Fall 2023

PLASTICS RECYCLING

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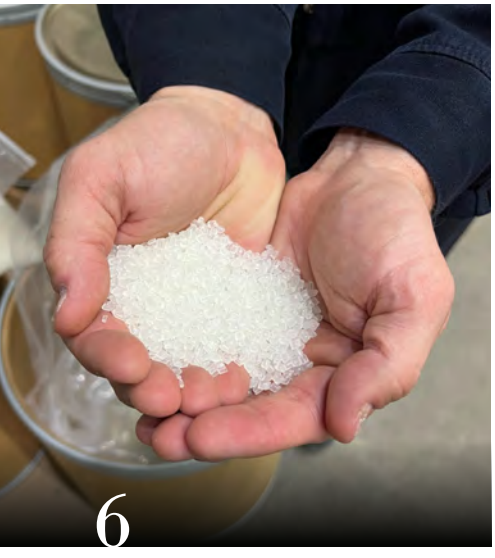

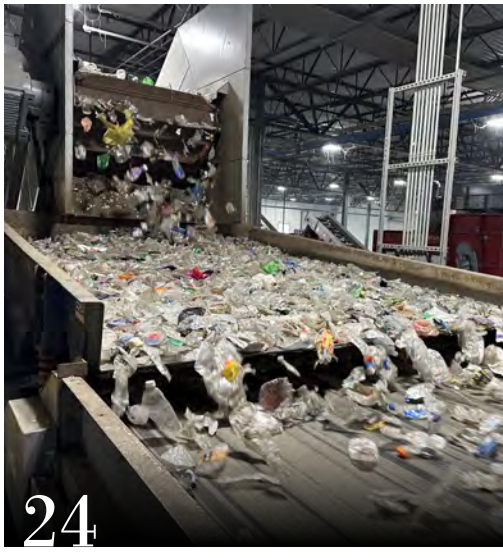

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To achieve plastics circularity, Alan Schrob says collaboration is needed among all areas of the value chain, along with investment in recycling.

Cover photo courtesy of PureCycle Technologies LLC

// BY RON SHINN

Do we need standards for bales and pellets?

Companies that buy bales of plastic scrap to make recycled pellets have horror stories about what they've found in bales—concrete blocks, chunks of metal and even dead animals.

But most recyclers learn of trustworthy suppliers that provide acceptable bales needed to make recycled resin for their customers.

That seems like a workable business model, but a recent report commissioned by the Alliance to End Plastic Waste argues that model is broken because it does not include standards for bale and recycled pellet content.

Knowing what's in a bale is necessary for recyclers to efficiently create flake or pellets that meet high-quality content standards. The recyclers' current business model of mostly designing one bespoke resin for a specific customer instead of a resin that is standardized for a specific product holds back the use of recycled plastic, according to the report.

What is a good-quality bale? It must support the end use of the resin but might include knowing nonpolyolefin content, nonplastic content, moisture, color and level of impurities.

What is a quality pellet? It depends on the application, but characteristics may include ash content, density, filtration, melt index, moisture content, odor, pellet color, polyethylene or polypropylene content, flex modulus and tensile strength.

The study, which uses the European plastic recycling industry as an example, suggests if the industry can decide on specific recyclate standards for various applications, recyclers will have more customers and improved circularity.

What would such a strategy mean for U.S. recyclers? Scott Trenor, technical director at the Washington-based Association of Plastic Recyclers (APR), says transparency in the recycling marketplace benefits everyone, but there are problems with the model.

"If you go to recyclers' websites, some have their material specifications listed and others just say, 'Contact us,'" Trenor says. "That makes it difficult for purchasing agents and product designers to find suitable recycled content that meets their requirements. Meeting a universal standard for some recycled resin would depend on where the recycler is on the spectrum of reclaimers—one who takes bales and pelletizes the resin to those on the other end of the spectrum who take bales and compound the resin. It is easier to meet specifications for those on the blending and compounding side."

He says recyclers who buy bales and process pellets might have difficulty meeting content specifications without investing in additional equipment, and adding specific requirements for resin content might give brand owners another reason not to use recycled content.

Is this proposed model just a solution looking for a problem? It has some of those characteristics. The study projects a 4 percent to 20 percent price improvement for recycled resin, which Trenor says probably would not pay for recyclers' needed investment. •••

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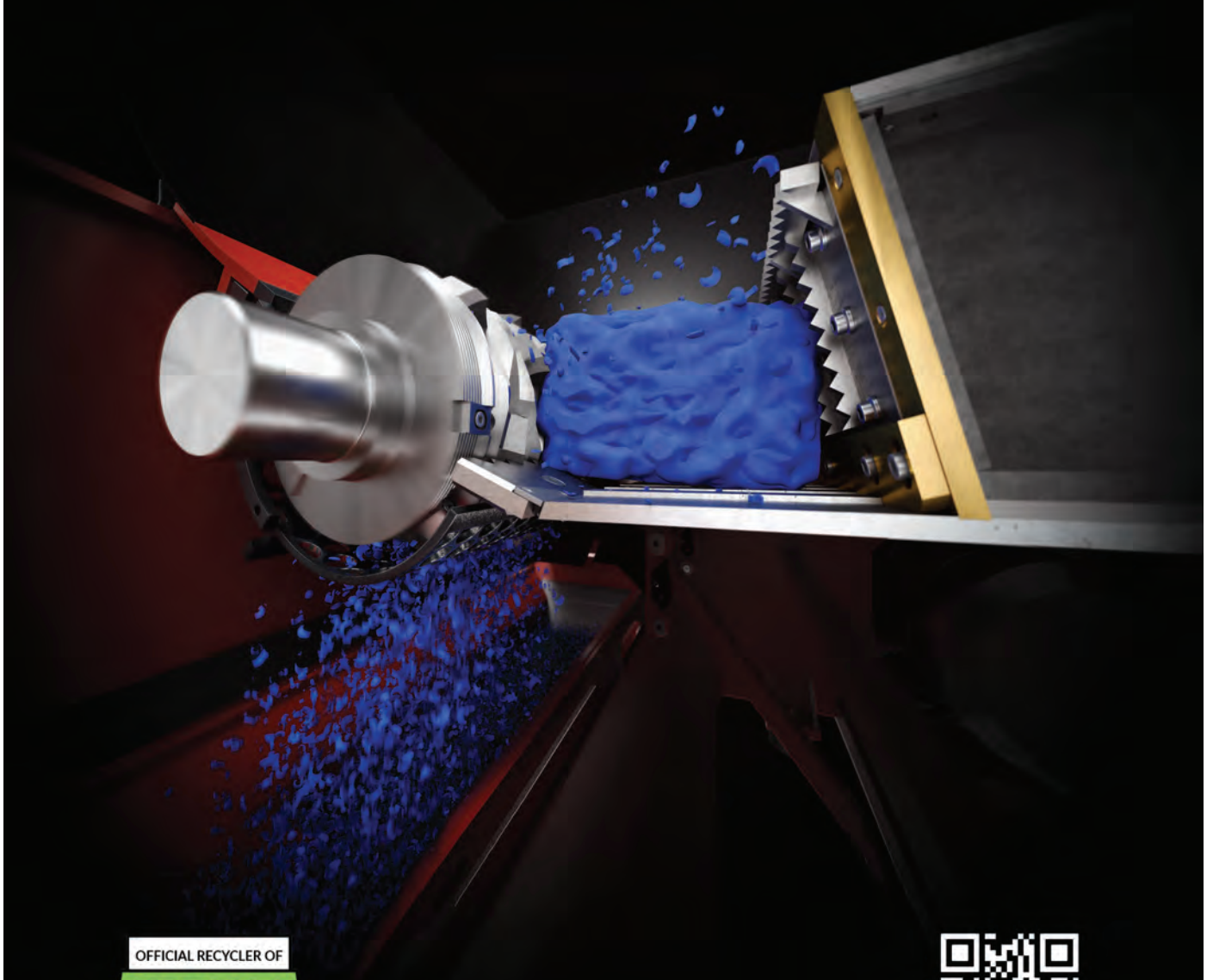

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BY **DEANNE TOTO**

A long road to STARTUP

PureCycle Technologies LLC is working to ramp up production at its site in Ironton, Ohio, as it looks to expand its footprint.

The passion and enthusiasm are contagious at PureCycle Technologies LLC's Ironton, Ohio, site, where the company is working to ramp up production of its ultra-pure recycled resin (UPR), made using an advanced recycling process that uses a solvent-based technology to remove colors and odors from postindustrial and postconsumer polypropylene (PP).

It hasn't been an easy road to get to this point, and PureCycle continued to encounter challenges as of mid-September, but the company's belief in its mission to transform the PP recycling industry has not wavered.

IMPASSIONED PEOPLE

"I've been involved with a lot of new plants, a lot of new technologies, a lot of new projects; I don't think I've ever seen one where the team was more aligned and more excited about working together and accomplishing the goal," PureCycle Board Chair Dan Coombs says.

Before retiring from LyondellBasell in 2020, Coombs spent five years in various executive vice president positions with the petrochemical company. Prior to joining LyondellBasell, he spent nearly 15 years at Chevron Phillips Chemical Co. and 15 years with Phillips Petroleum.

Photos courtesy of PureCycle Technologies LLC

PureCycle, which is based in Orlando, Florida, is working to get its flagship plant in Ironton, Ohio, up and running. The site includes a PreP area that resembles traditional mechanical recycling processes, and a purification area where its patented technology is used to remove color and odors from recycled postindustrial and postconsumer polypropylene.

"I wouldn't have come out of retirement for anyone else," he says of PureCycle and CEO Dustin Olson.

Olson has led the company since mid-2022. He replaced former CEO Mike Otworth, who had been in that role since 2017 when the company was formed. Otworth resigned to return to Innventure, PureCycle's former parent company before it went public in early 2021.

Olson served as PureCycle's chief operating officer and chief manufacturing officer before being named CEO, having led manufacturing and operations since 2021. Now, he leads all global operations for the company, including manufacturing, procurement, sustainability, commercial sales and joint venture partnerships.

