KERING, EILEEN FISHER Inc., and more join forces with Spiber to build a global circularity solution for transforming end-of-use textiles and agricultural byproducts into new materials

- Kering's Material Innovation Lab (MIL), EILEEN FISHER Inc., Johnstons of Elgin, and DyStar have joined Spiber's revolutionary "biosphere circulation" project, dedicated to transforming unused apparel and textiles, as well as agricultural byproducts, into nutrients for microbial fermentation and production of novel protein materials.
- Spiber invites industry stakeholders to join the project in order to implement the technologies, infrastructure, and policies required to realize this vision for a circular ecosystem of industrial materials that are biobased, biodegradable, and used as nutrients at their end-of-use.
- Spiber published an overview of the project, including product design principles that outline core concepts to designing circular products, offering the industry concepts to consider when designing textile and apparel products.
- Spiber reported on its annual activities, achievements, and challenges.

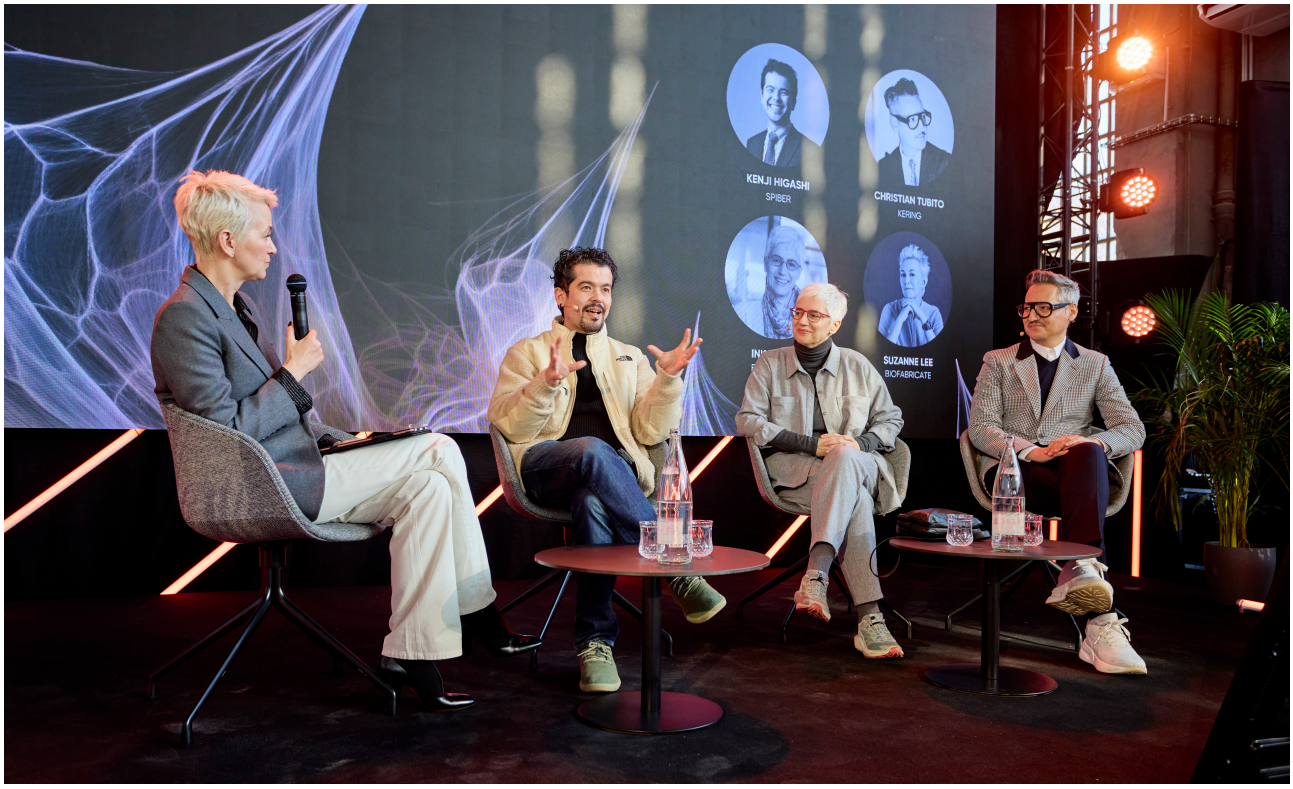
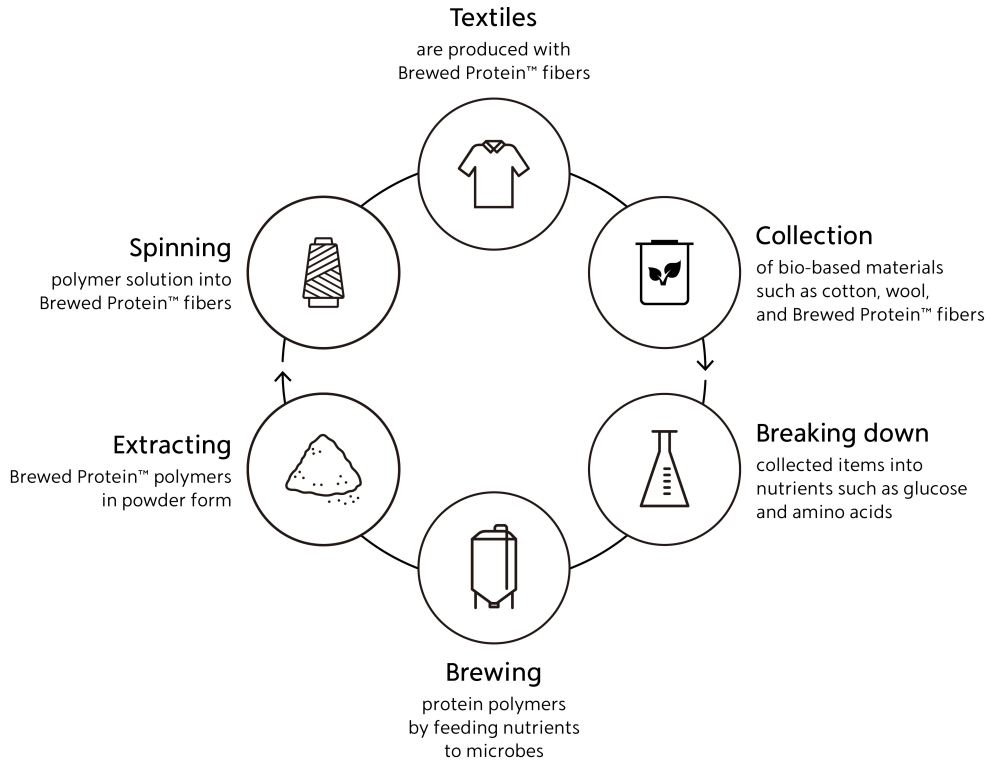


