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# A COMMON THEME

**IS SINGLE-STREAM RECYCLING SERVICE THE SALVATION OF ALL RECYCLING PROGRAMS OR IS THERE A BETTER WAY FORWARD? OUR AUTHOR DIGS INTO THE UNTOLD STORY OF REAL RESIDUE RATES AND A PREFERABLE METHOD TO TRULY RECYCLE MORE MATERIALS AT MATERIALS RECOVERY FACILITIES.**

BY SUSAN COLLINS

The importance of preserving material quality and avoiding cross-contamination has become a common theme in many recent technical reports on recycling. Indeed, the Container Recycling Institute's (CRI) website features over a dozen reports and articles about the issue of quality problems with single-stream recycling collection and processing. Unfortunately, there is widespread confusion about what losses in materials mean. Most studies rely on the materials recovery facility (MRF) residue rate, without quantitative consideration of additional losses that occur post-MRF. As the data in this article show, the additional losses after materials leave the MRF can be up to twice as large as the MRF residue rate. With an overall loss rate of 22 to 27 percent by weight, single-stream recycling is a system that is far from optimal.

*In the average single-stream collection program, if you collect 100 tons of recyclables at the curb, 73 to 78 tons will actually be recycled into new products, and most of the rest will be landfilled.*

There are existing systems in different parts of the world that use multiple streams of collection in order to maximize tonnage recovered, while delivering high-quality recyclables.

As we seek new policies to increase recycling rates, we need to start reporting what is *actually* recycled, not just what is *collected* for recycling. Collection and processing methods have changed dramatically in the last two decades, but reporting mechanisms haven't evolved to capture new recycling rate information correctly. Process losses occur at the MRF when contaminants are removed, and even greater levels of contamination are removed when materials arrive at paper mills, plastics reclaimers and other materials processing facilities.

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## Continuation of CRI's single-stream research

In the 2009 report, *Understanding the economic and environmental impacts of single-stream recycling*, CRI detailed the contamination rates and yield losses for specific recyclables, but at that time, there was not enough data to create an overall yield loss number for all recyclables

collected through single-stream curbside recycling. A key element that was missing was the average composition of single-stream residential recyclables. *Resource Recycling* released the results of their first annual survey of materials recovery facility (MRF) operators in the Jan. 2011 issue, and the results included the composition of recyclables at MRFs.

## Moving materials at MRFs

*Resource Recycling* received survey responses from 200 MRF managers of large and small facilities in 44 states. Some facilities were dual-stream, some single-stream. A few used mixed waste processing. The source of materials varied, from residential to commercial, to a mix of both. Incoming material types varied as well, with some facilities excluding such materials as glass, Nos. 3-7 plastics or other categories.

For this project, we selected all of the facilities that both processed all residential recyclables from single-stream collection, and were from states without a container deposit program. There were eight facilities that met these criteria located in eight different states. The average composition of the materials sorted by these MRFs is indicated in Table 1, with the majority of the material stream being paper. Note that the residual rate for these selected facilities, eight percent, is lower than the average residual rate of 10 percent for the entire list of facilities surveyed. Also, due to a lack of data about the contamination rate for "other" recyclables, we assumed, for the sake of these calculations, that there was no contamination. This is an unlikely scenario – therefore, the overall contamination calculation would likely be higher than that shown in Table 1.

## Averages and ranges

The data are presented here as averages and ranges. There isn't a single, specific number that represents the total yield loss from single-stream collection. Brokers, mills and processors will nearly always say "it depends on the MRF" when asked about quality and percent contamination. Brokers often go on to say that they have some single-stream MRF clients that produce lower levels of contamination than source-separated programs. The variation is due to different program parameters, such as types of materials accepted, type and frequency of public education, pay-as-you-throw or incentive-based programs, versus unlimited service, as well as the demographics of each community. All of these factors affect the percent residuals that will be received by the MRF due to improper sorting by residents. Therefore, if you want to know the quality and contamination levels achieved by a certain program, consult the documentation specific to that program.