Prior to joining PureCycle, Olson spent more than 20 years working in refining, olefins, specialty chemicals and specialty polymers throughout the United States, the Netherlands and China, which included positions with LyondellBasell and its predecessor companies.

Olson says PureCycle has been able to attract some of the best people in the industry—employees with a can-do attitude. He acknowledges he himself might be a little too optimistic at times about the company's potential.

"We've actually had some headaches getting the property up and running reliably," Olson says of the Ironton facility, which is on the site of a former Dow plant and next door to an AmSty plant making polystyrene and styrene monomer.

Those issues have been mechanical in nature, Olson says, and are not related to the purification technology, which PureCycle licensed from Procter & Gamble in 2017 and has been working as expected.

PREPARING FOR RAMP-UP

Headquartered in Orlando, Florida, PureCycle completed construction of its Ironton plant at the end of April and submitted documentation for formal certification of completion to the site's independent construction monitor.

At that time, Olson told *Recycling Today* that PureCycle's bondholders hired the independent company to monitor and certify the project upon completion, which was required to achieve key milestones in connection with financing for the facility.

The company prepared final closure documentation consistent with the third party's requirements and received certification May 1.

The site's 75 employees then turned their attention to producing pellets, and, as of mid-June, had completed the first run of UPR PP from postindustrial material at commercial scale.

Olson said PureCycle then planned to "build upon this accomplishment to optimize our process in order to demonstrate our technology across a variety of operating conditions and feedstocks."

But, according to a report the company filed Sept. 13 with the Securities and Exchange Commission (SEC), severe storms in early August caused a two-hour power outage at the Ironton facility, leading to the failure of a seal Aug. 25. The facility was offline for four days for evaluation. The same mechanical component suffered a catastrophic failure Sept. 3, and two repairs were attempted before the component was replaced Sept 9.

PureCycle provided notice of a force majeure event Sept. 13 and, as of press time, said it did not expect to meet its bondholders' Sept. 30 production milestone, requiring 4.4 million pounds of recycled PP to be made in a month.

Olson tells *Plastics Recycling*, "Since the force majeure declaration, we have been in active discussions with bondholders to reevaluate project deadlines and work toward resolving the matter."

In a document titled "Ironton Operations Update" dated Sept. 13 that was submitted with the SEC filing, the company writes that the Ironton operations team "is growing into a 24/7 operation, but at times it means slowing down to

Before the recovered PP enters the purification plant, which CEO Dustin Olson refers to as a "molecular washing machine," it undergoes preprocessing, or PreP, which is a conventional grinding process.

ensure the development of the right experience. This complements our intent to safely, reliably and methodically operate the Ironton facility."

"We have a very strong safety culture here, where we are all about doing it the right way every single time," Olson tells *Plastics Recycling*. "We hold that to the highest standard, so we do not compromise."

He adds that a previous delay at the Ironton site was related in large part to ensuring the safety of the site engineering. "I understand why our investors and shareholders want to see this plant succeed. No one wants to get this plant up and running at full capacity more than I do, but safety has to come first." Olson says. "We're going to be purposeful. We're going to be methodical. We're going to be careful with everything that we do."

THE PROCESS

What PureCycle is doing in Ironton is divided into two areas: prep and purification.

"We have a very strong safety culture here, where we are all about doing it the right way every single time."
– Dustin Olson, PureCycle CEO

Before the recovered PP enters the purification plant, which Olson refers to as a "molecular washing machine," it undergoes preprocessing, or PreP, which is a conventional grinding process. Incoming bales are broken, and the PP is washed and reduced in size before it can go on to the next process, which consists of seven main stages as the company explains on its website:

1. Melting and filtering of the reclaimed, ground PP removes large contaminants.
2. In the polymer/solvent mixer and extraction column, the PP is introduced to the solvent solution at conditions that start the purification process. During extraction, the solvent pulls out color and odor from the solution.
3. In the polymer mixer, additional solvent is mixed with the PP solution to reduce the polymer concentration before the large particle settler allows contamination and other plastics, also known as insoluble solids and polymers, to settle out of the process.
4. Conditions are altered to create an environment where similar things stay together, and the solution is filtered to remove micron-sized particulates.
5. The solution is further polished through contact with a solid, media-packed filtration column, removing color, tiny particles of contamination and other contaminants based on their physical and chemical properties.
6. Process conditions are altered to separate the purified PP from the solvent added initially. The PP settles in the product decanter, where the remaining solvent is removed and returned to the feed tank for reuse.

Photo courtesy of PureCycle Technologies LLC

Photo by Chris Voloschuk

7. The purified PP is fed into the final product extruder and additives that the process removed during the final extrusion are added back.

Olson says the PP spends approximately 12 to 16 hours in the purification process.

The process itself does not use heat, he says. However, the company uses steam to heat the outside of the pipes in its molecular washing machine, which facilitates the movement of the PP through the system.

Reusing the solvent is "environmentally friendly and also cost-effective," Olson says. "We've got really low variable costs. We don't use a lot of electricity, steam or solvents. We don't use any catalysts … it's really like a washing machine."

IMPROVING CIRCULARITY

PureCycle says its process helps it to close the loop on end-of-life plastic while making recycled plastics more accessible at scale, something Coombs and Olson say is necessary.

"Plastic is super efficient, very lightweight and very versatile," Coombs says. "It makes life better in so many ways. But the waste problem has to be solved, and that's what we're trying to do."

He says PureCycle's advanced recycling process is low in carbon emissions and produces a high yield of recycled PP that is as good as or better than virgin plastic.

According to PureCycle, the Ironton facility is projected to use 79 percent less energy than the production of virgin PP and is estimated to release 35 percent fewer carbon emissions than new PP manufacturing.

PLANNING FOR GROWTH

As it ramps up production at the Ironton site, PureCycle also is executing a growth strategy that includes a second purification location in Augusta, Georgia, with initial site development expected in the fourth quarter of this year, as well as two new PreP locations to supply that plant. The company says additional projects in South Korea, Belgium and Japan also are making progress.

The company broke ground on the Augusta plant, which is in the Augusta Corporate Park, in early 2022. That site will house up to eight purification lines that collectively will be able to produce approximately 1 billion pounds of recycled PP annually, according to the company. Last August, PureCycle announced plans to add a PreP facility at the Augusta site that will be able to sort 263 million pounds of plastic annually and wash 331 million pounds annually.

To support the Augusta purification plant, PureCycle also announced plans for a PreP facility in Denver, Pennsylvania, with the ability to sort 175 million pounds annually.

The company's team in Belgium has continued site engineering work at the Port of Antwerp to support the permitting process, which is expected to be completed by late 2024, according to an Aug. 8 update from PureCycle, while its joint venture team in South Korea has been working on engineering plans and evaluating various feed sources in accordance with the priorities defined by the joint venture with SK Geo Centric. The company continues its joint venture agreement discussions with Mitsui in Japan that began in late 2021, and PureCycle says the agreement is expected to be executed in the fourth quarter of this year and the list of purification plant locations to be narrowed down as well.

The company's plans are ambitious, but Olson says determination and discipline will lead to success.

He describes PureCycle as being at the intersection of entrepreneur and establishment. "We've got to have a can-do attitude," Olson says. "But we've also got to have a sense for how to build the right system to run it long-term. And we find that challenging but also awesome because it's like a true example of diversity in action: Diversity of technology, diversity of experience, diversity of concepts, diversity of science. The intersection of all that is where this kind of concept begins to work." •••

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Back to the Roots co-founders Nikhil Arora and Alejandro Velez began their business in 2010 with an urban farm in Oakland, California.

SEEDS OF CHANGE

Organic gardening company Back to the Roots is taking sustainability a step further with its industry-first recycled-content soil packaging. BY **MARISSA MCNEES**

A college lecture on sustainability prompted a life-changing move for Back to the Roots co-founders Nikhil Arora and Alejandro Velez.

The pair met in a business ethics class at the University of California Berkeley and were inspired to start their own gardening company after learning about using coffee ground waste to grow mushrooms. Velez turned down an offer to go into investment banking in New York City, and Arora turned down an offer to go into consulting. Using a $5,000 grant, the two started an urban farm in Oakland, California, in 2010—the beginning of Back to the Roots.

"It's been a wild, wild journey," Arora says.

The company started by upcycling coffee grounds from Peet's Coffee and Starbucks. Arora says at one point, the two had collected more than 3 million pounds of coffee grounds and used them to grow oyster mushrooms they then would sell to grocery giants like Whole Foods as well as farmers markets and restaurants.

"Over the next handful of years, it kind of evolved from a farm in the middle of Oakland to really becoming a gardening

Photos courtesy of Back to the Roots

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All products offered by Back to the Roots have been designed to be as recyclable as possible, including using ceramic planters, compostable trays and recycled packaging.

company … with a mission to help inspire a whole new generation to reconnect with the land, reconnect with their food and grow their own food," Arora says.

Arora and Velez have continued to explore ways to lessen their company's environmental footprint, including incorporating postconsumer recycled (PCR) plastic into packaging for several of their products, such as Back to the Roots' plant food and wildflower seed mix, hydroponic grow kit and seed-starting trays.

The soil category, however, has presented challenges when it comes to incorporating PCR plastic into its packaging—until now.

In September, Back to the Roots announced that, beginning in the 2024 gardening season, it would transition its organic potting mix to packaging made from 100 percent PCR plastic in a move the company says is a first for the soil sector and in a push for sustainability. The transition puts a spotlight on how recycling fits into the lawn and garden puzzle.

"Even in this category, we're like, 'How do we try to continue to push the envelope and do things a bit better if we can?'" Arora says.

CONFRONTING THE CHALLENGE

Arora says all products offered by Back to the Roots have been designed to make them as recyclable or "least impactful" as possible, including using ceramic planters, compostable trays and recycled packaging. When its research and development team started looking into its outdoor line of plant foods, it started experimenting with PCR materials.

