



BARGING IN
Sims Group
processes
New York
City's plastics
recyclables in
Jersey City, N.J.

FROM REFUSE TO REUSE

To keep growing, the **PLASTICS RECYCLING** industry needs more feedstock from cities and their residents

ALEXANDER H. TULLO, C&EN NORTHEAST NEWS BUREAU

AT A FAIR on a Staten Island, N.Y., beach, amid trailers hawking T-shirts, sugar-powdered zeppoles, and sausage sandwiches, sat a small stall sponsored by the New York City Mayor's Office of Recycling Outreach & Education. A folding table was cluttered with rubbish—props for an instructive game about recycling. Children and curious adults sorted out the garbage among three waste baskets: one for regular trash, one for paper, and another for mixed recyclables.

For the most part, the game was intuitive enough. The cardboard box went into the paper bin; the aluminum can and polyethylene juice bottle went with the mixed recyclables. But some of the game props, especially those involving plastics, revealed that the public has yet to fully understand the recycling process. A small child put a polystyrene foam egg carton into the paper bin; one grownup mistakenly added a plastic cup to the mixed recyclables.

David Hurd, who heads recycling out-

reach in New York City, says the office—a part of the not-for-profit Council on the Environment of New York City—was created to help New Yorkers learn how to recycle properly, or as he puts it, “get people to understand that just because something has reached the end of life for you doesn’t necessarily mean it’s at the end of its life.” The outreach office holds programs anywhere people gather, including street fairs, senior citizen centers, apartment buildings, YMCAs, and schools. Hurd has even done radio interviews on the subject.

Individual consumers are at the front end of a long recycling supply chain in which each link has its own reasons for wanting efforts like Hurd’s to succeed. Municipalities hope to get value for trash that otherwise would end up in landfills. Recycling companies stand to make money by cleaning and sorting these post-consumer plastics and turning them into new products. And even beverage makers, stung

by recent scrutiny of the large amounts of waste plastic generated by soda and water bottles, stand to benefit from a greener reputation with consumers.

Yet everybody involved in recycling agrees that not enough plastics are being recycled today to ensure the industry’s success.

Although consumers can find recycling symbols and designators (from 1 to 7) on a multitude of bags, bottles, and containers, municipal recycling centers tend to focus on bottles made from “plastic 1,” or polyethylene terephthalate (PET), and “plastic 2,” or high-density polyethylene (HDPE). In fact, bottles made of these plastics account for more than 99% of the plastic bottles recycled in the U.S. in 2005, according to the American Chemistry Council (ACC).

The National Association for PET Container Resources (NAPCOR) estimates that close to 1.2 billion lb of PET bottles was collected for recycling in the U.S. in

2005, only 23.1% of the PET bottles available on U.S. store shelves. In 2004, 1.0 billion lb of bottles was collected for recycling, a recycling rate of 21.6%.

According to ACC, 922 million lb of HDPE bottles was recycled in 2005, representing 27.1% of the HDPE resins sold into the blow-molding market. The recycling rate in 2004 was 25.9%. A mere 10.1 million

lb of polypropylene, mainly plastic used in soda bottle caps, was recycled in 2005. ACC estimates that some 650 million lb of plastic film from a variety of postconsumer and commercial sources was also recycled that year.

Much of this recycled plastic comes from municipal recycling programs that reduce the amount of waste going into land-

fills by collecting paper, metal, plastic, and glass. Such municipalities continually aim to increase what they call their diversion rates, the amount of materials collected for recycling instead of the landfill.

New York City residents start the recycling process by placing paper in one container and metal, glass, and plastic in another. Overall, the city's residential diversion rate is about 18%. The rate could be as high as 36%, but half the materials that should be recycled are carelessly thrown out with the regular trash.

PLASTICS MAKE UP about 13% by weight of the city's metal, glass, and plastics stream. The city collects HDPE and PET bottles and jugs. Plastic containers such as clear, thermoformed PET clam shells for strawberries or HDPE soda cups are excluded. Hurd explains that properties such as the melt index of such materials differ from those of blow-molded bottles. Moreover, he says, there aren't enough of these materials being collected to justify setting them aside.

The city's goal is to reach a 25% diversion rate for residential waste by the end of the year. Longer term, the city seeks a 70% rate for all municipal waste, including commercial trash, by 2015.

According to Hurd, the city has considered expanding the program to include all rigid plastic. "It would certainly ease the public's confusion," he says, but such a system would only improve the diversion rate by about 0.4%. Composting, if the city could overcome challenges such as finding a site for a composting facility, would improve diversion rates much more, he adds, because some 39% of the waste stream is organic materials.