It is important to understand that some of these losses are due to the collection and sorting method, while other losses are consistent across all collection methods. There will be unavoidable losses from processing even the cleanest materials. Some "contaminants" are attached to the recyclable, such as polypropylene caps on most PET bottles, or metal caps on glass bottles. We have explained the nature of the losses in the description for each material type.

## PET yield loss

Like paper mills, PET reclaimers carefully measure yield loss for different sources of materials. Yield loss measurement is critical to their financial health – they must know how much material they will be able to sell after cleaning and processing incoming bales. These reclaimers must also know how much the cleaning process will cost and the amount of material they will need to landfill.

Some of the yield loss in PET bottles is naturally attached to the bottle, such as caps, labels and adhesives, which, collectively, make up approximately 13 percent of the weight of PET bottles (note that this number varies from bottle to bottle, because bottle designs are so different). Many of the caps are polypropylene, and they are often removed and recycled, but the labels and adhesives are generally disposed of. Other contaminants may be "look-alike" bottles that were mistakenly added to the PET bale, but are a different resin type, and so they must be separated before the bottles are recycled.

The yield loss for PET is used as a proxy for all plastics in Table 1, but this may overstate yield losses for all plastics. The bale yield loss rate for "all bottles" was significantly lower (22.1 percent in 2009) than the yield loss rate for PET bottles (32.2 percent for 2010), but 2010 "all-bottle" data are not available. PET bottles make up more than half of all bottles recovered in the U.S., by weight, according to 2009 data from the American Chemistry Council (ACC).

If recycling rates are reported without removing yield loss from the contamination, it can lead to inflated recycling rates and double-counting. For example, when the polypropylene caps are recycled, the weight of those caps is counted in the polypropylene recycling rate. The labels, adhesives and other contaminants are disposed of, but their weight has already been counted as "recycling" in the annual National Association for PET Container Resources (NAPCOR) and Association of Postconsumer Plastic Recyclers (APR) report. For these reasons, the U.S. Environmental Protection Agency has recently adjusted its calculation

**Table 1 | Losses through single-stream recycling in states without container deposit programs**

| | Composition per 100 tons, as sorted at the MRF (%) | Percent loss at secondary processing facility | Remaining amount that is actually recycled (%) |
|---|---|---|---|
| Glass | 17 | 21 to 40 | 10.2 to 13.43 |
| Paper | 55 | 15 to 18 | 45.1 to 46.75 |
| Plastic | 10 | 32.2 | 6.78 |
| Steel | 4 | 0 | 4 |
| Aluminum | 3 | 2 to 11 | 2.67 to 2.94 |
| Other (recyclables) | 4 | unknown | 4 |
| Residual | 8 | 100 | 0 |
| TOTAL | 101 | 22.10 to 27.255 | 72.75 to 77.90 |

Note: total adds to 101, due to rounding.
Source: Container Recycling Institute, 2012

of the PET recycling rate to include only the amount of PET that is actually recycled, and to exclude contaminants, other materials and yield losses.

## Plastics

In 2009, *Plastics News* conducted a survey of HDPE and PET reclaimers, and the results indicated that yields in 2009 were 10 points lower than in 2007. The NAPCOR/APR *2010 Report on Post-Consumer PET Container Recycling Activity* has detailed information about yield losses, noting in 2010, "U.S. reclaimers reported yield losses ranging from 24.4 percent for deposit bottles to 32.2 percent for curbside material," which is an increase of about seven percentage points from 2009.

For non-bottle rigid plastic recycling, similar contamination issues exist, and they are also a threat to the plastics recycling industry and the jobs they create. As the ACC reported in its *2009 United States National Post-Consumer Plastics Bottle Recycling Report*, "This lack of adherence to quality standards is a significant barrier to developing more domestic reclamation capacity."

