Made to Order

By Maria C. Thiry

The dawn of "chemical" fibers was, historically, extremely recent, yet they've made a large impact. The era of these fibers is far from over, but their mission has been modified; new developments keep sustainability as well as improved performance in mind.

Chemical Fibers[1]

Synthetics—made from petrochemical sources.

Bio-polymers—made from both petrochemical and renewable sources

Man-made fibers—from renewable sources, but made into textile fibers through chemical means.

Synthetic Fibers

Polyester

"Synthetic fibers are constantly evolving," says Alasdair Carmichael, president of the Americas division of PCI Fibres and vice-president of the Synthetic Yarns and Fibers Association. Among synthetic fibers, versatile, economical, and easily available polyester is king. Carmichael says it is the dominant synthetic fiber, with 37 million tons produced globally in 2010. Recent developments in polyester have seen improvements both in sustainability and performance.

Polyester's main sustainability advantage lies in its recyclability. Recycled polyester comes from two main sources: post-consumer (mostly plastic bottles) and post-industrial (waste fiber or off-spec polyester products). "There is some small volume of post-consumer apparel fabric being recycled back to fibers. This is still very small, but is quite

high-profile as consumers can actually return their garments to some recycling centers and they go back through a recycle process," notes Carmichael.

Recycled fiber is slowly becoming a larger part of the polyester market. "Based on the success and growth of the Repreve brand, we have invested in building the new Repreve Recycling Center that will house state-of the-art recycling technology allowing Unifi to recycle various kinds of waste, including post-industrial and post-consumer waste and polyester-based fabrics," says Roger Berrier, president and COO of Unifi.

An interesting new development in the US market is the move to produce polyester carpet filament from recycled bottles, says Carmichael. He notes that there has been a well-established carpet fiber market for polyester staple, but the filament "could have a significant effect on the carpet industry and also on the demand for bottles" if it is successfully brought to large scale production.

DUPONT SORONA

Polyester is known for its performance qualities, including low moisture absorption, moisture transport, wrinkle resistance, water and wind resistance, and high tearing and abrasion resistance. Now, Outlast has added to that performance. According to Roy Beckwith, textile engineer for Outlast, the company designed a bi-component fiber with a phase change material (PCM) core and polyester sheath. "This is the first-ever heat management polyester fiber," says Beckwith.

Nylon

Nylon's star performance characteristics are greater tensile strength, and greater resistance to tearing and abrasion. Invista's Cordura brand team has brought nylon's strength and durability and married them to cotton's comfort factor. Cordura Denim, launched in 2010, and Cordura Duck fabrics are intimate blends of cotton and Invista's T420 Nylon 6,6 staple fiber.

Bill Colven, global business director for Invista's, Cordura brand, says essentially the same Cordura Duck fabric has been going into military uniforms for more than 40 years. "People started asking for it in workwear, too." Cordura Denim fabric offers the authentic look and feel of traditional 100% cotton denim with "exceptional durability. Jeans [with Cordura] last 50% to 60% longer compared to 100% cotton denim when industrially laundered," says Cindy McNaull, global Cordura marketing director. "They also have four times more abrasion resistance than 100% cotton denim fabric," she says. "Extending the life and performance of denim is our goal. Extended durability means a slower replacement cycle, which means the fabric is more sustainable as well as abetter-performing value proposition."

Bio-polymer Fibers

Bio-polymers claim the performance characteristics of synthetics, while incorporating the sustainability benefits of replacing some of their petrochemical makeup with natural, renewably-sourced components.


LENZING FIBERS

Nobuyoshi Miyasaka, manager of the business strategy section, business strategy & planning control department for Teijin Fibers Ltd., says that in the spring of 2012, Teijin Fibers will begin "the full-fledged production and marketing of a new plant-based polyethylene terephthalate (PET) fiber as the world's first commercially produced, bio-derived PET fiber."

The Teijin Eco Circle PlantFiber "is made roughly 30% from biofuels derived from biomass such as sugarcane," says Miyasaka. "Conventional PET typically is made by polymerizing ethylene glycol (EG) and dimethyl terephthalate (DMT) or telephthalic acid (PTA), with EG accounting for roughly 30%." The EG in Teijin's new fiber is bio-derived rather than oil-derived, but it has the same characteristics and quality of oil-derived polyester.

The Eco Circle PlantFiber also can be recycled using Teijin Fibers' Eco Circle closed-loop polyester recycling system. "Polyester is chemically decomposed at the molecular level by the system and then recycled as new DMT that offers purity and quality comparable to material derived directly from petroleum," says Miyasaka.

