Challenges Facing Recycled Polyester

Reusing waste and limiting the introduction of virgin materials are of tremendous economic and environmental value.

By Eric Joo and Jee-Eun Oh

Stemming from stories about the effect of plastic pollution on animals to microplastics in the Marianas Trench, awareness is growing about the impact of plastic waste on the environment. This, plus awareness of sustainable materials, has led to increased consumer adoption of environmentally friendly products with special attention given to polyethylene terephthalate (PET), also known as polyester. In addition to the waste and pollution aspects of plastics such as PET, the reduction of resources also is driving changes as recycled PET (rPET) saves significant amounts of energy, carbon dioxide, and petroleum resources compared to virgin PET.

As consumer consciousness evolves and becomes ever more aware of the growing problems regarding plastic waste, major brands and retailers — including Adidas, Nike, Walmart, Ikea and Coca-Cola, among others — have responded by undertaking various sustainability initiatives around PET use and waste in apparel materials and packaging. For example, Adidas has announced that it will use 100-percent rPET in its garments by 2024, Ikea has committed to this same goal by 2030, and Coca-Cola has announced that it will recycle one bottle for every bottle that it sells by 2030. Unilever also committed to 100-percent recyclable plastic

Fiber World

Eastman To Acquire Spain-Based INACSA

Eastman Chemical Co., Kingsport, Tenn., has entered into an agreement to acquire Spain-based cellulosic yarn manufacturer Industrias del Acetato de Celulosa S.A. (INACSA). The deal includes INACSA's entire yarn business and assets located in La Batllòria, Spain, as well as formulations and intellectual property, and customer contracts. The acquisition, expected to close in Q3, is subject to regulatory approvals and other customary closing conditions. Eastman reports it will use INACSA's assets to grow its Naia™ cellulosic yarn for the apparel market. Terms of the deal were not disclosed.

"With the acquisition of INACSA, Eastman gains a well-respected yarn producer and a European site that will enhance our ability to support the global textiles supply chain," said Brad Lich, executive vice president and chief commercial officer. "We look forward to welcoming the INACSA employees to the Eastman team. This bolt-on acquisition is consistent with the company's growth strategy and objective of delivering superior value through disciplined and balanced uses of cash for dividend payments, debt repayment, share repurchases, and organic and inorganic growth initiatives."

Kelheim Wins INDA's WOW Innovation Award®

Germany-based Kelheim Fibres announced it was the recipient of the Association of the Nonwoven Fabrics Industry's (INDA's) World of Wipes (WOW) Innovation Award® for its Danufil®QR fiber. The positively charged viscose fiber, made using renewable cellulose, was engineered for use in disinfectant wipes. The fiber binds less than 10 percent of the quaternary ammonium compounds, commonly referred to as quats, so that the disinfectant can work as intended when contained in the wipe. The fiber also is fully biodegradable and may easily be processed on nonwovens equipment.

According to INDA, the World of Wipes Innovation Award "recognizes the winning product that both expands the use of nonwovens and demonstrates creativity, novelty, uniqueness and technical sophistication." Winners are selected by equal one-third votes placed by the WOW Conference Planning Committee, the INDA Technical Advisory Board, and WOW attendees. "Product innovations have a right to exist only if they work in practice and if they create added value," said Matthew North, commercial director, Kelheim Fibres. "Therefore, we are particularly pleased about this approval from the industry."

Universal Fibers Invests In Twisting, Heat-Setting

Bristol, Va.-based Universal Fibers Inc. — a business unit of Universal Fiber Systems LLC — reports it has invested in twisting and heat-setting equipment for its manufacturing facilities in Poland and China. Both plants are fully integrated featuring extrusion through finished yarn capability for multiple fiber types including nylon 6 and nylon 6,6. The yarns — sold under the Helix®, Silkworks® and Revolve® brand names — are used by carpet manufacturers for commercial, residential and automotive applications.