San Francisco, which collects compostable materials, is a model city for recycling in the U.S. It posted a diversion rate of 69% in 2005 and aims to divert 75% of its waste by 2010. The figure includes commercial materials like paper from office buildings and construction and demolition waste. Plastics represent only 5% of that diversion rate.

Robert Reed, spokesman for Norcal Waste Systems, the hauler that picks up San Francisco's trash, attributes that high number to a strong "environmental ethic" among San Franciscans, as well as to 12 distinct recycling programs geared for single-family homes, restaurants, apartment buildings, and the like. "We have demonstrated that in a high-density urban area,

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you can accomplish a tremendous amount of recycling and diversion," he says.

Reed also points to the city's "pay-as-you-throw" system as a strong incentive for people to reduce the amount of waste they generate and to recycle instead. Residents pay a fee of \$23.58 per month for weekly pickup of a 32-gal black container that holds trash destined for the landfill. The service also empties bins each week for compostable materials and recyclables. If a resident is able to recycle more and throw out less, the city offers a 20-gal bin at a 25% discount. Reed calls New York City's system, where taxes pay for residential collection that can include up to six bags of trash on a regular collection day, an "incentive for people to create garbage."

The plastics collected in San Francisco include every variety of bottle as well as tubs and lids made from polyethylene and polypropylene. The polyethylene and polypropylene-based materials are recycled by Epic Plastics, a local manufacturer of plastic lumber and related products. PET, polyvinyl chloride, polystyrene, and other plastics are exported to Asia.

After collection, the focus of plastics recycling turns to sorting and cleaning. In New York City, the first half of that job is carried out by the Sims Group, which operates plants in Queens, N.Y., and Jersey City, N.J., that sort metal, glass, and plastics.

Some of the work is hands on. For example, workers pull out low-density polyethylene bags, mostly the bags in which residents put recyclables. "They are probably one of the most challenging materials to remove mechanically," says Tom Outerbridge, Sims's manager of municipal recycling. Norcal's Reed notes that plastic bags get caught in his company's machinery, slow production twice a day, and have to be freed with box cutters. Sims sends bundles of bags to a plastic lumber company.

At the Sims facilities, ferrous metals are

removed with magnets. Containers made of nonferrous metals, like aluminum, are removed by electric eddy currents that cause them to jump like fleas into a bin as they move down a conveyor belt.

The stream of plastics is then sorted with optical scanners. Sims uses scanners made by the German firm TiTech that detect light in the near-infrared range. Different plastics give back unique signature



waves to the machine, which blows targeted objects off the conveyor belt. Later, bottles are sorted with another scanner that operates in the visible spectrum to separate different colors.

The sorting adds value for Sims. "Recyclers like to receive the clear HDPE separately, and they will pay more for it if it is separated from the colored HDPE," Outerbridge says. The company also sells separate bales of PET bottles.

The revenues generated from recycling by companies like Norcal and Sims heavily depend on the commodity. For instance, according to NAPCOR, bales of PET bottles sold for about 20 cents per lb in 2005. Colored glass, on the other hand, has "negative value," Outerbridge says. Sims currently gives it away for use as a construction aggregate.

Reed explains that recycling programs

aren't financially self-supporting. "There is a misconception some people have that recycling will or should pay for itself," he says. "It doesn't. There is money generated from the sale of recyclables, but it doesn't pay all the costs associated with operating the recycling facility." The cost of running Norcal's California facilities is included in San Francisco collection rates, and these costs are partially offset by recycling revenues.

The situation is similar in New York City. "The combination of the value of the material as well as all of the costs associated with producing marketable products means that we cannot pay the city. We get paid by the city to take this material," Outerbridge says.

THE ECONOMIC incentive for the city is that it pays Sims only \$55 per ton to take away recyclable metal, glass, and plastic. Landfill operators charge \$77 per ton. The city's waste paper is actually worth \$14 per ton to a local paper mill. Offsetting any savings, of course, are the costs to the city of sending out special trucks and collection crews for recyclable materials.

Once collected and separated, plastic containers are eagerly sought as a cheap

raw material by a multitude of companies. Indeed, many recyclers say they are starved for raw materials and could easily buy more.

To convert bales of bottles into marketable products, recycling companies process the plastics further and either sell clean resins on the merchant market or make downstream products themselves.

KW Plastics calls itself the largest recycler of HDPE and polypropylene in the U.S., with capacity to process roughly 250 million lb of each plastic per year. It takes in bales of HDPE bottles from municipalities throughout the U.S. and processes them in its plant in Troy, Ala.

