

SOLVING FOR SUSTAINABILITY



Vartega Teams up with MITO® to Create a Performance Solution

* This vehicle depiction is a concept car and is featured to demonstrate a possible application for Fenix Fiber+™



STRONGER TOGETHER A MITO CASE STUDY



INDUSTRY:

SUSTAINABLE CARBON FIBER RECYCLING

WHO IS VARTEGA:

As an industry leader in sustainable solutions for carbon fiber recycling, Vartega is the premier US recycler with a closed loop and low-cost post-industrial fiber recovery process, creating a collection of EasyFeed Bundles™ used for thermoplastic compounding. The team at Vartega is committed to reducing manufacturing waste and improving sustainability. Their mission is to solve the world's toughest advanced materials recycling challenges.

WHO IS MITO® MATERIAL SOLUTIONS:

We develop hybrid additives by taking known materials, bringing them into our facility and combining them at the molecular level to achieve superior performance.

MITO develops solutions for material problems by creating new additives or adjusting their existing portfolio of hybrid additive products to fit your system. Our team works best with partners who are open and collaborative; partners who want to build something stronger together. We are able to do so by understanding customers' processes and listening to their needs, diving into their markets, and then creating a combined material that delivers on all of the lab promises in the real-world.

By partnering with carbon fiber sustainability leader, Vartega, the MITO team was able to harness all the behind-the-scenes development engineering of a sustainability process to create a custom solution that is the first of its kind and bring a new product to market.

SUSTAINABLE TEAMWORK

Vartega developed a relationship with MITO over a period of several years, starting in 2018 during a competition at SAMPE. The North America Society for the Advancement of Material and Process Engineering (SAMPE) is the leading conference and exhibition on advanced materials and processes, specializing in composite materials for high-performance applications. MITO and Vartega began looking for collaboration opportunities.

"I've known Haley and Kevin since 2018 when I first met MITO at a SAMPE competition. We've been in touch ever since, looking for opportunities to work together." notes Andrew Maxey, CEO of Vartega. "I was really impressed with their level of polish and the maturity of their company. MITO really had their stuff together for what was initially a basic concept."

"Since then, we've been talking about incorporating MITO's materials into carbon fiber reinforced thermoplastics. The stars aligned this year and we finally had the capacity, infrastructure, and right formulation from MITO to combine with our recycled carbon fiber. So, this collaboration is really the culmination of several years of discussion and iteration around what it could be."

"At SAMPE people kept saying, 'MITO makes everything stronger and lighter and more durable - It would be really cool if you guys could do something with Vartega's recycled carbon fiber, and then together you guys could change the world'," stated Haley Keith, MITO's CEO. "Then, in 2022, at the CAMX show, Andrew came over to me and said 'We should do a booth together next year'. And I told him 'I'm not doing a booth with you unless we have a product released'. That's what put the timeline on developing a product that would support improved sustainability."

RECYCLING IN CARBON FIBER

Because carbon fiber manufacturing is an energy intensive process, waste diversion is a big factor in improving carbon fiber sustainability. Carbon fiber is typically made from polyacrylonitrile (PAN) precursor fiber

that has been stretched and heated at high temperatures to first oxidize and then carbonize the material. These high temperatures coupled with PAN fibers traditionally coming from fossil fuels, means that carbon fiber has a considerable carbon footprint.

By diverting waste carbon fiber from landfill, Vartega resets the material's embodied energy to zero. Vartega's recycled carbon fiber is 95% less energy intensive than virgin carbon fiber.

Vartega incorporated MITO's LIGRA™ into their Fenix Fiber EasyFeed Bundle™ products - now offered as Fenix Fiber+™. Fenix Fiber+™ supplies documented game-changing performance with recycled materials.



CREATING MITO LIGRA™

Short for "liquefied graphene", LIGRA™ is an aqueous graphene-based solution with functionalized surface chemistry on top of the graphene that allows it to be suspended into water which provides superior dispersion and the ability to integrate into different chemistries that are more water-based such as coatings, emulsions, and sizing chemistries such as Vartega's Fenix Fiber+™.

DEVELOPING FENIX FIBER +™

Vartega's primary customers are thermoplastic compounders. These are the companies developing the materials and the formulations for their customers, which are injection molders, through to thermoplastic compounding, and the injection molders who are making the parts for OEMs.

When Vartega started, they focused on recycling aerospace carbon fiber prepreg scrap. Their original recycled carbon fibers were low density, fluffy, and difficult for customers to work with.



The team at Vartega did concepts and pilot projects with partners early on. The general feedback was, “This is really cool. The mechanical properties are good. The economics are good. We’re glad that it’s recycled but we can’t use this carbon fiber in our applications. The format’s not right.”

