

the percentage is 3% to 12%. It's a balancing act. If you put too much soy-based (content) in, you weaken the physical properties of the foam. The tensile, tear and elongation (or TTE) will drop."

Carpenter Co., a foam supplier based in Richmond, Va., offers Renew, a family of flexible foams for mattresses that contain between 3% and 12% plant-based content. The company has supplied this material to the furniture industry since 2007 and mattress makers since 2008.

Foams sold in the United States are made with soy polyols, says Ed Malechek, Carpenter president.

"We looked at castor oil and some others and we continue to pour some castor-based foams in Europe," he says. The company has the capability to produce foams with bio-based content at all 12 of its

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- ▶ "Polyurethane," www.wikipedia.org/wiki/Polyurethane and "Natural Oil Polyols," www.wikipedia.org/wiki/Natural_oil_polyols
- ▶ "USDA 'BioPreferred' Label Intended for Retail Shelves," www.environmentalleader.com/2009/08/05/usda-biopreferred-label-intended-for-retail-shelves

pouring plants.

Chicago-based Advanced Urethane Technologies manufactures Acella-Flex foams with sustainable content derived from castor oil.

Acella-Flex is offered in a variety of foam types and densities—from 0.9 pounds to 6 pounds. The company introduced the foams to the mattress industry in 2008 though, as with other bio-based flexible foams, they were first used in upholstered

furniture applications.

The amount of castor-oil derived polyol in a particular Acella-Flex foam typically ranges from 3% to 6% of the foam's total content by weight, says Joe Progar, Advanced Urethane Technologies executive vice president of OEM sales. Newer foams will contain up to 10% natural oil polyols. Levels are determined by foam type and customer requirements. **BT**

'Green' foams grabbing the spotlight

Renewable content in mattresses on the rise

By Barbara Nelles

Traditional flexible foam is the bubbly result of combining two parts petrochemical-based polyol with one part petrochemical-based isocyanate—and a small amount of water. Otto Bayer is credited with inventing the chemistry in 1937 in Germany and little has changed in the underlying polyurethane chemistry of flexible foam. Till now.

Fluctuating oil prices, a desire to reduce dependence on oil, concerns about climate change and consumer desire for "green" products have combined to spur research into polyurethane feedstocks from natural oil polyols.

Today, foams made with NOPs have found their way into mattresses, pillows and toppers. And foamers say new high-density and visco-elastic variations made from next-generation NOPs perform well with an even greater percentage of renewable content.

"Green foams have become mainstream. This is no fad," says Dimitri Dounis, corporate director of marketing and foam research at Hickory Springs Mfg. Co., a foam supplier based in Hickory, N.C. "We are taking the industry on a journey in a new direction, toward reduced energy consumption, reduced carbon emissions and toward greater sustainability. Each year we take bigger and bigger steps to get to a nonpetroleum-based composition."

NOPs were commercialized in flexible foams about five years ago.

They were first used in automobile seating, then upholstered furniture and then bedding. The first generation of these foams had an odor and, unlike petrochemicals, plant-based oils can turn rancid. Second and third generations of NOPs have been modified at the molecular level to produce odorless foams.



BASF Corp., which has U.S. headquarters in Wyandotte, Mich., also uses castor oil to manufacture Pluracol BALANCE 50 polyol for furniture and bedding applications.

Chemical companies began research and development of NOPs as early as the 1990s and say they continue to investigate a range of feed-

stocks. Seed oils such as soybean, castor, palm, rapeseed (or canola) and sunflower have shown the most promise, they say.

Cargill's BiOH polyols (www.bioh.com) were commercialized in 2006, says Jessica Koster, BiOH Polyols marketing manager. The bulk of BiOH polyols' business is currently in North America

The source

Four multinational companies are global players in NOPs; many others have smaller, regional roles. Agribusiness Cargill, with headquarters in Wayzata, Minn., manufactures BiOH polyols from soybeans at operations in North and South America. Dow Chemical, based in Midland, Mich., produces the Renuva family of polyols, also from soybean oil. Pittsburgh-based Bayer MaterialScience LLC produces castor oil-based polyol for the furniture and bedding industries.

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How 'green' is green?

WHAT PERCENTAGE OF NATURAL OIL POLYOLS IN A FLEXIBLE FOAM WARRANTS a "green" claim? Is it 3% renewable content by total foam weight? 10%? 15%? It's a subject of contention in the mattress industry.

Umberto Torresan, global marketing manager for Dow Polyurethanes-Natural Oil Polyols, a division of Dow Chemical, says his company would like to see the bedding industry create guidelines to define what level of renewable content makes a product green.

He also urges the foam industry to clearly label its products with precise information about sustainable content.

"The amount of natural oil in a particular foam is currently not part of the information available to consumers," Torresan says. "That is something that must change." Dow, based in Midland, Mich., produces the Renuva family of NOPs.

But determining and confirming how much renewable content a foam contains is not always easy. Foam suppliers *BedTimes* interviewed say that right now carbon-14 dating is the only way to check how much "new" (or renewable content) a competitor's product contains.

Other sustainability-related concerns center on the natural oil feedstocks themselves. The primary oils used in mattress foams—soy and castor—each have potential environmental and health impacts.

Worries about soybeans largely revolve around losses to the Amazon rainforest due to crop cultivation and the amount of energy required to process a soy polyol, regardless of the source country. To mitigate concerns about deforestation, some chemical producers buy soy that's only grown in the United States.

"We make sure soybean oil we use doesn't come from where people are exploited, the environment is destroyed or the food chain interrupted," Torresan says.