"Plant foods are much easier because they're mainly [stored] indoors," Arora says. "As we were learning, we started talking to different suppliers and started introducing [PCR content] into it. We launched our hydroponics kit that we use a lot of recycled materials in as well."

But soil, he says, has been the "holy grail" for the category, using hundreds of millions of pounds of single-use virgin plastic per year. Back to the Roots tweaked its soil so it no longer includes peat—a major emissions contributor—but no matter how environmentally friendly its soil is, it was still being packaged in single-use plastic bags.

"At the end of a weekend of gardening, you could have a trash can full of landfilled plastic soil bags," he says.

The challenge with packaging soil into bags containing PCR plastic is mirroring the strength and printability aspects of virgin plastic.

The packaging needs to hold up when it's stored on pallets or transported on a forklift, and it also needs to protect the soil from degrading. "You have tons of microbes in there," Arora says. "They're in high heat in the middle of spring and summer, 100-degree weather. Picture parking lots at Home Depot, [the soil is] sitting outside on asphalt baking in the sun with microbes inside, so it's that shelf life and integrity that was important."

The team at Back to the Roots was inspired by recycling technologies leveraged by consumer brands like Kind Bar, Mars and Unilever, and partnered with Cincinnati-based flexible packaging company ProAmpac to develop 100 percent PCR plastic packaging for its soil, with the recycled material certified under the International Sustainability & Carbon Certification (ISCC) Plus.

Because of the timing of gardening season, the transition to PCR packaging for soil will be complete next year, and Arora says other suppliers already have reached out hoping to get involved. "It's pretty crazy to see the energy around this," he says. "It's been energizing to see momentum build and even our retail partners wanting to lean into this.

"If we can't be the category that leans into sustainability and recycling and trying to do things a bit differently, how do you think any other retail category can lean in if lawn and garden can't? … There's just so much virgin single-use plastic in this category; it just seems so antithetical to what this category should stand for."

PHASED APPROACH

Incorporating PCR content into its packaging is what Arora calls Phase 1 of Back to the Roots' greater recycling mission. The next step is to close the loop on its packaging by designing it to be recyclable.

"Some of the technology we're trialing now can help the bags break down, then eventually [it's about] getting to a place where it's just reusing bags over and over and over again," Arora says.

"We need to think of them like a closed-loop system that we've already taken enough oil and gas, we should be able to reuse these things over and over again. … That's not to say no plastic, because just thinking about all the medical devices, how much stuff is going to need plastic in our lives, it's just how do we think about the circular ecosystem?"

Arora says the lawn and garden industry is in the infancy of rethinking its approach to packaging, but he hopes continued advancements in recycling boost demand for PCR content.

"It's this idea of how do we get closer and closer to this circular thing," he says, "because to me, it's not just about sustainability—doing more with less—we still want to all grow the economy, grow our businesses and [figure out] how you do it with less." •••

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A PRF-ect solution?

First Star Recycling is creating a circular business model by processing hard-to-recycle plastics and turning them into feedstock for plastic lumber in-house.

BY CHRIS VOLOSCHUK

Hard-to-recycle plastics First Star Recycling collects in orange Hefty ReNew bags are turned into plastic lumber at its PRF.

Photos courtesy of First Star Recycling

It is still early in the process, but First Star Recycling could be onto something.

Can a material recovery facility (MRF) capture items considered hard to recycle and convert them into salable end products under one roof? It is precisely the question First Star, based in Omaha, Nebraska, is attempting to answer.

Since opening its plastics recovery facility (PRF) March 1, the company has found success taking plastics that typically are landfilled or incinerated, ranging from food bags to foam cups and toothpaste tubes, processing them into pellets and flake then recycling them into lumber for decking, patio furniture and more.

As it continues to ramp up its project with the help of a $1.35 million loan and guidance from the Singapore-based Alliance to End Plastic Waste and the Hefty ReNew bag program sponsored by Dow Chemical Co., First Star is on its way to creating a truly circular economy for plastics that traditionally have not had strong markets.

"It's probably something that's always been in First Star's psyche, so to speak," says Danielle Easdale, director of sales and marketing at First Star. "I think becoming an end market as well as a recycler is something that has always been what First Star has looked to do."

ORIGINS AND ORANGE BAGS

First Star got its start in 1998 in Fremont, Nebraska, and has since expanded to become the city of Omaha's contracted recycling hauler. Additionally, the company offers education and outreach to help businesses, organizations and communities understand the importance of recycling, as well as providing recyclables marketing and brokerage, on-site recycling training for commercial customers, a zero-waste program for businesses and recycling and waste management grant-writing assistance.

The company's Omaha site spans 360,000 square feet, employs more than 100 people and processes about 100,000 tons of material per year. It also operates a baling and transfer station in Lincoln, Nebraska, and provides its services throughout Nebraska, Iowa and Colorado.

In the Omaha facility, separated by several walls and a storage area, sits a 7,500-square-foot PRF and plastic lumber manufacturing equipment, parts of a plan put in motion in July 2021 when First Star announced a three-year collaboration with the Alliance to End Plastic Waste to develop the integrated recycling complex alongside its MRF.

Since the announcement, First Star has sourced plastics preprocessing equipment from multiple vendors and used lumber manufacturing equipment from Rivalries Corp. of Barrie, Ontario. But before much of the hard-to-recycle material reaches those machines, it arrives at the MRF in bright orange Hefty bags customers can purchase at local grocery stores.

In 2016, Easdale says First Star became the first MRF in Nebraska to offer the Hefty Energy Bag program on a permanent basis. Initially, 6,000 households took part before it expanded citywide in Omaha, and Hefty—under the umbrella of Midland, Michigan-based Dow—gave the program its name because the bags, which were filled with hard-to-recycle items, would be sent to various sites to be converted into energy.

"That program [in Omaha] was initially designed for the bags to be sent for energy recovery in the cement-making process as a coal alternative," Easdale says. "Being recyclers, we like turning things back into new things. Once [bag contents] go through the cement-making process, that's it."

First Star Recycling's PRF uses plastic lumber manufacturing equipment to create boards in four sizes.

First Star wanted to find a way to keep those materials in the economic cycle, so it partnered with Hefty and Dow to find various end markets and technologies for the bags. "In that process, we started coming up with the concept of building the PRF and subsequent bolt-on manufacturing operations here at the facility," Easdale says. "That was how the concept initially came about, and it's been in the works for some time.

"We are going after plastics that didn't have a market with traditional recycling before," she adds. "So, things like the Hefty Energy Bag, agricultural film, other films or rigids that don't have existing markets [are targets]. It's a little different to what other PRFs are doing that are processing materials that have markets. This is going out to those harder-to-recycle materials. They are coming out daily through either the Energy Bag or other external sources."

As new end markets have emerged for the contents inside the bags, Hefty has since changed the name of the program to Hefty ReNew.

CREATING AN END PRODUCT

When loads of recyclables are dropped off at the MRF, the orange bags are removed from the stream by employees on the presort line and sent to the PRF. From there, material goes through a bag breaker and onto a sort line where contaminants such as metals are pulled out via a series of magnets and eddy currents.

After sorting, the materials are shredded, cleaned using a dry friction cleaning process, then pelletized or turned into what Easdale calls a "California cube," a larger, denser, cube-shaped piece made from the recycled film. "It's more of a larger cube, where the film's densified but it's designed to still be able to break up when they go into a remanufacturing process," Easdale says. Of all the plastic the PRF processes, about 10 percent goes into lumber First Star manufactures. To turn the recycled material into the end product, it first is fed into a blender system, then extruded to a carousel that contains

various die molds and creates different lumber profiles.

First Star CEO Patrick Leahy says the company is producing about 100 boards per day in four different sizes—1-foot-by-6-foot, 2-by-6, 1-by-4 and 2-by-4—with the smaller sizes accounting for the majority of boards created each day.

The PRF is staffed with five employees working one shift per day, with three working on the PRF side aiding in sorting and two on the lumber side. First Star's goal is to ramp up production so it can run three shifts per day and process 10,000 tons of plastic per year in the project's first phase.

As part of that eventual ramp-up, First Star aims to process about 1.5 million pounds of material to create the lumber and make about 85,000 boards in the four sizes.

"We will scale up as [project] phases go on," Leahy says. "It will depend on what we're doing. The lumber operation is taking about 10 percent [of the material] from the PRF. So, there's about 90 percent that is going into pellets and other options."

Easdale adds that continuing to establish end markets is the key to the program's success. Once enough lumber inventory is built up, First Star intends to sell it factory-direct or to smaller lumber yards, do-it-yourself deck builders and other small operations.

FUTURE FOCUS

As First Star continues to prove its business concept, the goal is to move into Phase 2, where the company will consider adding equipment to increase production to 20,000 tons of plastic lumber per year and attempt to find additional end markets for its pellets.

"Ultimately, what we're trying to do is prove out the bolt-on manufacturing operations model," Easdale says. "So, as we prove that out with Phase 1 and Phase 2, then we'll be looking at varying options, varying technologies around the country of MRFs that may be interested in partnering with us to replicate this model in other places. There's been a lot of interest, and people [are] watching to see how it shakes out."

Leahy says the bulk of industry interest in First Star's PRF and manufacturing venture comes from the pellet side of the operation. The lumber production side is the company's current end market, but as the project progresses, others already are in mind.

Plastic pallets, railroad ties and roofing boards all have been discussed as future products that could be manufactured with First Star's pellets. Regarding the pallets, Leahy says, "We have a vendor where we're looking at their equipment right now and they're doing some testing to see if it would be able to take hard-to-recycle plastics."

He adds that even though plastic lumber and pallets are not new inventions, First Star's use of hard-to-recycle material in their construction is more cutting-edge.

"When I heard plastic lumber, I kind of just shrugged and said, 'OK, plastic lumber. That's been done before,'" he says. "But this plastic lumber is very unique in that it's not a composite and it's not made of easily recycled plastics. It's made of hard-to-recycle plastics and, in tests, it performs just the same in terms of strength. It's something truly unique. … These will be very different because they're made of the hard-to-recycle plastics, which is the true game-changer for a lot of companies in the industry."