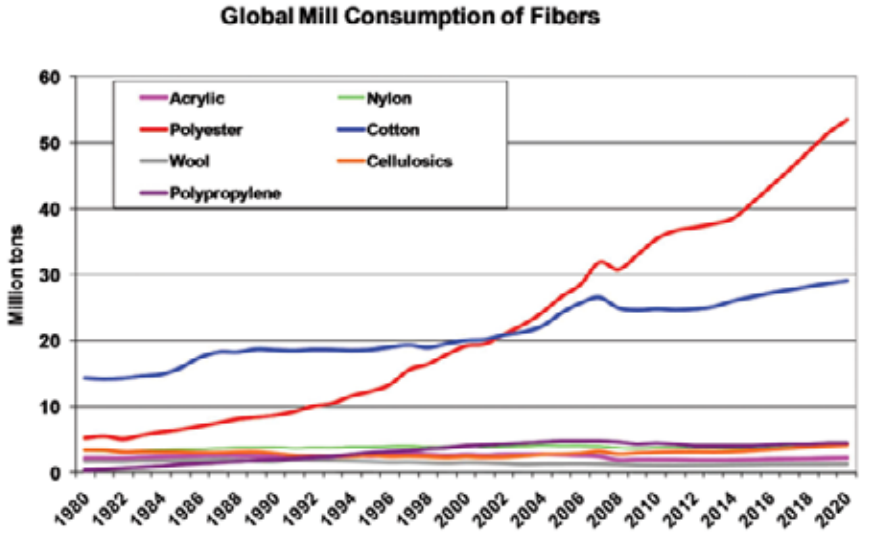
DuPont also has a bio-polymer fiber product under their Sorona brand—accepted in 2009 as a new generic category of fibers: triexta (polytrimethylene terephthalate). Dawson Winch, global brand manager for DuPont Applied BioSciences, says that it's DuPont's corporate sustainability goal initiative to reduce dependency on oil-based petrochemicals. Sorona helps to do this as well as offer other environmental benefits, like "reducing CO_2 by 63% over the production of an equal amount of nylon 6. It uses 30% less energy to produce on a pound for pound basis than nylon 6, too," she says. Winch says that Sorona can be recycled in a polyester recycling stream.

Besides sustainability benefits, Winch says Sorona provides unique fiber performance benefits: it extrudes and dyes at lower temperatures than its synthetic counterparts, is easily blended with other natural or synthetic fibers, is resistant to bleach, and is naturally stain resistant (without chemical anti-stain treatments). "In apparel, Sorona achieves the same level of softness as microfibers without having to be at a microfiber level," says Winch. "It also provides comfort stretch, increased wrinkle resistance, and improves fabric drape."

Man-made Fibers

Volatility in cotton prices has created a demand for other fibers, especially in blends. Tricia Carey, merchandising manager for Lenzing Fibers (makers of Tencel and Modal), says that this is part of an overall shift in the direction that fibers are going. "Brands looking for more blends, but with a cotton hand," she says. Carey says that cotton/Tencel performance blends can take best of both worlds: cotton's comfort and hand, and color retention, softness, and moisture transfer from Tencel. Carey says that Tencel performance benefits from enhanced fiber moisture transfer, and that a naturally reduced rate of bacterial growth means less odor.

Lenzing has recently launched a microfibers offering: MicroTencel. "People appreciate the fineness and soft hand of MicroTencel from eucalyptus trees, with closed-loop manufacturing (more eco-friendly), and MicoModal from beech trees," she says.



—Data courtesy of PCI Fibres.

Soy Fibers

Soy fibers were first produced back in the 1930s for Henry Ford, says Robina Hogan, representing the United Soybean Board (USB). She says that the fiber known generically as Azlon is made from natural proteins found in soy and milk. It's man-made from plant and animal proteins.

Today, the USB has invested in several research projects to develop new types of fibers based on using soybean meal and its derivatives. The intended fibers will compete with synthetic fibers derived from petrochemicals and not with other natural fibers, says Hogan.

She notes that a life cycle analysis of soy has shown that it provides many environmental advantages over synthetic fibers made from fossil resources. "As a legume, it produces its own nitrogen plant food and, with few natural pests, requires very low use of insecticides or fungicides," she says. A new version of soy fibers would be very attractive as an eco-fiber.

Made, not Raised

The genesis of synthetic and man-made fibers was an effort by people to go beyond the yarn, and engineer performance attributes into the building block of fabrics, the fiber itself. Today's researchers are still concerned with performance, but now "sustainability" is a new performance category for many new fibers and fiber technology refinements.

References

1. Möller, Martin and Crisan Popescu, Chapter 9.6 Natural Fibres, *RSC Green Chemistry No. 4: Sustainable Solutions for Modern Economies*, the Royal Society of Chemistry, **www.rsc.org**.