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Sustainability and value: Biomaterials and biomimetics become green alternatives

by Glenna B. Musante

Textile and outdoor gear communities are looking for ways to limit the use of petroleum products. To achieve this goal, apparel and gear brands, as well as ingredient manufacturers within the textile industry supply chain, are beginning to replace or augment plastics and polyester with biomaterials. Textile companies are also turning to biomimetic processes.

Developed by the R&D labs at DuPont™, Sorona® is made, in part, with glucose derived from harvested crops, such as field corn. The resulting high-performance polymer can be used in a variety of end-product applications.

Jan Beringer, senior scientific expert with the Hohenstein Institute for Textile Innovation, says this growing trend in the textile industry is tied largely to sustainability. But that is not the only reason textile companies are turning to Mother Nature for materials and design inspiration. Some natural products and processes can enhance the performance value of a product.

Natural successes

“The textile industry needs to make a greener product,” Beringer said, during an interview at the 2020 Winter Outdoor Retailer and Snow Show in Denver, Colo. He said companies across the textile sector are finding new ways to improve the degradation of synthetic textiles in the environment without sacrificing the performance characteristics consumers expect. “This has been a constant effort for the last one to five years.”

He named DuPont™ Sorona® as an example. DuPont’s marketing materials describe Sorona as a textile “on the forefront of the shift from oil-based materials to bio-based ones.” Developed by DuPont’s R&D labs, Sorona is made, in part, with glucose. The manufacturing process begins with harvesting crops, then extracting glucose from those crops and adding microorganisms to the glucose to begin a fermentation process (similar to the production of alcohol). Fermentation replaces chemical synthesis, producing PDO (1,3-Propanediol). TPA (terephthalic acid) is added to the Bio-PDO™, creating a molecular bond.

brrr° is a performance textile technology that uses natural salts and minerals that are integrated into the extrusion process to create cooling properties. It is is now being used by various clothing brands such as this Mizzen+Main men’s blazer. Photo: brrr°.

DuPont describes Sorona as a high-performance polymer with a variety of end product applications. Sorona Revive fabric, for example, can be used in applications with spandex to add

stretch in addition to recovery for apparel shape-retention. DuPont adds that 37 percent of the end polymer is made from annually renewable plant-based ingredients.

According to Beringer, a number of natural materials are being used by the textile industry to develop bio-based fabrics or fabric blends, including milk, cornstarch and algae (which uses CO2 from the atmosphere).

Enhanced performance

Formed in 2014, brrr° is a relatively new fabric technology that incorporates salts and natural minerals into the extrusion mix for a synthetic textile that has cooling properties. Mary Jane Credeur, speaking on behalf of brrr°, describes this as a cooling technology integrated into a polyester or nylon blend. “The secret sauce,” she says, “is a master blend of salts and cooling minerals” that was developed in 2014 by a team led by Mary-Cathryn Kolb, the former director of sales for SPANX®.

Basically, the salts and minerals are pulverized and then added to the polymer. The technology is a component of several high-end products, including golf apparel from Greyson and women’s dresses from Southern Tide®.

Breaking down degradation

Other companies are adding biomaterials to synthetics, such as polyester, to facilitate a process similar to biodegradation. That, however, is what Dr. Sonja Salmon, associate professor of textile engineering at NC State’s Wilson College of Textiles, describes as a “complicated space,” due to potential misunderstandings related to the various stages of a textile’s decomposition.

The first step, Salmon says, is deconstruction. This is where a textile product is taken apart. The next step is disintegration where a textile is physically broken apart into smaller microscopic fragments. The last is degradation, which refers to a chemical conversion of a larger or more complex chemical structure into simpler chemical structures. A subgroup of degradation, she adds, is biodegradation, where the remaining particles go through a chemical conversion into energy that can be consumed.

“When you eat something, you are biodegrading it,” she says, “and those layers are very important when we start talking about polyester or other acrylics.”

California state law, for example, has strict rules related to the use of the word “biodegradation” in connection with any polyester product. California law SB 567 prohibits any plastic product sold within the state to be labeled as “biodegradable,” “degradable,” “decomposable” or any form of those terms.

Sustainable synthetics

The makers of CiCLO® additive technology, a new fiber option in the textile industry supply chain, have taken that guideline to heart as they bring a new, more sustainable synthetic fiber technology to market. CiCLO chemistry is added to polymers during the extrusion process,

which helps fabrics, such as polyester, break down in a way that's similar to wool at the end of a product's life cycle. According to materials from Parkdale Mills, which is marketing the new fiber to the textile industry, the additive technology accelerates the speed at which a synthetic fiber biodegrades in the ocean or a landfill.

CiCLO is a product of California-based Intrinsic Textiles Group LLC, which was formed to develop and commercialize sustainable, closed-loop solutions for textiles. According to Cheryl Smyre, brand manager and director of advanced materials at Parkdale, apparel manufacturers can easily integrate the technology into their supply chain.

She adds that brands in the performance sector are looking to manufacture apparel made from synthetic fibers in ways that pollute less, without losing the performance strengths of synthetics such as polyester and nylon.

"Extensive testing by reliable third-party laboratories over a number of years has proven that CiCLO technology is effective at reducing synthetic fiber accumulation in landfills and microfiber pollution in the oceans," Smyre says. "At the same time, products made from CiCLO additive polyester can be washed and cared for just as you would any other polyester apparel item."

She adds that CiCLO fibers and yarns can play a role in reducing the impact of textile waste in landfills and synthetic microfibers in the oceans generated by the high volume of personal protective equipment (PPE) that will be used as the world fights the COVID-19 pandemic.

Plant-based performance

Other companies in the outdoor apparel and gear sector that are using biomaterials to replace or supplement synthetics include NEMO Equipment Inc. and Reima USA. NEMO is a camping gear brand that sells sleeping bags and tents, among other products.

Currently NEMO is looking at milkweed as a biomimetic model for plant-based insulation. Milkweed is an American wildflower that produces a fluffy material that has many of the same properties as down. The fluff attached to milkweed seeds is buoyant and very warm. In the past it's been used to stuff mattresses and pillows, as well as line winter clothing and footwear. It was also used during WWII as the stuffing for life jackets.

Reima USA has introduced a winter jacket made from what it describes as a "heat-storing coffee bean shimmer fabric." Reima is a leading premium performance wear brand for children. At Winter Outdoor Retailer, the company showcased the jacket made in part with ground coffee beans. Carbonized coffee bean particles are mixed in the polymer with polyester and add what Reima says is rapid heat storage and "a gorgeous sheen."

Other companies that serve the outdoors industry are also looking for ways to replace plastics with biomaterials. Costa Sunglasses, based in Daytona Beach, Fla., manufactures a line of high-end sunglasses with frames made from bio-resins derived from castor bean oil, which has a smaller overall carbon footprint than plastic. The company says the frames are designed to be durable, lightweight and hold their shape under harsh conditions.

All of these developments, which are taking place in textile labs around the globe, reflect a trend on the rise, says Beringer. Most are driven by a desire to improve the sustainability quotient of the apparel and gear that brands are selling to the world. And those efforts are needed now more than ever.

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