"This marks another investment in our commitment to provide the highest level of quality and service to our customers," said Phil Harmon, President of Universal Fibers. "As an expanding global company we continue to add resources and invest in our business to meet the unique and varied needs of our markets throughout the world."

Ecodown® Fibers Marble adds a new creative dimension to give garments unique, visual interest.

Thermore Introduces Ecodown® Fibers Marble Fiberfill

Italy-based Thermore recently added Ecodown® Fibers Marble to its lofty, recycled fiberfill line. According to the company, Ecodown Fibers Marble turns insulation into art. This aspect of the insulation ensures every garment is unique. Ecodown Fibers Marble offers the same level of performance and softness as the original Ecodown product, but with a new added creative dimension.

"We realized there was very little to improve, technically," said a Thermore spokesperson. "There was only one thing that we could change with this product and it would make all the difference: the way it looks.

"The progress in fabric technology now allows fabrics to be very resistant and so light that you can see through them. We felt the apparel world was ready for the next challenge: using insulation to give garments unique visual interest."

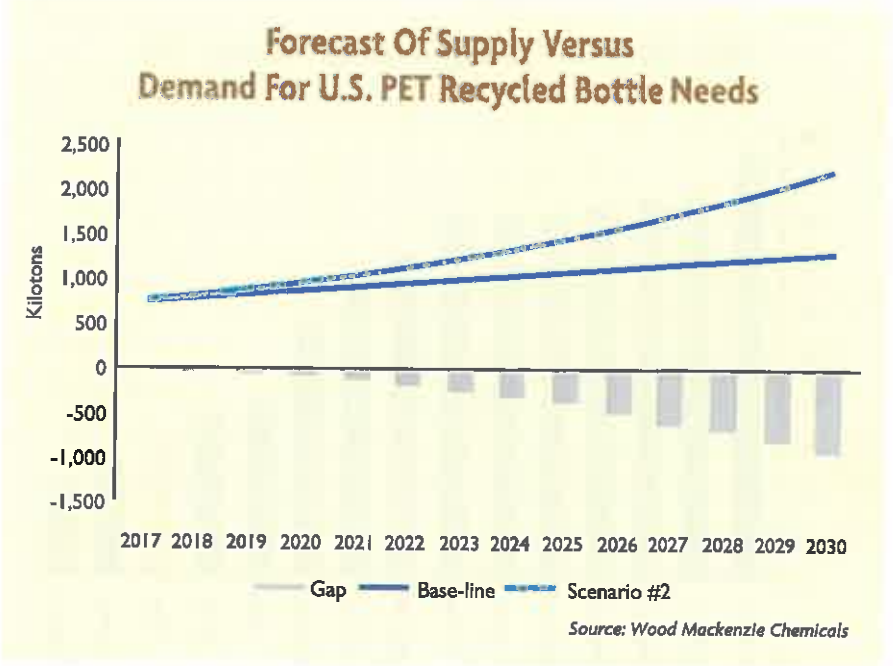
Thermore also introduced Ecodown Fibers Black which offers a 3D color effect using light colored fabrics. This insulation also changes the hue of any fabric used, according to Thermore. TW

packaging by 2025. Clearly, demand is growing, and the use of rPET will continue to increase. But with limited supplies of recycled material, there are significant challenges to meeting this demand.

Primary Issue: Supply Versus Demand

One of the primary issues facing increased growth and supply of rPET is the lack of an available, existing supply. Currently, the majority of PET is recycled using mechanical methods to recycle PET bottles by washing, flaking and melting the material to be formed into textile grade fiber or filament. In addition to mechanical recycling, there are alternatives such as chemical recycling that breaks PET down from a polymer to monomer or more basic chemical components and upcycling, which takes fabrics or old clothes and breaks them down into fiber components for spinning into yarns. The main drawbacks of chemical recycling are the high cost and relatively limited capacity. However, there are various new initiatives for improving and lowering the cost, spearheaded by companies such as Carbios, GR3N, Loop Industries, Resinate Materials Group and Worn Again. The challenge regarding upcycling is that upcycled products tend to be of lower quality and are generally only suitable for use in blends or coarse count applications. As the textile industry uses mostly inputs from mechanical recycling of PET bottles, this article will focus primarily on this source of material.