A GO-TO PLASTICS RECYCLER

Though the PRF and lumber manufacturing operations are still in an early phase, First Star is researching new feedstock and ways to help others in the industry find ways to convert hard-to-recycle plastics.

According to Leahy, First Star has begun testing agricultural films, or "ag bags," to see if they can be used in the PRF/manufacturing process.

"Ag bags are an industry problem," Leahy says. "Every state definitely has an agricultural base here in America, and these ag bags are getting used more and more by farmers, and they're becoming more of a problem. So, we're looking at that in Phase 1. We have some in supply right now that we're going to test. If we can prove out these tests, then we hope that will also garner some attention as a possible solution for another problem."

Leahy adds the company has been contacted by others in the industry about other types of hard-to-recycle plastics and has been sent samples for First Star to test in the PRF to see if it can make pellets or flakes to be used in the lumber operation.

"We're happy to do that," Leahy says. "We're not just out there having conversations with end markets who will take the pellets and use a chemical or mechanical recycling process, but we're also talking with folks who have issues with their offtake that we're trying to help solve on a case-by-case basis. If we solve it, then perhaps it becomes a true circular thing, where we're selling back to then remake a product."

Easdale says she believes the project is beneficial from a consumer perspective as First Star has opened up the collection of a wider variety of plastics with the inclusion of the Hefty ReNew program.

"This is a great project, because now we're not just taking No. 1 and No. 2 plastics," she says. "Now, we're developing something where you're looking at almost all plastics. From a consumer point of view, and certainly for rural America as well, a lot of these programs haven't been collecting plastics at all. So, this makes it a lot easier.

"The rural programs are able to collect their rigid containers. They can collect all the films and packaging, and that comes to our MRF," she adds. "If it goes in the [ReNew] bag, it also comes to our MRF. And it makes it very easy for [municipalities] to establish recycling programs across the state and utilize hub-and-spoke systems where they can actually start to capture plastics in areas where it was either going to landfill or being burned." •••

The author is associate editor of *Recycling Today* and can be reached at cvoloschuk@gie.net.

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By Dana Darley of Vecoplan LLC

the SUSTAINABLE APPROACH

Manufacturers have several factors to consider when contemplating recycling their production scrap.

Sustainability: The ability to be maintained at a given rate or level; avoidance of the depletion of natural resources to maintain an ecological balance.

By definition, sustainable plastics should be managed within a sustainable materials management system or circular economy that avoids creating waste, toxins and pollutants. Unlike a linear economy that takes resources, makes products, uses these products and disposes of them, creating waste, material in the circular economy is collected and reused after each use.

Plastic producers place heavy emphasis on a product's ability to be reused at the end of its life as they transition toward a more sustainable, eco-friendly position within the broader circular economy. However, an often-overlooked opportunity for reuse comes within the production of the product itself via in-plant recycling or reclamation of production scrap. Creating and implementing a reclamation program can help a producer become more sustainable and often can be a cost-effective, profitable endeavor.

But an in-plant recycling or reclamation operation is a large undertaking that requires significant analysis to determine if it is a fit for the organization and production process. Producers must understand the type of scrap produced and the economics behind such a program. They also must identify and form an implementation plan for the reclamation of production scrap and its reintroduction into the production process.

Meeting the demands of PLASTIC RECYCLERS

As demand for recycled polymers grows, it is essential for reclaimers to produce exceptionally pure material that can meet manufacturers' most exacting specifications. Achieving those specifications at high production rates is critical for cost-control and long-term viability.

The STEINERT UniSort family of sorters achieves these dual goals. The sorters benefit from Steinert's more than 130 years of materials management and separation experience. The UniSorts leverage state-of-the-art hyperspectral imaging (HSI) sensor technology. This allows exacting materials identification based upon the smallest differences in chemical composition.

Sixteen UniSort sorting machines with hyperspectral imaging technology generate plastics fractions with the highest levels of purity. © Graf

SORTING BLACK PLASTICS AND EVERYTHING ELSE

UniSort offers unmatched ability to sort any color of plastic to create the needed fractions. Using near-infrared (NIR) sensors and a color camera, UniSort Finealyse can sort plastic flakes by type and color. The UniSort BlackEye is based on the same design and features a sensor in the middle-infrared (MIR) frequency range.

Being able to sort black plastics adds tremendous value. A processor can, for example, sort black polyolefins (PO) into their constituent parts, such as polyethylene (PE) and polypropylene (PP), but also polystyrene (PS) and acrylonitrile butadiene styrene (ABS) copolymers.

"Our effective sorting of black plastic truly sets STEINERT apart," says the company's Nolan Lamb. "Our UniSort machines can sort all colors, which provides tremendous flexibility and value for processors."

HIGH PRODUCTION LEVELS

The proprietary active object control (AOC) system developed by STEINERT stabilizes material as it rides on the UniSort's accelerator conveyor toward the detection area. This highly effective system ensures that even the smallest objects remain in their calculated position, delivering accurate sorting at high speeds.

The speed and stability of this system ensure consistently high production coupled with unmatched productivity. While the material flows through the detection area, the corresponding sensors detect the type or color as necessary and the position on the conveyor belt. The controller then activates the correct nozzles at precisely the right time and position.

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In-plant recycling requires significant analysis to see if it is a fit for the organization and production process.

UNDERSTANDING, DEFINING PRODUCTION SCRAP

Production scrap comes in all forms, shapes and sizes. Some can be reclaimed online, offline or not at all.

In the cases of blown or cast film and sheet, startup purge, trims, bad rolls and loose products should be reclaimed. Blow- and injection-molded scrap, such as flash, sprues, runners and whole or cut-down parts, should be reprocessed. Other processes, such as compounding and fiber extrusion, also produce considerable production scrap.

Producers often can reclaim production scrap directly online, known as direct scrap reclaim. For film and sheet, edge trim can be processed and fed directly back to the extrusion line. In blow and injection molding, scrap such as flash, trimmings and runners can be granulated beside the machine and fed directly back to the process. Producers must handle production scrap offline for all other processes, such as pipe and profile, compounding and fiber extrusion.

Processors that still need to develop their internal recycling capabilities typically are left with three choices when dealing with their scrap: disposal, resale or toll processing. Disposal is the last resort before incineration, where the scrap can be used as fuel to recover its British thermal unit, or Btu, value. Disposal is the only option for scrap that cannot be reused or converted to energy. Often, size reduction and compaction are used to prepare the material for efficient transport and disposal, which can be critical for cost-effective operations.

ECONOMICS AND DECISION-MAKING FOR IN-HOUSE SCRAP REPROCESSING

The first step is to evaluate the economics of the current production scrap handling process. You then can calculate the potential savings per year to substitute the current handling methods, including disposal, resale or toll processing. After calculating potential savings, you can compare them against the costs associated with an internal scrap reclamation operation, including any process modifications.

To understand the true economics and cost of disposal, you must calculate real and ecological factors. The cost calculation should consider factors such as the carbon footprint from transporting the waste as well as landfill tipping fees. If you plan to sell the scrap, you must calculate the net profit from the resale, considering costs such as marketing, administration, storage and logistics. These costs can offset a considerable amount of the price per pound received from selling the scrap. When determining an accurate cost analysis for toll processing, producers also must consider additional factors, such as the implications of quality control and material loss.

Once a complete cost profile is established for the current methods used to handle your production scrap, you can calculate potential cost savings per year to substitute your scrap's disposal, resale or toll processing with in-house processing.

It's important to evaluate the production process to determine the potential reuse of reclaimed materials. You can collect much of the necessary information by running trials on your processing line using reclaimed materials. Identify any detrimental effects that reclaimed materials have in the process, such as reduced output or automation and product quality issues, and study the impact of different reclamation forms, such as regrind, densified particles or repelletized material. Process modifications needed to optimize reclaim use need to be determined, as well as the costs associated with their implementation.

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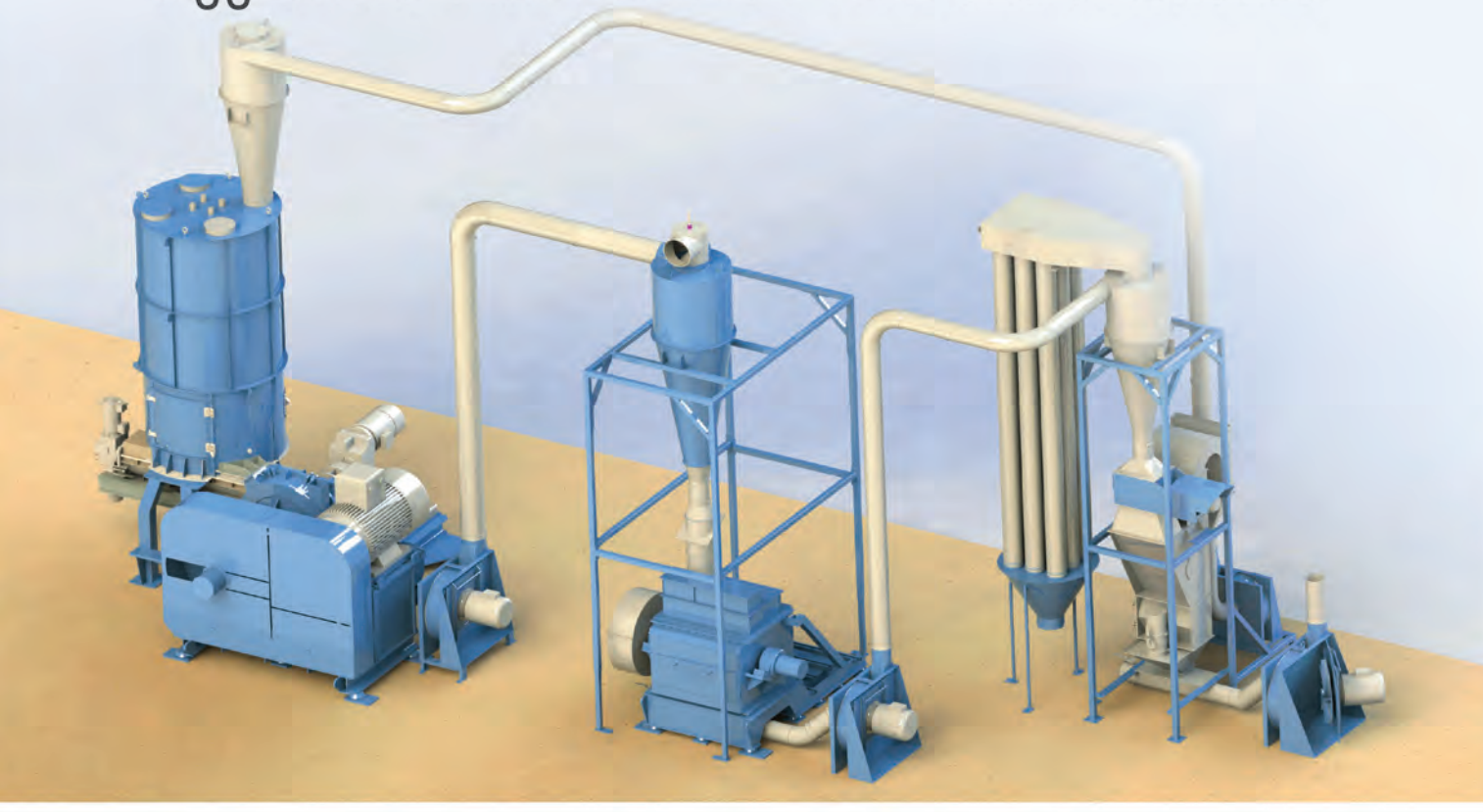