## Paper

In CRI's 2009 report, *Understanding economic and environmental impacts of single-stream collection systems*, we found that paper mills that receive materials from single-stream MRFs have contamination rates that are as high as 18 percent. Individual interviews with several paper mills indicate an average contamination rate of 15 percent, but these mills are all in regions that have container deposit programs, which remove most of the glass and much of the plastic from the curbside stream.

## Aluminum

An interview with the largest aluminum recycler, cited in the 2009 CRI single-stream report, give us the average contamination rate range of 2 to 11 percent. Like other materials, aluminum recyclers report that contamination rates are increasing, and that they have made additional investments in pre-treatment facilities to improve material quality. Contamination in aluminum is not merely inconvenient – there can be serious consequences. For decades, the aluminum industry has fervently warned against the inclusion of plastics in the aluminum stream because of safety concerns in processing and melting.

## Glass

It is important to know the breakdown of the amount of glass that is recycled for use as cullet to make glass bottles or fiberglass, versus the amount of glass that is used for aggregate or landfill daily cover. Recycling tonnages are often used in calculations of energy savings, greenhouse gas and other emission savings, and job creation, and there is a potential to overstate these environmental and economic benefits if the use of the glass is misunderstood.

Data from a dozen glass processing (beneficiation) facilities indicate that 60 percent of glass coming from single-stream programs is useable for making glass bottles or fiberglass. Another 19 percent is undersize material, some of which can be used as road base or landfill daily cover, and 21 percent is a combination of non-glass residue and undersize material, which is not useable and is sent directly to landfill.

In contrast, 90 percent of glass from dual-stream programs can be recycled into containers and fiberglass, with the remaining 10 percent being glass fines used for low-end applications. Glass from container deposit programs is color-sorted, resulting in 98 percent being recycled and only 2 percent marketed as glass fines.

## Alternatives to single-stream collection

Multi-stream collection is the norm in European countries such as Germany and Belgium, where municipalities collect all glass separately in neighborhood drop-off igloos, while paper and paperboard are collected separately from containers and packaging. European glass recycling rates reached 67 percent in 2009, around twice the U.S. glass recycling rate.

In addition to accepting glass in its curbside recycling program, the City of Fort Collins, Colorado encourages residents to use glass-only drop-off bins to ensure that 100-percent of the glass can be used to make new glass bottles.

Mark Bowers, of Sunnyvale, California, reports that his community has provided dual-stream collection, using split carts, for over a decade. Mr. Bowers concludes that, "Based on our data compared to data from single-stream conversions, it is clearly the cart, not the ability to put all of one's recyclables in one container, that spurs the increase in recycling when people switch to carts and (coincidentally) single-stream. That is, you get the same participation boost by going to carts and dual stream. At the same time, processing capital and operating costs are lower and you maintain the value of the fibers by keeping them separate from the other materials."

The City of Auburn, Maine had implemented a single-stream recycling program, but decided to convert the program to a dual-stream collection program, in order to preserve material quality. A 2011 report by the Waste & Resources Action Programme in the U.K. goes a step farther, and recommends curbside sorting of materials, to preserve maximum quality.

Daniel Lantz, of Cascades Recovery Inc., reports that the City of Ottawa conducted a survey of the public and, in response, they chose to retain their dual-stream collection system, relying on alternating week collection to provide the same cost savings as single-stream.

## Conclusion

While there have been many debates about the merits of single-stream versus dual-stream recycling, they have occurred in the absence of complete data on the total losses that occur as a result of single-stream collection systems. This article attempts to quantify the amount that is *actually* recycled as a result of single-stream collection, which provides a correction to the previous error in the calculations of recycling rates and recycling tonnages. However, there is much more work to be done to correct cost-per-ton calculations and convert to cost-per-ton-recycled, as well as to research best practices for dual- or multi-stream collection that achieve the best possible cost efficiencies. With better data, we can make better decisions. RR

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