Mechanical recycling of PET is achieved through the reprocessing of primarily PET bottles. Global PET production for 2018 is estimated at 79.3 million tons, of which 55.5 million tons were used in fiber and filament applications. Global collection of PET bottles was only 12.8 million tons and during the process of converting the used PET bottles collected, approximately 2.2 million tons is lost as waste, leaving 10.6 million tons as usable flake. Of the remaining flake, approximately 56 percent is used in fibers, which means that 5.9 tons is used in fiber applications ranging from nonwoven industrial end-uses to automotive, home and apparel textiles. There is only a very limited supply of recycled flake available to meet the growing demand for recycled products across a wide range of industries.



The primary problems that exist on the supply side are with waste stream collection and recovery. Waste stream collection is limited through lack of incentives, piecemeal regulations and inefficient collection practices. On the recovery side, the waste stream is not optimized for recycling, making the processing of waste materials difficult and expensive. There are many opportunities for improving cost and efficiency of recycling with varying degrees of cost and difficulty.

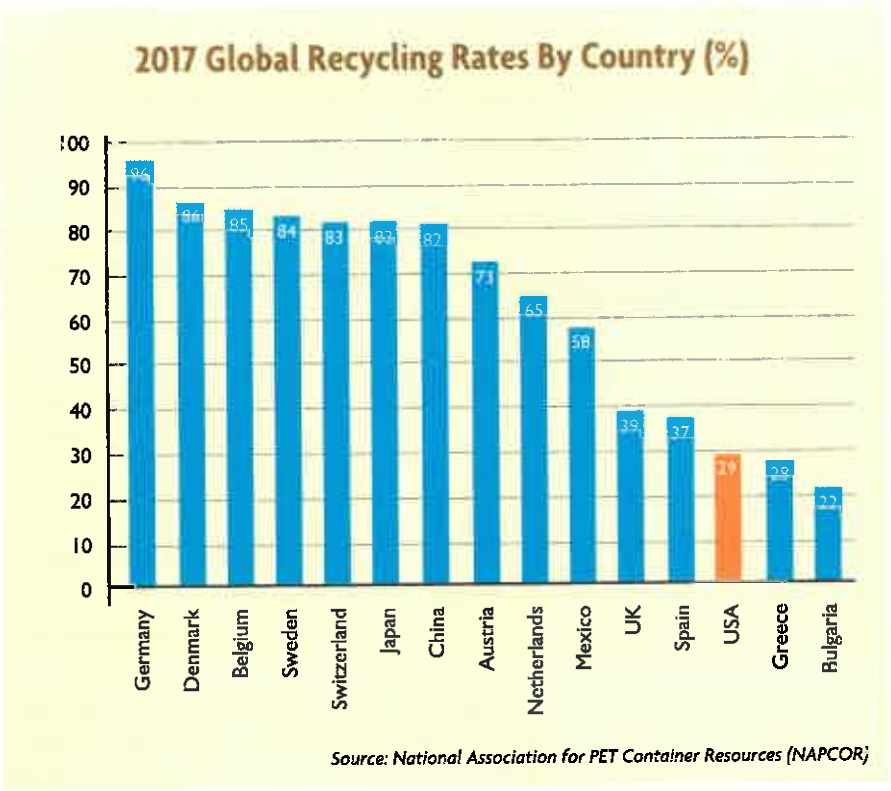
In the United States, only approximately 29 percent of PET bottles are recycled. The main reason for this low rate is the lack of a uniform incentive system to motivate consumers to recycle bottles. One of the most effective methods of incentivizing bottle collection is through regulations that offer a financial incentive. In states that have implemented container rebate values (CRV), recycling rates exceed 70 percent, but in those states that have not implemented a CRV system, recycling rates are 20 percent or lower. Other countries, such as Japan, have implemented mandatory recycling and have realized recycling rates of approximately 84 percent.