To recycle HDPE, KW chops up the bottles, removes contaminants like residual PET, washes the resulting flake, and pellets it for sale. Clear HDPE resins are sold to the bottle industry and usually end up as colored detergent bottles. Colored resins are heavily dyed and used in applications

ORANGE CRUSH A machine made by TiTech optically sorts different kinds of plastics.

"Just because something has reached the end of life for you doesn't necessarily mean it's at the end of its life."

such as motor oil bottles and flower pots. Scott Saunders, KW's director of procurement and resins sales, says the recycled-resin content in all such applications is usually about 25%, though he notes that the amount can conceivably be pushed up to more than 50%.

Some of the company's polypropylene comes as a by-product of PET recycling by

other companies. After these firms chop up soda and water bottles and wash them, the PET, which has a specific gravity greater than 1, sinks, while the polypropylene caps float, Saunders explains. "We are able to buy that material as they skim it off," he says. The company uses the polypropylene resins to make paint pails.

Recycled resins save money for plastics

molders, especially small ones that don't get big discounts on the virgin resin they buy, Saunders says. Recycled HDPE resins usually sell at a substantial discount to virgin plastics.

Plastics molders are trying to get more recycled resins into more products, as well as into increasingly challenging applications, according to Keith Hughes, marketing director at plastics additives producer Chemtura. They don't want to trade down, such as when milk jugs end up as detergent bottles. "They are looking for ways to upgrade the recycled plastics they get by using additives," he says.

Chemtura offers stabilizer packages specifically for the HDPE recycling market. The idea, Hughes says, is to replace the additives that might have been used up when the resins were processed into their original products. The company also makes coupling agents used to fabricate composites of wood and recycled plastics.

THE RECYCLING WORLD is populated by numerous niche players all seeking to find the highest value for their products. Houston-based Reterra, for example, focuses on upgrading X-ray films from hospitals. General Manager Jason Ball says his company culls the high-purity silver from the film and sells it to electronics companies and other industrial users of silver.

Reterra depolymerizes some of the remaining PET film to make a relatively low-valued product that Ball calls "simple polyols." They are sold to companies that make unsaturated polyester resins.

Reterra also chops the PET into flakes and sells it to fiber companies or manufacturers of PET film and sheet. Producers of food-grade containers pay premium prices for specially processed recycled-PET resin, but the X-ray film that is Reterra's raw material does not have a high enough intrinsic viscosity to work in this application.

In contrast to specialized player Reterra, carpet maker Mohawk Industries claims to be the largest recycler of PET in the U.S. The company is highly integrated, controlling a manufacturing process that starts with about 250 million lb of PET bottles per year and ends up with 80 million to 100 million sq yards of carpet.

Frank Endrenyi, vice president of sustainable development for Mohawk, says the bales of bottles his firm buys can be filthy when they come to its Summerville, Ga., plant. The contamination ranges from mundane cans and cigarette butts to the

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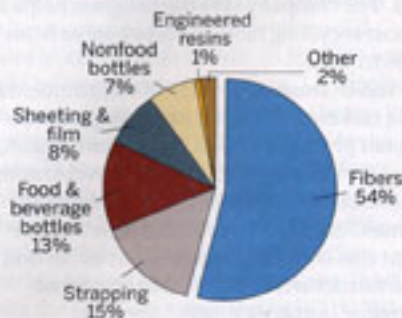


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HIGH DEMAND

Fibers provided the biggest U.S. market for recycled PET in 2005



2005 U.S. market = 864 million lb

PET = polyethylene terephthalate.
SOURCE: NAPCOR

exotic. "One day, we had an engine block that came in a bale," Endrenyi says.

The company puts the bottles through various sorting processes before they are chopped up and purified into "99%-plus-pure" flake that is extruded into small filaments. Other materials that the company gets, such as polypropylene caps, are extruded into the hollow cores that the final carpet is wrapped around.

The company built its recycling plant in 1989, not out of a commitment to sustainable development, but to cut costs. "It is a good source of raw materials that we could actually add value to," Endrenyi says, noting that it has also saved the firm money. Since it opened, he notes, labor costs have increased to the extent that producing recycled resin now costs about the same as buying virgin materials. He says it would be challenging for a company to get into recycling now.

But the world's largest consumer of PET resin is doing just that. Coca-Cola said in September that it will spend \$60 million on recycling in the U.S. Among its investments will be the construction of a 100 million-lb-per-year recycling plant in Spartanburg, S.C., in a partnership with PET recycler United Resource Recovery Corp.