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Implementing system modifications to the production process is a complicated step in reprocessing material.

After identifying the ideal form or forms of the reclaimed material for reintroduction and any process changes needed to accommodate them, you can begin looking at different processes to recover the material.

Once you have decided on the correct processes to convert scrap into the desired form for reprocessing, you can determine the associated costs. Calculate the potential savings per pound of material recovered. Based on the process limitations of your production lines, the maximum percentage of reclaimed material introduction should be established, thereby indicating the potential material savings per year.

The final step is to calculate the cost for an internal scrap reclamation operation; this includes the capital equipment and operational cost per pound for the reprocessing line. With this information, you can compare the estimated cost savings per pound and factor in the amount of scrap that can be reprocessed for a projected payback.

Armed with this information, you can prepare the business plan for upper management to evaluate and make a tentative decision on whether to move forward with the project.

DETAILED EVALUATION FOR INTRODUCING RECLAIMED MATERIAL

With the initial cost analysis and justification completed and management's OK to move forward, you are ready to dive into the implementation details. Transportation and storage of reprocessed material is the first consideration, knowing regrind materials and densified scrap handle differently than pellets.

All standard options—gaylord boxes, super sacks, hoppers/bins and silos—are available. Your material conveying systems, however, must be analyzed for these reprocessed material forms, including material line sizes, dust collection systems and material holding bins. If you repelletize material, storage and transportation equipment typically can be used as is.

Blending and feeding systems need to be evaluated. While you can use existing systems to introduce reclaimed material in most circumstances, blending and feeding equipment might need to be added or modified to accept the new material stream.

The most complicated step is identifying and implementing any modifications needed to the production process for making your end products. The extruder and/or extruder screw might need modification to accept higher levels of reclaimed material. Nonpelletized reclaimed materials could require a larger feed section, deeper metering flights and improved venting. Melt pumps also can be incorporated into the process. Mixing sections or static mixers can be added to the extruder to improve melt homogenization. Upgraded melt filtration could be required to handle increased material contamination arising from using reclaimed materials. Gauge measurement and control could need to be upgraded or added to better monitor the product's overall dimensions.

Despite best efforts, reprocessed material can negatively impact end products. Viscosity loss, gel formation and color degradation can result, as well as loss of mechanical properties. Process output and stability issues can lead to loss of production and gauge control. Contamination and visual imperfections also could be unavoidable. Though the market insists on

Continued on Page 40

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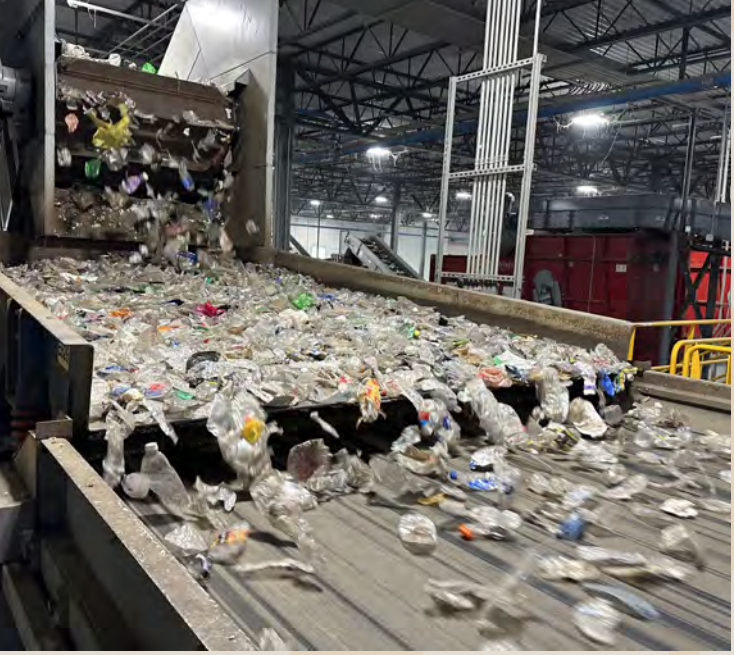


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By Ron Shinn

A MODEL *of* EFFICIENCY

Alpek Polyester USA is playing a key role in bottle-grade PET recycling in its region.

The largest stand-alone bottle-to-bottle recycling plant in the Americas now is fully operational after an arduous journey from a greenfield site through a company bankruptcy and machinery commissioning challenges during the COVID-19 pandemic.

The 270,000-square-foot plant in Reading, Pennsylvania, was built by CarbonLite Holdings LLC before it was acquired by Dak Americas LLC—now Alpek Polyester USA—for $96 million when CarbonLite declared Chapter 11 bankruptcy during the early stages of commissioning.

Alpek Polyester is a subsidiary of Alpek S.A.B. de C.V., headquartered in Monterrey, Mexico, and has recycling operations in Richmond, Indiana; Fayetteville, North Carolina; and Argentina. Alpek had revenue of $10.5 billion in its most recent fiscal year, with about 66 percent, or $6.9 billion, coming from the Alpek Polyester business. The company does not release U.S. sales figures.

Construction in Reading started in 2019, equipment commissioning started in early 2020 and the final production line was approved in March 2022. The process was delayed primarily because technicians from machinery manufacturers around the world could not travel because of COVID-19 restrictions, Alpek Polyester Flake Operations Manager Rodrigo Castro Uribe says.

Alpek Polyester USA's bottle-to-bottle recycling plant in Reading, Pennsylvania, spans 270,000 square feet and has been operated by Alpek since May 2021.

The facility now produces bottle-grade recycled polyethylene terephthalate (rPET) from bottles collected mostly in New York City, Washington and Baltimore, Castro Uribe says. Most of the resin goes back to bottlers in the region, giving Alpek Polyester a key role in the area's bottle-to-bottle circular network.

"Our mission is to promote that circularity," says Ricky Lane, director of public affairs, trade relations and corporate communications at Alpek Polyester. "The benefit we do have is true circularity in bottle-to-bottle [recycling] by those pellets going directly back into bottles."

Castro Uribe says approximately 95 percent of the plant's feedstock is postconsumer material.

The plant has 60,000 tons of flake capacity per year and 45,000 tons of pellet capacity per year. Alpek Polyester declines to provide the plant's current output, but says more capacity is available as resin demand increases.

All the flake produced at the plant goes into the company's rPET pellets.

HOW IT WORKS

The facility is a model of efficiency. It can take in up to 360 tons of postconsumer bottles per day through a single bottle line. Incoming bales are broken, and clear and colored bottles are separated before going through a grinder. The bottle line's final output is prewashed flake.

Photos courtesy of Alpek Polyester USA


Castro Uribe

Two Nashville, Tennessee-based NRT SpydIR optical sorters and two robots with Max-AI from Bulk Handling Systems (BHS), Eugene, Oregon, identify and pick out non-PET material in the stream.

Next, the material goes through one of two Sorema wash lines with a capacity of 185 tons per day for clear bottles and 53 tons per day for colored bottles and other byproducts. Separation of other polymers in the stream continues during this step, and the flake is cleaned and sorted to achieve clean, clear flake. Two flake sorters with laser Unisensors from Tomra Recycling Sorting, headquartered in Germany, handle flake sorting.

The washing process involves six steps, according to Castro Uribe. Adhesive and pieces of labels are removed, a flotation process takes out caps, material is dried and sorted by size and color contamination is removed.

The next step requires putting the clean flake through one of three extruders from Starlinger, with U.S. offices in Fountain Inn, South Carolina, that have a capacity of 47 tons per day each. Each extrusion line is equipped with a Starlinger solid-state polycondensation (SSP) reactor needed to produce food-grade material.

The extrusion step removes organic contaminants, pelletizes and crystallizes the material and increases its intrinsic viscosity (IV). The final product is a food-grade pellet.

The SSPs, which are part of the extrusion step, raise the IV of the material back to acceptable levels for food-grade applications. IV is a measure of the polymers' molecular weight and reflects the material's melting point, crystallinity and tensile strength. It is used to determine the right grade of PET for a particular application.


Reilly

The material handling system used in Reading is from BHS, and the site features six grinders from Erema North America, Ipswich, Massachusetts.

Five silos store flake and pellets, and all material shipped in or out of the plant is by dry truck or via supersacks in dry trucks. Because there is no separate warehouse, incoming material and finished product are stored inside the plant.