Quality, As Well As Quantity

In addition to improving recycling rates, there are additional opportunities to enhance the recyclability of PET materials. During the recycling process, bottles are crushed, washed and flaked. Any contamination or inefficiency of process results in loss of materials and utilization rates in the United States in 2017 were estimated at 79.1 percent for PET bottles, which means that approximately 20.9 percent was unable to be recovered as clean flake.

Two of the main contributors to flake loss are bottle design and waste contamination. With regard to waste, encouraging practices that enable better recovery such as dual or multistream recycling, can lead to higher quality of recyclable materials.

The way in which the United States collects bottles lacks standardization and results in great variability of materials. Collection practices may range from bin sorting



Source: National Association for PET Container Resources (NAPCOR)

of different materials, single bin recycling and single-stream recycling. This creates difficulties when consolidating materials because the materials are mixed and sorting is needed prior to processing. In addition, practices such as single-stream recycling, while resulting in higher recycling rates, often creates waste material that is cross-contaminated with other materials. Japan has one of the most advanced recycling industries in the world and one of the main contributors to this status is because of regulations in place since 1997 that call for consumers, industry and government to cooperate in recycling and reusing plastic containers. The result of this regulation has led to an increase in the plastic recycling rate from 46 percent in the year 2000 to 83 percent in the year 2015.

With respect to the design of materials, selecting plastics that are easier to recycle and not combining different materials into the same packaging can lead to a much higher rate of recovery. Packaging and materials often are designed for ease of manufacture, cost savings or market impact and sustainability is not always considered. In the case of water bottles, these choices lead to designs that may feature different types of plastics, utilize label adhesives that are not easy to wash off, and incorporate colorants that limit the use of the plastic. By designing bottles and packaging for a circular economy and limiting or prohibiting the use of adhesives, colorants, or property altering additives, the recyclability of materials can be greatly improved.

Solving The Issues

Addressing the limited rPET material supply base will help tremendously in meeting sustainability goals, as well as improving the overall health of the planet. However, gains in only bottle collection will not be sufficient to meet growing demand. Substantial improvement can be made in the collection of bottles, but the majority of virgin polyester production and thus waste is not used in bottles. Therefore, methods of collection and recycling of items such as clothing, fabrics and carpets will need to be undertaken as well. Mechanical recycling for these types of materials is even more challenging than bottles, and as such, significant strides in the area of chemical recycling will have to be made so the recycling process can break down the polymer, remove any contaminant impurities and convert the polyester component materials back into PET.

Currently, there is no single company that is capable of addressing the limitations of the supply chain with regard to rPET. At this time, because of supply constraints, prices for rPET are higher than that of virgin PET and the processing costs also limit the end-use applications to companies that can support a higher cost structure. There are some brands and retailers that are leading the way, supporting the higher cost and helping to develop the supply chain. However, more effort will be needed in terms of long-term commitments and significant capital investment. To meet the needs of only recycled materials for PET bottles alone for the U.S. market, it is estimated that $3 billion will be required. With regard to chemical recycling, there is much needed research and development in the technology to realize a cost-effective process that also can deliver the scale required to meet growing demand.

The challenges arising from shifting supply chains to meet changing demand from virgin PET to rPET are significant. However, the benefits of reducing the environmental impact by reusing waste and limiting the introduction of virgin materials are of tremendous value. With the right partnerships and development, the future could be very bright for rPET.

Editor's Notes: Eric Joo is general director of Honduras-based United Textiles of America S. de R.L. de C.V.; and Jee-Eun Oh is an educator based in Los Angeles. Please see ***TextileWorld****.com for a complete version of this article including references.*