Castor oil is produced directly from the plant without molecular modification and its cultivation doesn't require irrigation or pesticides. But castor is often grown in remote, arid regions and there is a concern that an oil extraction process using hexane can pose a health risk to workers.

"It's important to remember that bio-based foams are greener, but they are not green," says Dimitri Dounis, corporate director of marketing and foam research at Hickory Springs Mfg. Co., a foam supplier based in Hickory, N.C. "My belief, though, is that nothing is impossible. One day, we could have a flexible foam that is all renewable content."

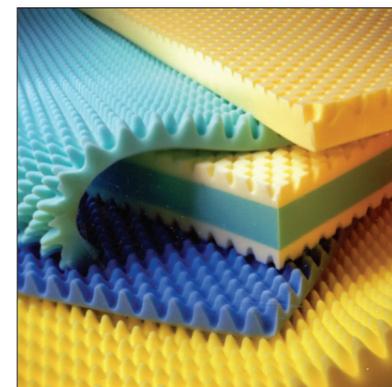


Market moves Cargill commercialized its BIOH polyols, made from soy, in 2006. (Photo courtesy Cargill Inc.)

foamers to create a visco-elastic with up to 30% total renewable content by weight. We have our own method of breaking apart the soy oil molecules and putting them back together in a different way that allows you to use even more renewable content in a flexible foam."

Trends toward sustainability are driving interest in green foams, Torresan says.

"The Obama administration is making a huge push toward alternative energy and renewable resources," he says. "For instance, the U.S. Department of Agriculture's BioPreferred program (www.biopreferred.gov) will soon come out with a BioPreferred label



Carpenter's 'renewal' Carpenter Co. offers the Renew line of flexible foams for mattress manufacturing.

where, she says, "the environmental mindset is stronger among consumers than it is in Latin America." The company also ships to Europe and Asia.

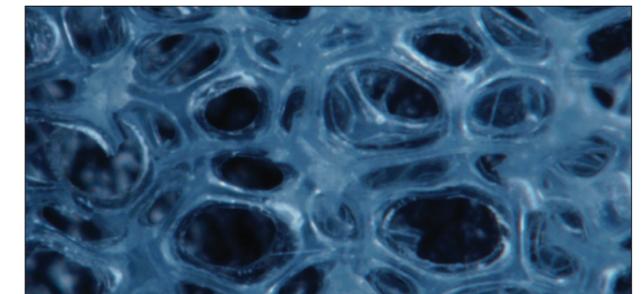
"Initially, some mattress makers were using BiOH polyols, but not talking about it," Koster says. "They wanted to get comfortable with the product first. Now, they are taking credit for it and even designing

the entire bed around the soy-foam concept. It's a huge win. Consumers are so interested in products with smaller carbon footprints."

Dow Chemical's Renuva (www.dow.com/renuva) is "robust and customizable and especially geared toward specialty foams," says Umberto Torresan, global marketing manager for Dow Polyurethanes-Natural Oil Polyols. "Renuva allows



Plant-based blocks Advanced Urethane Technologies incorporates castor oil into its Acella-Flex foams.



Changing formulations FXI Foamex Innovations has been supplying foams with renewable content for about three years.

for products that contain a certain amount of renewable content." (You can follow news about the BioPreferred program on Twitter using @BioPreferred.)

"And then there is almighty Walmart," Torresan says. In July 2009, the retailer announced plans to create a "worldwide sustainable product index" by surveying its 100,000 global suppliers about such things as their greenhouse gas emissions, water use and solid waste production. The resulting global database will be used to help provide consumers with information that will allow them to make more sustainable choices, according to the retailing giant.

Mattress industry offerings

In 2005, Hickory Springs began a collaboration with Cargill to assist in the development of soy-based polyols for flexible foams.

"We poured the very first foam using soy polyol in the first quarter of 2006 at our Conover, N.C., facility," says David Duncan, Hickory Springs national product manager for bedding foam products. The company markets the foam under the Preserve brand and has launched a Web site, www.preservefoam.com.

Hickory Springs' first renewable foams were 5% to 6% renewable content by weight, Dounis says.



Marketing opportunities Hickory Springs Mfg. Co. created a Web site just to promote its Preserve brand of foams.

"Second-generation renewable foams were released in 2008 and have higher content percentages," he says. "Third-generation foams are in development now." Preserve foams are between 10% and 16% renewable content, according to the company.

FXI Foamex Innovations began producing foams with renewable content in 2007 as part of a 15-year-old commitment to become a greener company, says Alvaro Vaselli, senior vice president of foam products for the Media, Pa.-based foam supplier. The company has minimized emissions at its four largest U.S. plants with its closed-chamber Variable Pressure Foaming process and initiated a range of recycling and energy conservation efforts. The VPF process is used to manufacture the company's Reflex Natural line of foams with bio-based content.

"We use both castor- and soy-based polyols and have found that the second and third generations of these products have a much improved performance," Vaselli says. "We experimented with other types of oils, but have found that the level of refinement and consistency in the soy and castor products yield the best results. We use as much of these plant-based polyols as possible without compromising product performance."

FXI's Reflex Natural portfolio includes Aerus Natural, a visco-elastic foam launched in 2008.

In 2007, Flexible Foam introduced BioFlex with soy-based polyols. And in early 2008, the foamer began using a percentage of soy polyol in all of its foam formulations, says Michael Crowell, vice president of marketing for the Spencerville, Ohio-based company.

"We did it because the American public is very interested in green and natural products and because it's a step toward reducing dependency on fossil fuels," he says.

"We are continually working to use more soy content," he says. "We recently completed our third trial with a new visco-elastic foam and recently had a breakthrough that will allow us to use as much as 20% soy polyol by weight. Currently,