The Reading facility can take in up to 360 tons of postconsumer bottles per day through a single bottle line.

Alpek Polyester does not compound material at the Reading location, but other Alpek Polyester virgin resin manufacturing sites can perform that for customers.

Since taking over plant operations, Alpek Polyester has needed to add only one flake sorter.

The facility was launched with electric power coming from three on-site diesel generators that can produce 3.6 megawatts, but a 69-kilovolt line to the plant is in the works, site Director Todd Reilly says.

The plant has 105 full-time employees—up from 70 when Alpek Polyester took over plant operations in May 2021—and runs seven days a week with two 12-hour shifts. All CarbonLite employees were retained.

Feedstock comes primarily from material recovery facilities, but Castro Uribe says the facility is trying to work with municipalities that have deposit laws. "Most of the time, those are higher-quality bales," he says.

POSITIONED FOR SUCCESS

The plant's location also gives it a strategic advantage.

Several major bottle manufacturers are in the vicinity of Reading, which is 30 miles southwest of Allentown, Pennsylvania. Lane says Alpek Polyester is a leader in the production of virgin and recycled PET and has relationships with almost all major brands using those products. "We are the largest recycler in North America, as well as the largest PET producer, so that leadership position allows us to work with most of the major players," he says.

Lane says Alpek Polyester expects demand for rPET to increase as laws mandating recycled content increase. "As more and more policy and legislation are put in place, there will be higher demand," he says. "It will not be a demand caused by desire [to use recycled material] but by legislation. Those periods are coming soon.

"It is very important all the process steps that we have to bring true circularity, and that's what the brand houses and the customer relationships that we have are focused on so they can make their marketing claims that they are a circular producer."

Ron Shinn is editor of *Plastics Machinery & Manufacturing* and can be reached at rshinn@endeavorb2b.com.

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MINIMIZING IMPACT, MAXIMIZING PERFORMANCE

Circular Polymers by Ascend has launched a new line of polymers made from recycled carpet.

BY BRUCE GEISELMAN

Circular Polymers by Ascend is turning postconsumer carpet into Cerene, a new line of recycled polymers and materials made using its proprietary technology.

The Cerene line includes polyamide 6 and 66, polyethylene terephthalate (PET), polypropylene (PP) and calcium carbonate, and the company says the recycled materials can be used as a consistent, sustainable feedstock for applications including molding and compounding. The new line also can be used in many high-performance applications, which is unusual for postconsumer recycled (PCR) polymers, according to company officials.

"Customers around the globe are seeking consistent and reliable postconsumer recycled materials," says Maria Field, business development director of Circular Polymers by Ascend. "Cerene is mechanically recycled using a process that minimizes our carbon footprint and environmental impact."

Headquartered in Houston, Circular Polymers by Ascend converts postconsumer carpet into fiber and pellets using a proprietary process in its Lincoln, California, factory.

The launch of the Cerene line follows Ascend Performance Materials' purchase last year of a majority stake in Circular Polymers. Thanks in part to Ascend Performance Materials' experience in providing nylon engineered resins for high-performance applications, the new line can be tailored into compounds to help companies balance performance and sustainability targets. Circular Polymers is targeting the automotive industry, including electric vehicle manufacturing, as well as the home appliances market. PP and PET in the Cerene line can be used in consumer products, textiles, engineered wood and other applications.

"Because the nature of postconsumer recycling can lead to variability, one major challenge for manufacturers looking to incorporate recycled feedstock is consistency, quality and reliability of supply," Field says. "Because of our vertical integration combined with the availability of landfill-bound carpet, we can assure our customers that they can count on consistent, readily available materials that will scale to their needs, even for demanding applications."

Circular Polymers collects the carpet for recycling and thus better controls the quality of material in the supply chain. Through its proprietary mechanical recycling process, it can produce plastics that rival virgin materials, according to Field.

Photo courtesy of Circular Polymers by Ascend

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Based in Houston and with a factory in Lincoln, California, Circular Polymers by Ascend aims to provide new life for every component of carpet and backing, and says it has redirected 85 million pounds of carpet from landfills since 2018.

"In our space, it's a little bit more challenging because we have to meet the higher thresholds of performance," Field says. "We [produce] parts under the hood of your car … the thresholds of performance and quality that we need to meet is really, really high."

While it is not uncommon for PCR materials to be used in applications such as consumer packaging, their use in high-performance applications is more challenging.

"What Ascend brings to the table is engineering leadership to bring our polyamide products into higher-value, longer-lasting applications," Circular Polymers CEO David Bender says. The company aims to provide new life for virtually every component of the carpet and backing. Since 2018, Circular Polymers by Ascend has redirected 85 million pounds of carpet from landfills.

More than 4 billion pounds of carpet go to landfill in the United States every year, Bender says. At its California plant, the company can recycle about 95 percent of the material that comes in.

Currently, California is the only state that has an extended producer responsibility (EPR) law in place for carpet. EPR legislation imposes fees upon the makers or distributors of specified products to help cover the costs of the materials' disposal or environmental mitigation.

New York recently became the second state to enact an EPR law targeting carpet. The New York law goes into effect Dec. 28, 2024, with implementation of carpet collection programs July 1, 2026.

As more states across the country enact EPR laws for the carpet industry, it could create additional business opportunities for carpet recyclers.

"We're working with a number of states who have interest in expanding their circular economy to include carpet, so, we do see this expanding," Bender says.

The author is a senior staff reporter at *Plastics Machinery & Manufacturing* and can be reached at bgeiselman@endeavorb2b.com.

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Three Piece Mixer A universal mixing head with mixing blades that turns the MetaStation 4E with MetaBridge software into a high-precision analytical instrument. For post-consumer recycled (PCR) poly(vinyl chloride) (PVC), ASTM D2538 measurements of thermal stability times are critical for incoming quality control (QC), qualifying new resins or resin sources, and developing new manufacturing processes.

Single Screw Extruder A 3/4" 25:1 L/D single screw extruder with a 2:1 compression screw is standard for visual inspection of rigid PCR PVC extruded ribbon. With a 3:1 compression screw, viscosity of flexible PCR PVC as a function of shear rate and temperature can be measured using a Rheometric Capillary Die (see below).

Conical Twin-Screw Extruder A must-have addition to a MetaStation 4E for compounding and extruding rigid PCR PVC. The low-shear profile of a counter-rotating conical twin-screw extruder is more gentle for extruding shear-sensitive rigid PCR PVC than a standard single screw extruder. With the conical twin-screw extruder, coupled to a Rheometric Capillary Die (see below), viscosity as a function of shear rate and temperature can be measured with rigid PCR PVC.

Rheometric Capillary Die Determine viscosity values at various shear rates and temperatures. A MetaStation 4E, Three Piece Mixer, Conical Twin-Screw Extruder, and Rheometric Capillary Die complete any QC department for critical measurements of rigid PCR PVC.

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Rare earth tube circuit enhances metal detection

ProGrade: Eriez makes a variety of magnetic separation equipment that can protect against damage caused to machinery or potential end-product contamination that results from weakly magnetic fine ferrous material entering the plastics recycling stream. The ProGrade product line features standard magnetic plates, grates, traps and tubes.

What's new? The improved Xtreme RE7 rare earth tube circuit, which is available in Eriez ProGrade tubes, grates and liquid line traps.

Benefits: In head-to-head tests, Eriez says the Xtreme RE7 was shown to be 13 percent to 40 percent stronger than other magnets on the market today, providing greater separation efficiency. Additionally, the company says its Xtreme RE7 beats competitors' models in terms of pull-testing, gauss rating or both and is the strongest technology currently available.

Eriez, Erie, Pennsylvania, 814-835-6000, www.eriez.com

Zerma shredder processes range of pipe sizes

ZRS 2600: Zerma's latest pipe shredder can process plastic pipe in a range of sizes. The shredder begins working automatically once its horizontal feeding trough is loaded and its heavy-duty hydraulic cover is locked in place. It features a hydraulic pusher that forces the pipes against its two vertically arranged rotors. An intuitive touch screen gives users complete control for monitoring all operations.

What's new? The ZRS 2600.

Benefits: The ZRS 2600 is capable of processing pipes up to 7 feet in diameter and up to 22 feet in length. Pipes of different diameters and wall thicknesses can be loaded within the shredder in a cascading array or nested inside one another. Worker safety is ensured because power remains off while the hydraulic cover is open for loading and secured by a light-grid.

Zerma America LLC, Fort Meyers, Florida, 239-219-1100, www.zerma-america.com

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THE NEW WAVE OF EXCELLENCE

Sabic PCR-based resin helps customers reduce carbon footprint

PCR-based resins: Sabic has developed sustainable polyphenylene ether-based resins with a new formulation that uses at least 25 percent postconsumer recycled (PCR) content. Its PCR-based Noryl resin technology can be incorporated into more than 200 existing Noryl resin grades, including a glass-fiber-reinforced (FR) grade and an unreinforced, non-FR grade.

What's new? Noryl NH5120RC3 resin, which has up to 30 percent PCR content.

Benefits: The resin features improved circularity. Sabic says, depending on the requirements of a particular application, its new PCR-based technology could replace fossil-based Noryl grades currently in use, giving customers the performance they require while reducing their carbon footprints. For example, compared with a fossil-based resin grade, Noryl NH5120RC3 resin's PCR content has 10 percent less global warming potential, according to Sabic.

Sabic, Houston, 713-430-2301, www.sabic.com/en

New camera improves optical sorter's precision

SpydIR-HS optical sorter: The latest optical sorter from National Recovery Technologies (NRT) features an improved near-infrared (NIR) camera and other updated technologies to boost its sorting capabilities.

What's new? The SpydIR-HS optical sorter. It features a hyper spectral imaging (HSI) camera and software that gives operators greater flexibility to configure targeting profiles to optimize recovery.

