



# Bio-Based PLA Finds Novel Packaging Uses

*From hemp-filled cannabis packaging to flax-filled pest repellent containers, natural materials feed the circular economy*

By Robert Grace

**T**wo entrepreneurial U.S. companies have developed novel but very different consumer packaging applications for polylactic acid biopolymers. For one, the prospects may be sky high; for the other, they are literally repellent.

PLA thermoplastic resins are polymers derived from renewable natural resources. The firms in question—Sana Packaging Inc. in Denver, Colo., and EarthKind LLC in Bismarck, N.D.—are each using bio-filled PLA in their products.

Sana just a few months ago began shipping its child-resistant cannabis packages molded from corn-based, 30 percent hemp-filled PLA, while EarthKind has designed flax-filled PLA containers to hold sachets infused with essential oils whose aromas are fine-tuned to repel a variety of pests, from mice and spiders to ants and moths. Both brand owners worked with Minnesota injection molder Steinwall Inc. and North Dakota compounder c2renew Inc. to develop the products in question.

Sana Packaging's co-founders Ron Basak-Smith and James Eichner met at the University of Colorado Boulder during their MBA program. They decided to work on a class project together, won a university pitch competition for their concept of child-resistant cannabis packaging made from natural materials, and concluded their idea was worth pursuing outside of the classroom.



**Sana Packaging co-founders James Eichner (L) and Ron Basak-Smith.** Courtesy of Sana Packaging Inc.

## High Expectations

“Nobody was working on cannabis packaging,” Smith explained in a recent telephone interview. So, he and Eichner saw an opening. They applied to Canopy Boulder, a nearby venture fund and accelerator program for startups focused on serving the legal cannabis industry, got accepted, and were off and running.

And it appears they may have picked a good target. A September 2018 market study by New York-based Reports and Data projects that the value of the global cannabis packaging industry will soar from an estimated \$1.1 billion this year to \$4.12 billion by the end of 2025.

Smith (now Sana’s chief executive officer) and Eichner (the firm’s chief sustainability officer) both earned MBAs in Sustainability, Entrepreneurship & Finance from CU Boulder. They wanted to create a Made in the USA company committed to supporting domestic agriculture and domestic manufacturing, while also promoting the circular economy concept to minimize waste.

## Bio Research in North Dakota

Meanwhile, back in 2012, by Dr. Chad Ulven, an associate professor of mechanical engineering at North Dakota State University—together with his research team there—founded c2renew in Colfax, N.D., to commercially develop the biocomposites materials technology they had been working on at NDSU. The startup licensed the green technology from the university’s research foundation.

“Six years ago,” Ulven said at the time, “it was my vision from the start to see my research end up in a company located in North Dakota which supplies renewable-based materials to a variety of molding companies, benefits agricultural producers, and is staffed with engineers who want to stay in this region with high-tech, well-paid positions.”

The process methodology developed by Ulven—who earned a Ph.D. in materials engineering—and his team uses lignocellulosic fibers from various agricultural sources mixed in with commodity thermoplastics to reinforce and strengthen the plastics. This method works with virgin and recycled commodity and



**Sana Container and roll-tray lid (above), and a collection of Containers and Sana Tubes (left).** Courtesy of Sana Packaging Inc.

engineered thermoplastics such as polyolefins and polyamides, respectively, where other natural fiber reinforcing processes have not succeeded, according to Ulven, who serves as chief technology officer for c2renew.

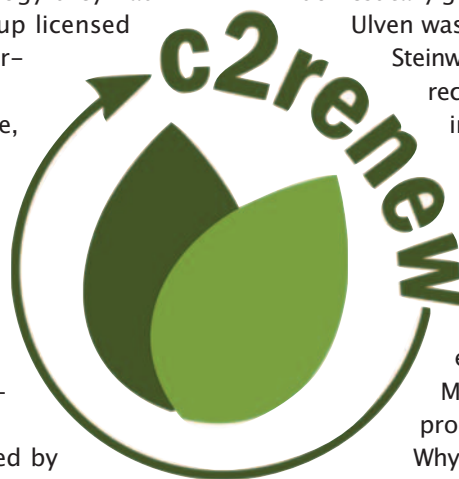
c2renew today describes itself as a material designer and customer compounder that uses proprietary, biocomposite formulations to create materials “that offer price stability and a greener alternative.”

## Friends and Partners

Smith and Eichner at Sana learned of c2renew and engaged with Ulven and his team to develop PLA reinforced with domestically grown hemp for its packaging. As it happens, Ulven was college friends with Jeremy Dworshak at Steinwall, the Minneapolis injection molder. Ulven recommended Steinwall to the Sana founders in spring 2017 and kick-started that relationship. Smith said that Dworshak—now Steinwall’s research and development manager—and Steinwall “have been great with product development.”

A separate recommendation led Sana to connect earlier this year with a smaller molder—PCM Custom Molding Inc. in Mesa, Ariz.—who also has become a valued production partner.

Why hemp as a filler? Smith explains that hemp is both sustainable and regenerative. It requires less water than other industrial crops and none of the pesticides. It’s an ideal rotational crop and remediates the soil it’s grown in, while also sequestering one and a half times its weight in carbon.