Photo credit: Biofabricate/Robert Leslie

Yamagata, Japan – On January 11, 2024, Spiber Inc. announced and welcomed new partnerships with Kering, EILEEN FISHER Inc., Johnstons of Elgin, and DyStar at Biofabricate Paris Summit, a global network serving the needs of bio-innovators, consumer brands, and investors, for Spiber's groundbreaking initiative, the biosphere circulation project, which presents a pioneering methodology for regenerating biobased and biodegradable textile and agricultural waste through the utilization of its proprietary fermentation technology.

The primary objective of this project is to propel society towards the creation of fully circular textile products that can be regenerated at an industrial scale into Spiber's innovative Brewed Protein™ materials at the end of their lifecycle.



Understanding the pressing need to confront the sustainability challenges currently facing the apparel industry, Spiber advocates for a collaborative approach to expedite research and development, hastening the implementation of this cutting-edge system.

In support of this vision, Kering, EILEEN FISHER Inc., Johnstons of Elgin, and DyStar have now elected to join the project following Goldwin and Pangaia, who began participating in June 2023. These collaborations aim to catalyze the transition from a linear "take-make-use-dispose" model to a circular "take-make-use-reuse" model.

KERING

"To achieve a more circular textile industry, different multilevel approaches are necessary as well as validating and deploying different solutions. The biosphere circulation project is an ambitious and challenging initiative opening a new path to textile recycling. From being a last resort, recycling can become a new promising alternative for unusable textile materials."