Benefits: The HSI camera provides nearly 10 times the detection resolution of its predecessor, while the new system provides double the air ejection precision and includes lifetime calibration. The new sorter also can be integrated with Bulk Handling Systems' Max-AI visual identification system, allowing it to intelligently target its recovery by ejecting or suppressing polyethylene terephthalate (PET) trays from a PET material stream, for example, or ejecting natural high-density polyethylene (HDPE) containers from a mixed HDPE stream. The enclosure of the sorter has an internal height of 6 feet, providing easy access and improving ease of maintenance, which protects workers.

National Recovery Technologies, Nashville, Tennessee, 615-734-6400, www.nrtsorters.com, www.youtube.com/watch?v=wpGGHUaooOY

What's the next challenge?






Gamma Meccanica regeneration lines **GM Tandem** and **Tandem PLUS** are able to recycle the most "difficult" plastic waste: heavily printed, wet and highly contaminated. With the **Tandem PLUS** version the single-screw extruder is combined with a twin-screw extruder to enrich and compound the material with additives granting higher value during the upcycling process.

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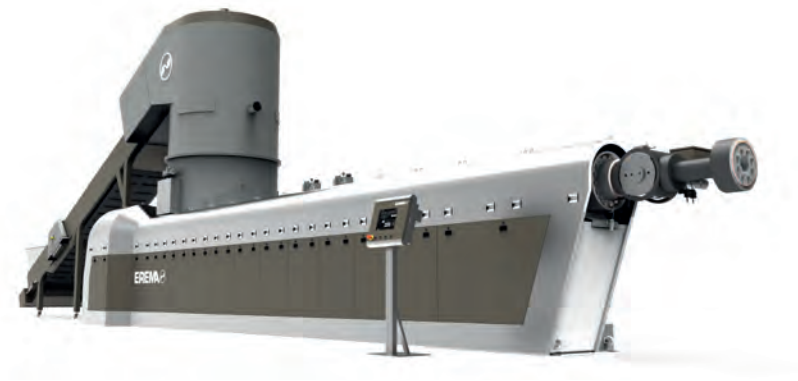
Erema systems recycle highly contaminated packaging

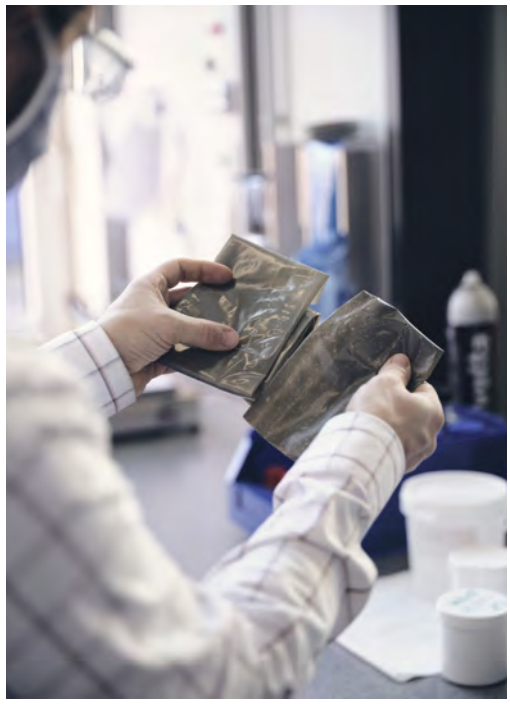
Chemarema: Designed for applications upstream from pyrolysis, this portfolio of custom-built Erema systems combines preconditioning units for cutting, homogenizing, heating, drying, compacting, buffering and dosing and the company's extrusion technology to prepare plastic scrap not appropriate for mechanical recycling. The Chemarema range includes cascade solutions with single- and twin-screw extruders, shredder-extruder combinations and vacuum-assisted extrusion solutions available for special applications. The systems can be designed to accommodate an array of polymer types, material shapes and varying bulk densities and levels of moisture or contamination.

What's new? The Chemarema, available since the K 2022 trade show.

Benefits: The ability to recover value from highly contaminated postconsumer input streams, such as packaging films with low bulk densities from about 3 pounds per cubic foot and moisture levels of 4 percent to 12 percent, to prepare them for chemical recycling in just one process step at throughputs of up to about 5.5 tons per hour. According to Erema, the systems perform reliably, continuously and energy-efficiently. Compared with conventional systems, they have a process window three times wider for handling the input variability that typically occurs with material flows for chemical recycling given fluctuations in composition, impurities and moisture.

Erema North America Inc., Ipswich, Massachusetts, 978-356-3771, www.erema.com





Evonik additives aid recycling

Tego Cycle: Evonik's Tego Cycle family of additives offers products that can be used at every stage of the mechanical recycling process for plastics. For example, in the washing stage, Tego Cycle additives include wetting agents and antifoam products to prevent adhesion of dirt and air, providing excellent plastics separation, as well as additives for deinking and delabeling. The Tego Cycle product line also includes additives that reduce odor and improve the compatibilization of rigid and flexible materials, including additives optimized for resins such as polyethylene and polypropylene.

What's new? The Tego Cycle brand, which debuted at the Plastics Recycling Show Europe in May.

Benefits: The additives can improve efficiency of mechanical recycling, decreasing the energy required. Additionally, Evonik's Tego Cycle additives can help improve processing and enhance polymer properties, leading to more competitive costs and higher-quality pellets.

Evonik Corp., Richmond, Virginia, 804-727-0700, www.evonik.com, www.youtube.com/watch?v=ygFFkyOrZYQ&t=27s

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Removing contaminants for a purified thermoplastic polymer

Thermoplastic contaminant removal. A patent application from Midland, Mich.-based **Dow Global Technologies LLC** proposes a process for removing contaminants from thermoplastics, such as post-consumer recycled (PCR) plastic, that avoids the negative aspects of previously devised methods, including solvent extraction, surfactants, caustics or complex/multistep processes. The result is a purified thermoplastic polymer useful for making other articles.

The PCR could contain a wide range of thermoplastics, including polyolefins, thermoplastic urethane and thermoplastic silicone, with potential contaminants including inorganic materials, paper, oil and food residue. The contaminated thermoplastic potentially could have contaminant levels as high as 50 percent of its total weight.

The method combines the contaminated thermoplastic with water and a dispersing agent, then subjects the combination to a shear at a temperature above the melt temperature of the thermoplastic. Optional additives include a cleaning agent to keep contaminants from redepositing, a compatibilizer and a neutralizer.

The process can run in a single extruder at a temperature from just above the thermoplastic's melt temperature up to 536 F and, generally, a single extruder would not require venting. "However, in a system with two extruders in a series—one to convert the contaminated thermoplastic to a melt and a second to shear the combination of the contaminated thermoplastic melt, water and dispersing agent [and optional components] … there could be venting toward the end of the final zone for cooling—to dewater the combination to some extent," the application states.

After shearing, the aqueous solution containing all the components can be separated to collect the purified thermoplastic polymer, which then can be dried to form a powder or pelletized.

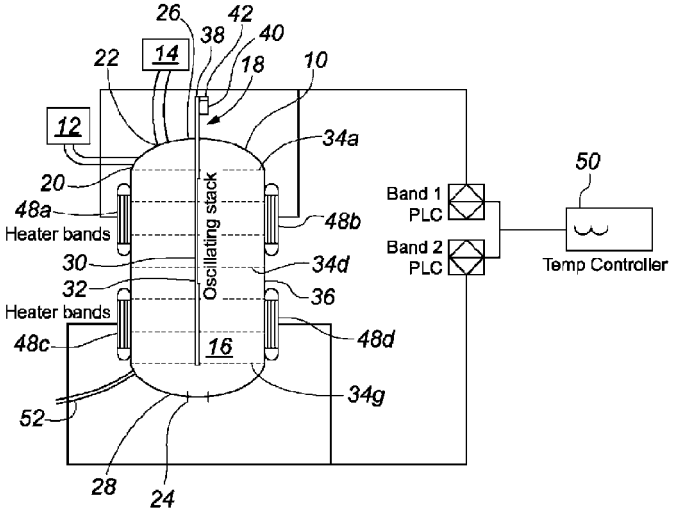
Patent application 20230272180; published Aug. 31, 2023

Oscillating stack. A patent application by **Reventas Ltd.** of Livingston, Great Britain, describes a method of dissolving a polymer in a solvent to remove additives that can be used at commercial scale by cutting the required process time.

Current mixed plastic recycling methods offer limited value for resale and reuse, with most of the created products relegated to black, low-value and out-of-sight products.

While earlier patents discuss turning postconsumer or postindustrial polymers into virgin-like polymer using solvent, elevated temperature and pressure, the processes are time-consuming, limited to lab or batch scale and require a typical minimum polymer-to-solvent ratio of 1-to-100.

"It is therefore an object of the present invention to provide a method to dissolve at least one polymer in at least one solvent in a process for the removal of additives in plastics, which obviates or mitigates one or more disadvantages in the prior art," the patent states.



Reventas Ltd. proposes a reactor vessel with an oscillating stack to cut the process time required to dissolve a polymer in solvent. Image: U.S. Patent Office

The patent application calls for combining polymer and solvent in a reactor vessel equipped with a stack of perforated discs that oscillate in a linear motion, which can be arrayed vertically in some embodiments and horizontally in others.

The envisioned thermoplastic feedstock could be polyethylene (PE), polypropylene (PP) or, preferably, a mixed PE/PP recyclate.

According to the patent application, the stack's linear motion cuts the dissolution time required to remove additives such as color pigments or odors from hours down to minutes and also can decrease the polymer-to-solvent ratio to 1-to-20 or even as low as 1-to-10. The patent application describes the ability to scale this process up to a vessel with a capacity of up to 30,000 liters.

