

# Specialty fabrics Review

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## Discover the Potential of Natural Fibers

It's Not as Simple as "Oil Versus Cotton," but Technological Advances Have Sparked Renewed Interest in Nonsynthetic Textiles

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If a white-clad John Travolta dancing disco could be called polyester's shining moment, perhaps the British Petroleum (BP) oil spill could be its defining moment. Since DuPont™ synthesized nylon in 1928, petrochemical fibers (including acrylic, vinyl acetate, and polyester) grew in popularity for their wrinkle- and abrasion-resistant, wash-and-wear ease. But all the retired leisure suits in the world can't do what Seshadri Ramkumar says raw cotton could do: clean up the Gulf oil spill by soaking up to as much as 40 times its weight.

"Natural fibers like cotton have been found to have three times higher oil absorbency than synthetics," says the associate professor at Texas Tech's (TTU) Institute of Environmental and Human Health. Technology adds another benefit. TTU's 2009-patented Fibertect®, which sandwiches porous carbon between layers of cotton, "can take oil as well as hold noxious gases," Ramkumar explains. Fibertect was submitted for consideration to BP's Alternative Response Technology process for the Horizon Incident.

Even before the disastrous spill (and whatever inducements it may create to spur people away from petrochemical products), businesses and the general public were returning to the fold, as it were. Natural fibers are "in" again. If the green movement was (and is) the driver, technology was (and is) the vehicle. Researchers and manufacturers have found new ways to use old materials and improve upon them with treatments, processes and hybridization.

A scrap of fabric from 8000 B.C. earns hemp a credible history in textiles. Of course, Mesopotamians probably were not as spoiled as Modern Man when it comes to wanting a soft touch. Naturally Advanced Technologies Inc. (NAT) of Vancouver, B.C., Canada, tames hemp's inherent roughness with a three-stage, high-pressure enzyme bath. "Velvety-soft" CRAiLAR® can be used in apparel, home furnishings and automotive applications. It resists shrinkage and abrasion and is durable, absorbent, breathable, colorfast, recyclable and biodegradable. Best of all, hemp is a renewable, cost-effective, high-yield crop that grows without irrigation, chemical fertilizers, pesticides or herbicides. Although it requires specific equipment and knowledge to make CRAiLAR, once the hemp fibers have gone through NAT's process, it can be spun on conventional cotton-spinning equipment and run through traditional nonwoven machinery.

The growing interest in and use of natural fibers and fabrics stems from environmental and sustainability issues, as well as the rising cost of oil, says Jason Finnis, NAT's COO. "It started as a consumer-driven mandate to move away from synthetics, and manufacturers are now realizing that there are also cost benefits to moving toward natural fibers."

### Embracing bio-based resources

In Waco, Texas, Hobbs Bonded Fibers and Baylor University have jointly developed a line of automotive parts (trunk liners, mats and interior door covers, for example) with a nonwoven composite made from coconut fibers called coir.

"We can get a wide range of properties, depending on how it is processed," says Walter Bradley, distinguished professor of engineering at Baylor, which holds the patent. In June, Hobbs' automotive customers were testing and assessing the natural-fiber parts. The material replaces a standard polyester-polypropylene composite

with a blend of coir and polypropylene, and requires no special equipment. Benefits include cost savings, less weight (for better car mileage) and earth friendliness. “Fifty percent or more is coir fiber, which is quite sustainable,” Bradley says. But that’s not his sole motivation.

“There are more than 10 million coconut farmers, with an average income of \$500 a year. We’re trying to create large markets with reasonable price points that will help them double or triple their income,” he explains. “There are 50 billion coconuts grown a year; they get 10 cents apiece for them. Currently, they burn the husks, and that’s environmentally unfriendly. If we can find valuable uses and generate more income for them, this will be a win-win-win. Just in automotive parts, the amount of oil saved would be between 2 million and 4 million barrels a year.”

NatureWorks LLC, headquartered in Minnetonka, Minn., also borrows from agricultural crops—in this case, to create a polymer called Ingeo™ that has been used in corn-based natural fibers for carpeting, automotive floor mats, office panels, upholstery and bedding.

“Every material has its particular characteristics, and that’s certainly the case with Ingeo,” says Robert Green, business director of fibers and nonwovens. “But we have a number of years of experience working with a pretty broad range of folks throughout the supply chain. We feel we have a good handle where it works well and where it may not work so well. It typically can be introduced to systems where folks are using synthetic materials with minor process-setting adjustments.

“Our material ends up replacing things like polyester or polypropylenes in various applications. In carpeting, it replaces nylon or polypropylene,” Green says. NatureWorks’ production facility in Blair, Neb., uses corn sugar; but the company is considering a second production facility in Asia that might use cassava, or in Europe that might use sugar beets. “It depends on what is the most cost-effective plant-based sugar,” Green explains. Ingeo “bridges the gap between what you would call traditional natural fibers such as cotton, hemp and jute and thermoplastic synthetics,” Green says. Benefits include excellent UV performance, better moisture management, comfort and, of course, a smaller carbon footprint. “What we are seeing and hearing throughout the supply chain is that people want to have more environmentally friendly options,” Green says. “We have moved to an area that we are cost competitive with other materials. What we hear from customers is that most all the incumbent materials are linked to oil, so they see a lot of volatility in price. What we offer is steady pricing.”

Even DuPont—which has developed numerous synthetics offering high-performance features—has embraced what technological advances allow manufacturers to do with bio-based resources. In 2006, the Wilmington, Del.-headquartered company announced its new process for turning corn sugar into a polymer called Sorona®.