### Leveraging Domestic Suppliers

The hemp that Sana uses is grown in Colorado, North Dakota, and Kentucky, and is processed in Kentucky. c2renew makes the PLA compound in North Dakota, and Steinwall and PCM mold the final products in Minnesota and Arizona, respectively.

“In a post-tobacco, post-cotton, and post-corn era, hemp has the potential to reinvigorate economically stifled agricultural communities all across the United States,” Sana claims.

Sana delivered its first orders to customers across North America this past summer.

It currently offers two products—the Sana Container and the Sana Tube. The Container is said to be ideal for flower, concentrates, vaporizer cartridges, and edibles. It stores up to 3.5 grams of flower with a lid that doubles as a rolling tray. The versatile box has space for branding and compliance labeling, as well as a nesting design for efficient shipping and storage.

The Sana Tube is designed for pre-rolls, vaporizer cartridges, and vaporizer pens. It fits up to a king-size pre-roll, two vaporizer cartridges, or a 10-centimeter vaporizer pen.

Sana’s 100 percent plant-based and chemical-free hemp plastic products are odor resistant and certified by ASTM as child-resistant. The company says it also offers cus-

tomizable hemp paperboard secondary packaging, and a wide range of custom branding and compliance labeling solutions.

### Seeking to Repel Pests Humanely

Living on a farm in North Dakota, inventor and EarthKind CEO Kari Warberg-Block could be described as mom on a mission. She doesn’t like insects and pests in her house, but she doesn’t want to kill them, either. And she wants to eliminate the use of harmful chemicals in the home and the environment.

That led her some 18 years ago to start the company that she calls “America’s kindest pest control company.” EarthKind, she notes, was “the first to make effective botanical pest prevention products as an alternative to poisonous pest control.”

“Our mission,” she adds, “is to reduce people’s reliance on harmful pest control products from 90 percent today to 50 percent by 2020. Achieving this means empowering people with education. EarthKind is leading a movement of women and families who demand safe, sustainable alternatives.”

Having been raised on a farm, Warberg-Block appreciates the value of growing things naturally, and she wanted all of EarthKind’s products to be agriculture-based. She says



**EarthKind's Warberg-Block: Seeking a safe, natural way to repel pests.** Images courtesy of EarthKind LLC



**EarthKind's current, plant-based StayAway and Pouch Pod product line, which is selling well in big-box stores across the nation.**

she started mixing essential oils as a hobby as a young girl. She since has spent hundreds of hours of watching animal behavior. She starts with trial-and-error to get the oil mix right for each application, before turning it over to the universities and/or labs for the trialing required for labeling and registration.

Her research into how to use aromas to repel pests has led to fascinating discoveries, such as the fact that ants have 400 odor receptors on each antenna.

Warberg-Block received a \$65,000 grant to research her products and develop test protocols, which she then took to the U.S. Environmental Protection Agency, leading to the agency's very first repellent protocol. Previously, she said, the EPA "only counted dead bodies" as a means of determining a pest repellent's effectiveness.

Once the company received EPA approval for the first rodenticide using natural materials, EarthKind sprang into action. To be closer to customers and to farmers, it retrofitted an old textile mill and launched production in Mooresville, N.C.

As the base material, EarthKind uses cellulose plant fiber, which it soaks in the tailor-made oil mixtures. Then, using a form-fill-seal machine, the company packages these materials in sachets made of non-woven fabric that each hold about 2.5 ounces. The fabric needs good tensile strength, to hold together if it gets wet, or stepped on, etc.

## Supporting U.S. Farmers

"To improve economic opportunity outside our company, we source all our ingredients from American family farmers," the firm states on its website. "For example, our Stay Away®

Pouch Pod™ is a 100 percent bio-based product made from flax, beets and sunflower hulls grown in North Dakota. Our pest control products are made with plant fiber and oils grown in Indiana, Ohio and Iowa. We continually seek new uses for ag products that currently go to waste." EarthKind says it has purchased millions of dollars in value-added byproducts from U.S. farmers.

EarthKind today also strives to have handicapped individuals represent at least 20 percent of its workforce, giving them fulfilling, long-term jobs (mostly assembly tasks) that suit their abilities and needs. And its manufacturing footprint is 98 percent carbon-free, according to a Building for Environmental & Economic Sustainability (BEES) analysis from the University of Iowa.

Warberg-Block wanted to extend EarthKind's product line by developing a rigid, bio-based container to house the sachets. The initial efforts did not go well. "The first product was a failure," she says, since the PLA plastic got too brittle. Her son, a structural engineer, used a tabletop 3D printer to continue to work on the design.

While sourcing its PLA from Chad Ulven and c2renew, Warberg-Block also received an introduction to Steinwall, which brought some much-needed some materials and processing expertise into the project. The relationship blossomed. "Working with Jeremy is an absolute delight," she says. "He has good technical knowledge and incredible communication skills."

