Bikes, bowling balls, and the delicate balancing act that is modern recycling



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Video by Jennifer Hahn.

> ***Update**: It's New Year's eve and Ars staffers are enjoying a winter break (inevitably filled with some joy rides and whatever that choose-your-own Black Mirror thing is). As such, we're resurfacing a few favorites from the site archives appropriate for the occasion—like this tour of a facility that will inevitably be busy post-holidays. Our story on the Sims Municipal Recycling Center originally ran on December 7, 2015, and it appears unchanged below.*

BROOKLYN, New York—A conveyor belt is keeping material flying past at speeds that require both concentration and rapid eye movement if you wanted to track a single item. Above the constant roar of all the heavy equipment, it's just possible to make out the brief hissing of jets of high-pressure air. Those jets are produced where the conveyor belt ends, and most

of the material plunges onto a second belt below. Each hiss, however, causes a carefully chosen item to leap off the end of the belt and soar into a different collection area, where yet another conveyor belt takes it on its way.

The process of carefully choosing which items to sift out is all done without human intervention. It’s based on how that object reflects light that’s outside the range of human vision.

All this is happening within just one of a dozen stations inside a modern recycling center, each of which isolates a single class of materials based on their physical properties. Over the last several decades, recycling has gone from a manual process to an extremely automated one, where things like infrared sensors and small jets of air mix with massive front-end loaders and enormous material balers.

A lot of technological innovation has gone into figuring out how to take a chaotic mix of items and separate it into relatively pure streams of materials. But being able to do so isn’t enough—it has to be made into a sustainable business. So today, a lot of the innovation that is taking place in the recycling industry must dually focus on the economics.

Large-scale materials science

Recycled materials are only valuable if they’re pure—a collection of a single type of metal or plastic that can serve as a feedstock for manufacturing or other industrial processes. The economics of recycling would actually be spectacular if you could get people to separate out a dozen individual classes of recyclables and then deliver them to a recycling center.

Unfortunately, there’d be almost no recycled materials then, since almost nobody would put in the effort to do all the sorting and carting. In fact, sorting recyclables into

anything more than one or two separate streams causes the recycling rate to plunge. Single-stream recycling has a big advantage in transportation terms, as well. When trucks aren't required to have spaces dedicated to individual recyclables, they're more likely to end up completely filled before they bring the material to its destination.

That pushes the problem of separating out pure materials to the recycling center itself. Here again, economics limits the choices: the more people involved in carefully distinguishing each type of recyclable, the more expensive the process. For recycling, automation is key. But how can a machine distinguish different types of material and separate each of them out?

The answer is that no one machine can. Instead, a combination of hardware is used with different machines separating out specific classes of material. To get the technical details on how all of these machines operate, we visited each type of hardware at the Sims Municipal Recycling center in Brooklyn and had Eadaoin Quinn explain the process to us.

Smash and grab

As barges and trucks arrive at the facility, the material (often still in its clear bags) is dumped as a single stream onto a large conveyor. It's quickly divided into two streams; having two parallel tracks allows the facility to continue operating even if key pieces of hardware are down for maintenance, Quinn told Ars. Typically, the site is in operation for two eight-hour shifts a day.

The first material to go is glass. Lots of it gets broken during transport; large asymmetric steel rollers break down the rest into small pieces. These simply fall through the cracks and are collected below. The rest of the material is too large and continues on its way. Sims can separate out clear glass for reuse; any colored material is typically used

as construction fill.

The next station uses a huge rotating magnet to pull out any ferrous metals, which range from tin cans (which have very little tin) to car parts. The problem here is that some of the metal may be buried under other recyclables that weigh more than the magnet can lift. To overcome this, the magnetic drum is located above a conveyor that's on a vibrating platform. The vibrations give everything in the recycling stream a small boost toward the magnet, allowing it to latch on to the metal.

The vibrating platform is large and heavy enough that it physically shakes the whole facility, and it accounts for a lot of the noise.

Everything that's not attracted to the magnet falls off the conveyor and onto a second one below, moving on into the facility. The rotating drum is set up so its magnetic strength drops on the far side of the platform of its rotation, allowing the metals to drop off into a separate conveyor.

It's not 100 percent effective—Quinn says you'll often see the metal hangers of a city that runs on dry cleaning hook into a plastic bag and carry it off among the metals. But it's a *lot* better than where things started.

Other metals are sorted by a similar machine. Materials like aluminum aren't natively attracted to magnets, so the hardware uses an electric field to induce enough of an attraction for them to latch on to the drum. Again, most other materials fall immediately off the end of the conveyor and drop onto a new one below; the drum lifts all the remaining metals across to a separate conveyor.

Listing image by John Timmer

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