— Christian Tubito, Kering Material Innovation Lab Director

EILEEN FISHER

"We need all the tools in our toolbox in order to jointly move our industry forward towards circular economy for textiles. The biosphere circulation project looks at the fundamental principles of circularity at the level of building blocks of our materials, including dyes and finishes. It is a new yet essential approach to circularity that EILEEN FISHER Inc. is glad to support. Let's solve these challenges collaboratively!"

— Inka Apter, EILEEN FISHER Inc. Director of Material Sustainability and Integrity

The brands' participation in the project will provide multi-faceted support to Spiber, including through supplying samples for Spiber's lab-scale testing. The samples brands' supply may require custom production by their supply chain partners, as the textile samples must be composed of specific fibers processed with key types of textile chemicals.

Lab-scale testing of these and other materials will enable accumulation of valuable data for Spiber to analyze and help determine how various types of textile chemicals, like finishing agents and colorants, affect the conversion of cellulose and protein-based materials into nutrients that can be used in the fermentation process, such as sugars and amino acids.
Spiber intends to compile the results from this testing into a database that will indicate the efficiency of different materials in combination with textile chemicals when converted into nutrients for fermentation. This database will serve as a resource for the industry to refer to when designing products for circularity, and products which will be compatible with circularity solutions such as Spiber's biosphere circulation system in the future.

In 2023, Spiber's biosphere circulation project published principles for product design to offer the industry a framework for creating products that are compatible with circularity solutions. In addition, Spiber and biosphere circulation project brand participants began testing and analyzing combinations of fibers and key textile chemicals to determine how various types of chemicals affect the conversion of cellulose and protein-based fibers into nutrients for fermentation as an initial step. (Progress details can be found later in this release.)

Spiber and its partners are dedicated to shaping a future in which all products can be incorporated into a circular system and find new meaning at their end-of-use. With this initiative, we would like to invite all players in the industry to join the project and collaboratively strive towards making this vision for a better world a reality.

Biosphere circulation project

Spiber's biosphere circulation project aims to enable a materials circulation ecosystem in which biobased waste, such as agricultural residues or natural fiber components of discarded textiles, can be broken down into "nutrients" (sugars and amino acids) and used as feedstock to produce materials via fermentation, including Spiber's proprietary Brewed Protein™ materials.The project envisions a more sustainable future marked by a circular ecosystem of industrial biomaterials that can be broken down into biological nutrients, in which mainstream products are designed, made, used, discarded, collected, and regenerated to be kept in circulation as resources after their end-of-use.

Brewed Protein™ fibers

Brewed Protein™ fibers are lab-grown, plant-derived, and circular materials made through a proprietary microbial fermentation process. The fibers are a compelling solution to the growing demands of animal- and petrochemical-free fibers to address numerous pressing environmental issues and risks. Spiber has recently increased the production volume of these new materials, and Brewed Protein™ fibers are now available for commercial-scale purchase internationally.

Spiber Inc.

Established in September 2007, Spiber Inc. is a Japanese biotechnology startup utilizing cutting-edge synthetic biology, polymer, and material science for the development of its novel Brewed Protein™ materials made from plant-based sugars utilizing microbial fermentation technology.

Spiber website: https://spiber.inc/en/
Spiber's Sustainability webpage: https://spiber.inc/en/sustainability/

Enabling extraction of bioavailable nutrients from end-of-use products

Background

To build a biosphere ecosystem at the industrial scale, it is important that scalable and efficient technology solutions are made available for nutrient extraction from various types of mixed waste streams, and that products entering the waste streams are designed to be compatible with such solutions.

Achievement

- Spiber has completed lab scale "Proof of Concept" experiments in which nutrients (sugars) were successfully extracted from post-consumer waste textiles and were used as raw materials for fermentation to produce Brewed Protein™ fibers.
- Spiber has published an overview of the biosphere circulation project with product design principles to enable products to be designed for circularity, which is available on Spiber's website.
    - The biosphere circulation project overview presentation: *https://spiber.inc/wp-content/uploads/2023/12/Spiber-Inc._the-biosphere-circulation-project_overview_Dec-2023.pdf*
    - The product design principles are intended to enable products to be designed for biosphere circulation.
    - The principles include key points to consider when selecting materials and chemicals used in a product, and detail the need for product composition information to be made available to enable circulatory.