Steinwall's engineering team worked with Warberg-Block's son, John Job, to fine-tune the design of the rigid pouch holder. It took quite a while to get it right—from the material formulation to the color to the tooling.



**Steinwell Research & Development Manager Jeremy Dworshak.** Courtesy of Steinwall Inc.





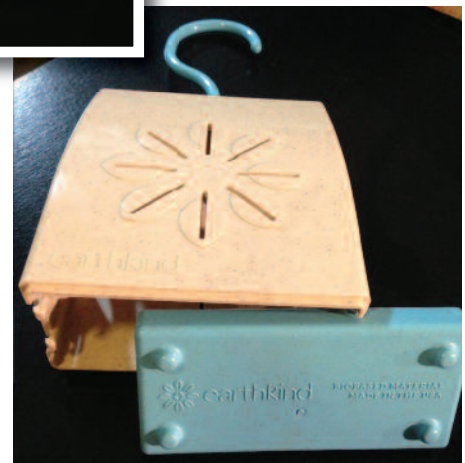
The partners eventually settled on using a flax-filled PLA resin that Steinwall could injection mold. In a recent interview, Dworshak commented on some of the challenges, including the need to delicately balance the relationship between time, melt temperature, and shear.

“You need to inject the resin slowly—which is counter-intuitive to what you normally do with engineering thermoplastics—but not too slowly,” he says, to avoid polymer degradation and resulting brittleness. “PLA can be quite brittle, and we needed to formulate it to make it tougher.” He said Steinwall eventually determined it needed to slow down the fill time in the mold by a factor of four, compared to typical ETP injection molding.

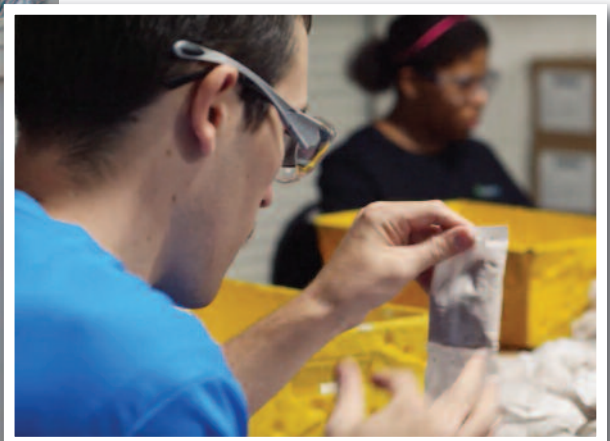
For his part, Ulven at c2renew notes: “Developing these new bio-based composite materials has been quite challenging but working with a molder like Steinwall has made all the difference in bringing them to market for companies such as Sana and EarthKind. These companies usually start with us to create a unique material for their product, but it is up to us to work with molders to make it happen. It is one thing to create a new compound, it is another to be able to mold it. And Steinwall is forward-thinking enough to work with us to figure it out.”

### Learning to Design for PLA

The product’s design also was key. “You need full, round radii, with no exposed tabs or features that extend beyond the part,” Dworshak says. The container needed a flat, removable bottom panel (into which one inserts the sachet).



**EarthKind's Pouch Pod container, made of flax-filled PLA, needed to be redesigned to allow the snap-fit, removable base to eliminate external tabs that tended to break off.** Photos by Robert Grace



**EarthKind strives to employ a number of developmentally disabled workers at its plant in Mooresville, N.C.**

Courtesy of EarthKind LLC

The first version's external tabs kept snapping off.

"We had to completely redesign the mold," Dworshak says, noting the need to optimize the design to minimize part stresses. "We also had to keep the walls above 2 mm thick, for durability." (While the product's flax-filled PLA is technically "bio-compostable," he acknowledged that the used containers, because of their thick walls, need to be mechanically ground up to enable composting.)

After roughly two years of collaboration, they finally got it right, and EarthKind brought its reusable accessory—dubbed the Pouch Pod™—to market in 2016, priced at just under \$10. An added benefit to the pod is that it allows for a slow, steady release of the pouches' essential oils, thereby extending their shelf life. The product also comes with a hook that can be used to hang it in a closet, or one can remove the hook and set the container on a countertop or window sill.

EarthKind has been selling its non-toxic pest repellent products in stores such as Ace Hardware, Target, Lowe's, Tractor Supply, and now is in talks with WalMart Stores,

Warberg-Block says. The farmhouse startup has now grown to have nearly 40 full-time employees and annual sales of \$12 million.

"There had been no innovation in the pest-control industry for years," she says. So, she decided to grow her own and is now relishing the sweet smell of success.

## ABOUT THE AUTHOR

Robert Grace is a writer, editor and marketing communications professional who has been active in B2B journalism since 1980. He was founding editor of and worked for 25 years at *Plastics News*, serving as editorial director, associate publisher and conference director. He was managing editor of *Plastics Engineering* from July 2016 through October 2017, and now is both editor of SPE's *Journal of Blow Molding* and directing content strategy for SPE. He runs his own firm, RC Grace LLC, in Daytona Beach, Fla., and can be contacted at [bob@rcgrace.com](mailto:bob@rcgrace.com).