Patent application 20230295394; published Sept. 21, 2023

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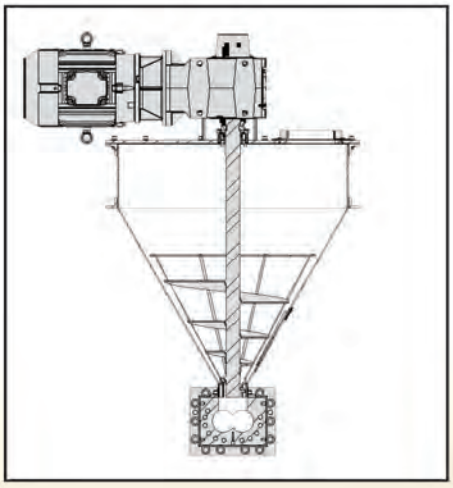

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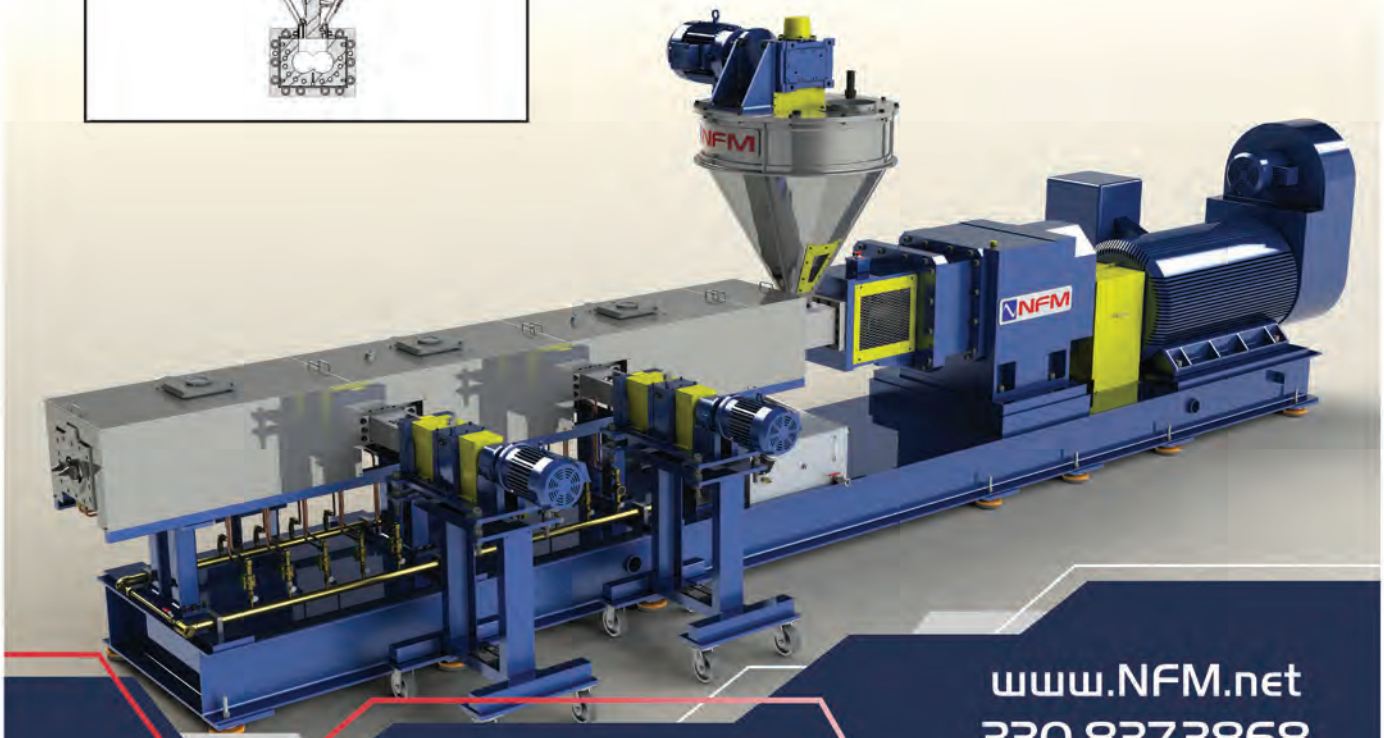

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Continued from Page 22

products manufactured with reclaimed content, the producer also must maintain the highest possible level of aesthetics and performance, so, identifying potential adverse effects on the final product early on and implementing solutions to offset them are critical.

PROCESSES FOR RECLAIMING PRODUCTION SCRAP

A critical first step in any reclamation process is size reduction. A preshredder might be required for proper sortation, inspection and separation of foreign materials. A second size-reduction step, or reshred, might be needed for further material processing for either densification or repelletizing. Further size reduction also could be required to granulate the product to a processable size or even to pulverize it to return materials to their original powdered or granulated form.

Complex material streams, even postconsumer streams, could require sorting for color and polymer type. Contamination removal is a critical last step and often includes ferrous and nonferrous metal removal and soft contamination removal by wash systems, including wet and dry cleaning operations.

Consider hiring a sustainability manager responsible for looking into all aspects of production to minimize waste.

If the recovered material cannot be used in a simple regrind form, either densification or pelletizing must be incorporated. The extrusion process can include traditional single-screw extruders, twin-screw compounding extruders or specialized recycling extruders.

Pelletizing can be done either by "strand," using a bath or water slide, or "die face," either air- or water-cooled. Techniques are available to help preserve polymer properties during the recovery process, including viscosity recovery, to boost color, remove odor and improve mechanical properties.

FUTURE CONSIDERATIONS

There's a lot to think about when you want to go green and move toward a more sustainable, circular production process, considering ecological and economic factors must be addressed. Consider hiring a sustainability manager responsible for looking into all aspects of production to minimize waste. As your internal recycling capabilities grow, you also can consider bringing in other producers' production scrap as well as postconsumer scrap to supplement your own.

Grow your sustainability program into a profitable business unit your competitors will admire and lead the way toward the ultimate goal of zero waste.

The author is the business development and complex applications manager at Archdale, North Carolina-based Vecoplan LLC and can be reached at dana.darley@vecoplan.com.

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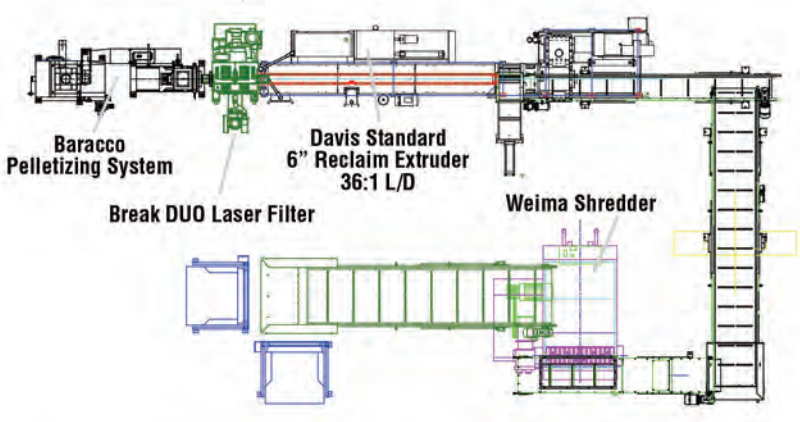

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Name, title: Alan Schrob, director of mechanical recycling
Company, tenure: Nova Chemicals, 24 years
Location: Pittsburgh
Years in industry: 30 years
Education: B.S. in economics, Old Dominion University
Website: www.novachem.com
Visit www.RecyclingToday.com/article/plastics-trailblazers-alan-schrob-nova-chemicals for the whole Q&A.

FAST FACTS

Stronger together

Interview by DeAnne Toto

To achieve plastics circularity, Alan Schrob says collaboration is needed among all areas of the value chain, along with investment in recycling.

Alan Schrob has spent 20 of his 30 years in the plastics industry encouraging circularity in a variety of roles, including business development, marketing and the rigid and performance films markets. His work has involved exploring innovation opportunities for downstream applications in plastics and plastics sustainability and improving plastic circularity.

"Our goal at Nova Chemicals was to reduce plastic waste through efficiency in packaging and production, maintain performance with lighter-weight materials and eliminate multilayer structures that could not be recycled," he says. "This work led to the company's commitment to a low-carbon, zero-plastic-waste future and my transition to postconsumer recycled [PCR] business development two years ago."

Last year, Schrob was named director of mechanical recycling at Nova Chemicals and now helps create lower-emission, recycled products for converters and brand owners.

Schrob shares some of what he has learned about plastics circularity throughout his career.

Q: What lessons have you learned about the industry that have helped you throughout the years?

A: Creating a zero-waste economy is a complex problem that cannot be solved by any one company or any one step in the value chain. It requires collaboration between all areas of the value chain, even if building those relationships can feel challenging in the beginning.

The biggest takeaway from my career is that making progress on a global scale requires vulnerability. Sometimes, businesses must give up part of their competitive edge to solve larger problems.

At Nova Chemicals, we have had the most success when we prioritized cooperation and worked as a team with other partners to develop innovative solutions.

Q: What prompted Nova Chemicals' decision to open a recycling facility in Connersville, Indiana? Why did you partner with Novolex Holdings LLC to operate it?

A: The Connersville facility will allow us to use our know-how, mechanical recycling technology and expertise to produce the highest-performing recycled polyethylene (PE) materials and help businesses throughout the value chain meet their objectives.

With Novolex as the operator, we can leverage the best practices they have developed through more than 15 years of producing and recycling plastic film.

Q: How have equipment suppliers helped advance plastics recycling?

A: We are seeing equipment manufacturers invest heavily in improving the performance of their recycling equipment to meet brand owner PCR objectives.

One such promising collaboration is the founding of Blueone Solutions, a joint venture between the Erema Group, a plastics recycling systems and extruder manufacturer, and Lindner Holding, an expert in waste management and washing facilities. The two companies plan to work together to optimize the recycling process and develop industry standards that can be replicated in facilities around the world.

Q: Where do you see upcoming opportunities for plastics recycling? What about challenges?

A: We need to invest in recycling infrastructure to increase opportunities for recycling and then find uses for the PCR material.

In terms of challenges, recycled materials can be difficult to adapt into demanding product applications. Sorting and cleaning are required to produce feedstock of appropriate purity for downstream processors, and these processes require combined effort from recycling facilities and end users.

Photo courtesy of Nova Chemicals


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