The plant, expected to start up in 2009, will use URRC's Hybrid UnPET process to chemically clean up PET for food-grade applications. The technology is already used in URRC's own pilot plant, at a plant it built for Coca-Cola in Mexico, and by two licensees in Europe.

A key partner for the Spartanburg project will be Coca-Cola Enterprises (CCE),

the bottler that handles about 80% of Coca-Cola's volumes in the U.S. CCE has established Coca-Cola Recycling, which will handle procurement of PET bottles for the plant. CCE will also be the largest user of the plant's output.

John Burgess, CEO of Coca-Cola Recycling, says the venture's near-term goal is to incorporate 10% recycled content into

new bottles and to gradually increase the level from there. "We're being a little cautious because we don't want to go too fast too soon and have it adversely affect the performance of the bottle," he says. He notes, however, that Coca-Cola includes as much as 50% recycled content in bottles in Switzerland and more than 10% content elsewhere in Europe.



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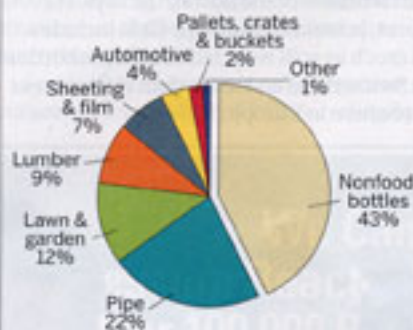
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MANY MARKETS

The largest domestic use of recycled HDPE resins in 2005 was as bottles



2005 U.S. market = 791 million lb

HDPE = high-density polyethylene.
SOURCE: American Chemistry Council/R. W. Beck

In the U.S., recycled material has been incorporated into beverage bottles since the 1990s, but the amount has varied over time and by region. The problem for Coke has been the availability of food-grade

recycled PET. "There has been a variety of available supply out there. Some of it is good, some of it is not as good," Burgess says. "One of the greatest things about Spartanburg is continuity of supply."

Existing recyclers are eyeing the new market entrants warily. They say they already have trouble obtaining postconsumer plastic to run their facilities, and they fear that Coke's entry into the market will make it difficult for them to earn a living. "They will drive the bale bottle price way up for a short period of time," says Reterra's Ball. "Anybody that's weak, that's it. They're done."

RECYCLERS ALSO have competition from companies that buy up baled bottles for export to Asia. Some 162 million lb of HDPE bottles, almost 18% of what was recovered in recycled programs, was exported in 2005, according to ACC. "We have a tremendous amount of competition from foreign buyers for our raw material feedstock," KW's Saunders says.

But with the right incentives, observers think more material can be extracted from the consuming public. This is why Coca-

Cola is investing in Philadelphia's Recycle-Bank, which operates an incentive-based recycling program in which residents earn coupons redeemable at participating retailers. The company says the program helped boost recycling rates in Philadelphia from 15% to 50%.

Judith Dunbar, director of environmental and technical issues for packaging and consumer products for ACC's plastics division, sees the need for still more improvement in this area. "Given the supply-and-demand dynamics of recycled feedstock, it's important that we continue to support collection infrastructure, as it's often the case that demand outpaces supply," she says.

Indeed, Saunders points out that only a quarter of the PET and HDPE bottles manufactured in the U.S. today are being recycled. As recycling plants "starve for material," the rest of this potential feedstock is going to landfills. Saunders contends that it's up to municipalities like New York City and San Francisco to better advertise their programs and more fully engage the public. "There is not enough scrap material being collected," he says. ■

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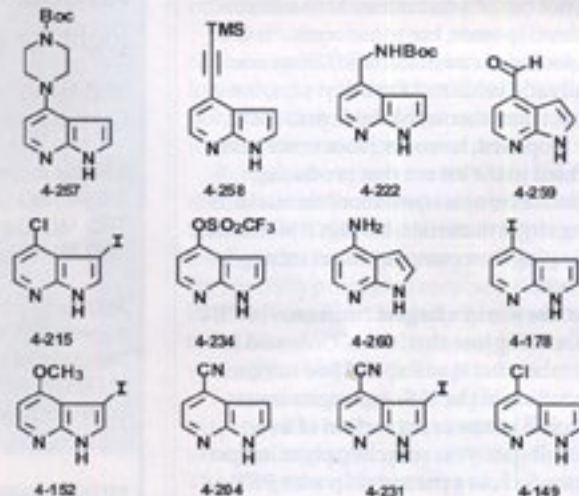
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