.

"It's totally uncommon for a plastic to be this flexible, this heat resistant and to also have a melting point that is that low that you can print it at temperatures uncommon for other plastics," he said. "That's what's very interesting about this material."

In fact, while BioInspiration initially thought that the compostability of the material would be its main selling point, initial feedback from interested buyers shows just as much interest in the material's tolerance for extreme temperatures. WillowFlex is capable of maintaining its structural integrity in excess of 212 degrees Fahrenheit (100 degrees Celsius) and retaining its flexibility to at least 5 degrees Fahrenheit (-15 degrees Celsius).



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Deurer also cited WillowFlex's excellent layer adhesion as another key strength of the material, explaining that with other flexible filaments, there is a tendency for layers to peel apart after being printed. Even at extreme temperatures, layer adhesion remains strong with this material.

Duerer is sure to point out that WillowFlex should be processed at lower temperatures than other plastics. Without knowing this, printers run the risk of burning the material. But once it's understood that WillowFlex melts around 347-356 degrees Fahrenheit (175-180 degrees Celsius), this does not present a problem and can even lead to energy savings.

BioInspiration also found that they were able to print WillowFlex at the high end of the speed spectrum. "3D printing is already not a very quick process," Crotty said, "and if you have to move into even slower printing times, it can be a problem." Fortunately, WillowFlex can be printed at speeds around 60 millimeters per second, whereas many other flexible materials on the market print at around 30 millimeters per second.

And then there's the smell. Heating traditional plastics to the temperatures necessary to print them, predictably, leads to the strong odor of melted plastic. Since WillowFlex is bio-based, the smell it gives off during the printing process has been likened to a smell that might waft out of a bakery that's baking bread. If, as more than a few predict, 3D printers have serious educational value and are to be considered learning tools, melting these materials in classrooms certainly seems preferable to melting their petroleum-based alternatives.



Across the planet, for the planet

A partnership covering a distance of nearly 5,000 miles may require splitting his workday in two, but other than that, Brian Crotty says that technology made other hurdles relatively easy to overcome. From his office just outside Berlin, Crotty is able to talk with Green Dot through VOIP, send photos in realtime and even videoconference with the Green Dot lab to pinpoint specific problems with early rounds of the material's formulation.

"A lot of the restrictions to working internationally are falling away," he said. "It opens up a lot more possibilities. We can look around the world for solutions."

When an initial pass at meeting BioInspiration's material property request produced a material that was too soft for 3D Printing, Crotty and Deurer were able to describe in detail the issue, and Green Dot was able to correct it on the very next round.

"It was essentially a single phone conversation where we were all able to get on the line, describe in great detail what the problems and limitations were, and also our product wishes for the material," Crotty said of the process. "We allotted for a couple different back-and-forth revisions, but after that first round we were able to get a winner."

According to Crotty, the fact that both Green Dot and 3dk.berlin have inhouse material testing facilities was one of the main reasons BioInspiration chose to work with them. He and Duerer were able to directly contact Green Dot personnel within the testing facility to diagnose the first-round issue.

"This was pretty straightforward," Deurer said. "We knew what we wanted, and that was important. If you want a material to have certain properties, you have to be able to describe those properties. Having someone who knows what you're asking for helps."



Bioplastics, 3D printing and the future



BioInspiration is excited to be able to offer their WillowFlex filament at a comparable price point to those already on the market, with the added benefits of increased tolerance for extreme temperatures and compostability. With growing environmental consciousness and a relatedly growing negative perception of petroleum-based plastics, especially in Germany, Crotty and Deurer think the decision to use biocomposites may eventually become a nobrainer.

"Lots of people don't even know bioplastics exist," according to Deurer. "They still think 'bio' and 'plastic' are words that cannot go together. It's pretty interesting to see people's reaction when we show them these materials."

Applications for WillowFlex are expected to be as diverse as the makers capable of operating a 3D printer. Duerer sees special promise in using dual extrusion techniques to make products where some of the parts are rigid and some of the parts are flexible. He uses the example of, in a single print, creating a door hinge with rigid attachment points and flexible center that is



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able to bend. There is excitement, also, for products that typically only have a lifespan of a few years, such children's toys and footwear. But perhaps the material's greatest strength is its ability to become anything someone with a 3d printer can imagine.

BioInspiration is excited about the possibilities of 3D printing from compostable materials on an industrial scale, but also for independent makers all over the globe. That's why they decided to initially go to market with <u>a Kickstarter campaign</u>. Ten days after it began, it was more than halfway to reaching its funding goal. Both Crotty and Deurer say that's in line with demand they've seen elsewhere for a material like WillowFlex.

"Florian and his team have actually had this material at a couple of conferences," said Crotty. "And as soon as they showed it off and explained what it was, the only question was 'when can we have it?""





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