Future vision

- The biosphere circulation project aims to further improve and scale-up Spiber's nutrient extraction technology to enable use of a wide range of textile waste streams (including blends of multiple fiber types) as nutrient inputs for commercial fermentation to produce regenerated materials.
- The project will continue to refine its product design principles and will create guidelines to help designers create textiles and garments that can be efficiently regenerated at end-of-use through nutrient extraction ecosystem.
- The project aims to publish a database listing materials and textile chemical combinations that have been evaluated for their efficiency of conversion into nutrients for fermentation. This database will serve as a resource to help enable designers to create products that are compatible with end-of-use regeneration through biosphere circulation.

Fiber and textile chemicals testing

Background

In order to convert biobased "wastes" into nutrients for fermentation efficiently, we must understand how specific dyes and textile chemicals affect the efficiency of the conversion process. Spiber has seen cases where certain dyes inhibit the efficiency of this conversion, and cases where dyes cause unintended coloration of fibers produced using the resulting nutrients.

Achievement

- DyStar, a leading dyestuff & chemical manufacturer and solution provider, elected to support the project, and has provided Spiber with a range of dye samples to use in its lab-scale testing to assess a variety of fibers combined with dyes.
- Spiber has begun lab-scale testing of dyed cellulose-based fibers to analyze how the dyes affect the ability of the fibers to be converted into nutrients that are useful for fermentation.

Future vision

- Spiber will work with biosphere circulation project participants to obtain all of the samples needed for testing, as samples must be tested in sets that are identical in all ways except for the presence or absence of a particular textile chemical. The project's brand participants are providing key support by working with their supply chain partners to prepare and provide sets of samples composed of highly specific combinations of fibers and key textile chemicals.
- The project will continue to test dyed cellulose-based and protein-based fibers to examine how the dyes affect the conversion of fibers into nutrients for fermentation.
- The project will begin testing various other types of textile chemicals, such as finishing chemicals, to evaluate their impact on the ability of natural fibers to be converted into nutrients useful for fermentation.
- The project will create a public database to inform viewers how various types of textile chemicals affect the ability of various natural materials to be regenerated into nutrients for fermentation at their end-of-use.

Product composition, traceability and transparency

Background

Traceability and transparency of product composition data is critical to the biosphere circulation project and product circularity, as it is essential to know exactly what a product is composed of, including all of the chemicals it has been processed with, in order to enable efficient sorting and reverse logistics.

Achievement

- Spiber worked together with Goldwin in 2023 in development of the "Basque shirt", a demo product made of biobased fibers and textile chemicals. Together, Spiber, Goldwin, and the brand's supply chain partners compiled a list of all items that went into production of the product. This was released in the form of a "product passport" detailing product, care, and end-of-use information, and a list of all of the materials that the product is composed of.
- Spiber has accumulated product traceability information for a number of its yarn and fabric products that contain Brewed Protein™ fibers. This information will be made available for users to view online in late January 2024.

Future vision

- Spiber will continue to work with its supply chain partners (textile mills, etc.) to obtain detailed product composition information, traceability information, and permission to publicly disclose that information in regard to yarn and fabric products containing Brewed Protein™ fibers that Spiber offers to brand customers.
- The biosphere circulation project aims to prepare a simple solution, such as an online platform, for brands to share composition information of their products in order to allow customers to

understand and verify the circular design of the product, and to enable efficient product sorting and regeneration at end-of-use.

A vision for biosphere circulation in the apparel industry

Spiber invites industry stakeholders including apparel brands, textile industry, manufacturers, and circularity innovators to join as allies to work together to shift the industry towards a biosphere circular ecosystem by implementing the necessary technologies, infrastructure, and policies.

The biosphere circulation project hopes that:

- Brands will shift towards designing products for circularity by using combinations of materials and chemical components which have viable circularity solutions, while ensuring product traceability, transparency, and labeling that enable products to be utilized efficiently at end-of-use.
- Textile and apparel supply chain manufacturers, mills, and processors will ensure use of textile chemicals that are compatible with circularity and will provide data on all materials, chemicals, and components used.
- Innovators developing circularity solutions will work together to build an ecosystem of solutions for converting as many combinations of fibers and textile chemicals into resources as possible, and that they will work together to collectively ensure that end-of-use materials are fully utilized.