“Companies with a buying preference for products based on nonpetrochemical sources, either because of concerns with raw material availability or because of the societal benefits, will likely be very interested in these developments,” said Nandon Rao, vice president of global technology for DuPont Performance Materials. Offering resiliency, softness, stain resistance, and superior stretch and recovery, Sorona is used for carpeting, apparel, and fabric automotive parts such as seat covers, door trims and headliners.

### **A matter of performance**

As the long-term success of DuPont and Glen Raven Inc. of Glen Raven, N.C., proves, synthetics still have a place in the textile market.

“[Natural fibers] don’t last very long outside,” says Hal Hunnicutt, vice president of marketing for Glen Raven, whose business thrives on supplying the awning, marine, patio furnishings and other outdoor markets. “Properly engineered synthetics that last 30 times longer than cotton canvas save a lot more in other areas. We have an R&D team constantly evaluating bamboo and hemp and other products. We just haven’t found the technology for a natural fiber that will yet measure up to the expectations our customers have for the technology we have been delivering with synthetics.”

Karla Magruder, president of Fabrikology Intl., stresses that there shouldn't be a purely natural-fiber-versus-synthetic-fiber debate. "There are appropriate end uses for both," says Magruder, a textile consultant based in Hoboken, N.J.,

Magruder recalls a recent comment of a client, who noted that in the past, everyone wanted synthetics to be more like natural fibers, and now everyone wants natural fibers to be more like synthetics. "There are lots of different performance features that every product can have," she notes.

According to Magruder, wool has experienced a huge resurgence in performance fabrics, and more bio-based materials such as cellulose fibers are becoming available that people will look to "because it gives you a natural feel, a soft hand, but it's not raised on land that could be agricultural land."

She also reports that cotton prices "are going crazy," in large part because the economic downturn resulted in less cotton being planted.

"There's a jockeying for everything," Magruder says. "It's not just that we are going to run out of oil, but we are also going to run out of land to grow things on."

### **Keep the change**

"Textile companies are saying that the raw materials—the way we build product—is really important," says David Bennell, executive director of Organic Cotton Exchange, a nonprofit dedicated to supporting and expanding organic fiber agriculture worldwide. According to Bennell, today's purchasing decisions encompass more issues than in the past, including labor conditions, the pollution generated by factories and whether products contain lead or cadmium. "We now understand why this matters at a deeper level," he says. "So much has changed.

"There are interesting natural fibers that we may be giving a very good new look at because we understand the pressures we are under in terms of natural resources," Bennell continues. "We do understand that petroleum is limited. It may be why natural fibers and recycled products are getting such attention."

Retail sales of organic cotton products grew from \$245 million in 2001 to \$4.3 billion in 2009. But while cotton was once the go-to source for "greening" products, it now has to be placed in a bigger context: the concept of sustainable textiles in general, says Bennell. That's why Organic Exchange board members voted last October to broaden the organization's strategic direction to include other sustainable textiles. "We have an appreciation for some of the basic qualities 'hard-wired' into natural fibers, combined with new technologies," Bennell says. "There are very mature developments in textiles made from wood fiber, with Lenzing from Austria at the pinnacle of that work."

Lenzing's eucalyptus-based TENCEL® has resulted in the "botanic bed." The company claims TENCEL offers greater moisture absorption than even cotton (reducing the number of mites), inhibits the growth of bacteria and can be fabricated to create a suede- or silk-like touch. Lenzing's MicroModal®, made from beechwood, is primarily being used for apparel and towels.

Ultraflex Systems Inc. of Randolph, N.J., makes 100 percent natural fiber-based substrates for backdrops, point-of-purchase displays, banners and awnings. In addition to cotton, the company makes a product of 100 percent organic plant material (they decline to state the fiber source) that they coat with a 100 percent biodegradable, water-based solution that makes it printable with solvent, eco-solvent, dye sublimation and UV inks.

### **Applied science**

In late 2008, Bradley and two of his former students incorporated Whole Tree Inc. to commercialize the technology developed at Baylor. While he says there is enough interest in coconut fibers to keep them busy for some time, Prof. Bradley wants to explore other natural fibers being grown by poor farmers in tropical regions of the world.

"There are 30 different natural fibers that have possibilities," he says. "Other people who have interest in jute, hemp or flax are all doing what we are doing: figuring out how to make the best possible consumer goods. Coir

will have more applications in five years. There's a lot of interesting possibilities, but it takes time to explore which of those already work and then go into full production.

"With any new product, people are expanding the performance, whether by using additives or in processing. We're seeing things we didn't think were possible two or three years ago because of innovation," NatureWorks' Green says. "One thing that's very different today than five to 10 years ago is companies are interested in taking steps to be able to offer sustainable materials—looking at how they replace one layer with a more environmentally friendly material."

"Sustainability and global warming issues will drive natural fibers' growth in industrial applications," Ramkumar says. "New applications include blends of recycled fibers. Post-industrial and consumer materials that are natural will also be used in industrial wipes and even consumer products. Flax and jute will get more usage in automobile and civil engineering applications. Natural fiber-based agro-textiles, such as mulches made from waste cottons, will also come into vogue.

"Developments and already existing products have to be quickly adapted and tweaked to tackle emerging issues and applications," Ramkumar asserts. "Fibertect is a clear example of this. It was originally developed to counter chemical toxins. By changing the absorbent layers to raw cotton, it can find applications in an oil spill."

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