To address this, Vartega explored and developed alternative formats to improve handling. Ultimately, they landed on the EasyFeed Bundles™ now known as Fenix Fiber™. The Fenix Fiber™ format is favorable because of the increased bulk density and unique geometry that allows the carbon fiber bundles to flow in common thermoplastic compounding systems. This is critical for use in injection molded parts.

The thermoplastic compounding process requires mixing molten plastic pellets with carbon fiber in a twin-screw extruder. Vartega’s EasyFeed Fenix Fiber™ bundles are a drop in replacement to virgin carbon fiber. They are used with traditional feeders and side stuffers.

As a result of the early customer feedback, Vartega’s core customer philosophy became “making materials that are easy to integrate into existing manufacturing processes.” Any new product Vartega developed with MITO had to fit that parameter. The development cycle with MITO and



Vartega was key to understanding how Vartega’s process worked and where the best opportunities were for MITO to plug in. The determination was made that the best fit for a graphene additive was in the sizing chemistry. The chemistry is quite specific, and the MITO team tried multiple iterations of different types of graphene to determine the optimum size and morphology. The key requirement was that it would disperse well in the type of aqueous solution used in sizing.

WORKING WITH OUR PARTNERS

The MITO team explored multiple surface chemistries to ensure that the carbon fiber and graphene additive would bond and work together. In the end, integrating the graphene additive directly into the sizing solution that was already being used was the best approach. MITO’s team sent samples of LIGRA™ to Vartega to test in their system. The first trial yielded fantastic results. Third party testing showed a 50% improvement in elongation and a 37% improvement in impact toughness. The MITO/Vartega team knew they had a winner in Fenix Fiber+™ at that point.

Fenix Fiber+™ addresses the needs of the composites industry for thermoplastic applications. The easy-feed bundle format of Fenix Fiber+™ makes it very easy to use as a drop-in replacement for virgin fiber, making it much

UNDERSTANDING THE CHALLENGES

COLLABORATION REQUIRES TACKLING CHALLENGES:

- Dispersion
- Bond
- Integration

The MITO team used tools like scanning electron microscopy and mechanical testing to verify that graphene was adhering to the Fenix Fiber™.

GRAPHENE ENHANCED SIZING:

MITO developed a liquid graphene additive that was compatible with Vartega’s bundle process. When sizing with graphene, the additive adheres to the fiber to create Fenix Fiber+™.



more accessible for those applications. Manufacturers that have been running virgin carbon fiber can now process Fenix Fiber+™ without any changes.

SUSTAINABILITY IMPACTS OF LIGHTWEIGHTING

Higher performing materials create opportunities to use less material to achieve the same strength. For automotive applications, the weight reduction is significant.

MATERIAL EMISSIONS REDUCTIONS

DID YOU KNOW for every kilogram of carbon reinforced composite made, an average of 46 kilograms of CO₂e are produced?

With the use of Fenix Fiber+™, that number would drop to 27.6 kilograms of CO₂e – a **50% REDUCTION** in material emissions.

“MITO additives mean we’re making materials stronger and more durable, we have the possibility of making things lighter,” notes Keith. “The MITO team is also optimizing processing and efficiency, which is creating a more sustainable manufacturing environment by utilizing less energy. And Fenix Fiber+™ is sustainable - it’s made from recycled fibers and LIGRA™ graphene which is derived from carbon neutral processing. It ties the whole value chain of sustainability all together through two points of sustainability. We’re very excited to explore additional plastics chemistry on the top half of the plastics pyramid with Vartega.”

THE RESULTS

9% IMPROVEMENT IN TENSILE STRENGTH

50% IMPROVEMENT IN ELONGATION

18% IMPROVEMENT IN FLEXURAL STRENGTH

16% IMPROVEMENT IN IZOD NOTCHED IZOD IMPACT

37% IMPROVEMENT IN UNNOTCHED IZOD IMPACT



FENIX
FIBER+

CREATED WITH



About MITO® Material Solutions

MITO® Material Solutions unlocks the power of hybrid polymer materials with specialty additives which dramatically improve performance. The MITO family of products include graphene additives, E-GO™ and LIGRA™, as well as cornstarch-based, ACRE™. All of MITO's products are easily dispersible, safe to handle, scalable solutions designed to empower manufacturers. Woman-led, MITO is becoming a startup sensation in the composite industry. Visit www.mitomaterials.com to learn more.



About Vartega Inc.

Vartega is making carbon fiber more accessible to more industries by solving the world's toughest advanced materials recycling challenges to create circular supply chains, decarbonize transportation, and enable a sustainable future. Vartega's carbon fiber and specialty thermoplastics are used in consumer electronics, sporting goods, additive manufacturing, and vehicle lightweighting. Their patented carbon fiber recycling process connects a captive supply in the composites waste-stream to an unmet demand for low-cost carbon fiber downstream. Visit www.vartega.com to learn more.