MOORE
& Associates

White Paper: The State of Paper Cup Recycling

January 27, 2022

1. The Evolution of Paper Cup Recovery Efforts

Residential Paper Cup Recycling in the US

In 2011 the Foodservice Packaging Institute (FPI) formed an alliance of restaurant and foodservice packaging industry leaders to investigate how paper-based single-use foodservice packaging could become more widely recycled. A series of studies indicated that at least half the packaging generated by foodservice locations makes its way back to the home. In the case of paper cups, sources suggest that as much as 70% leave the store.[1] The Paper Recovery Alliance (PRA) was formed with the initial task of benchmarking the types of paper cups in use, where cups are used, and where cups end up at 'end-of-life'. If most single-use cups are taken to home or work, cup collection at the store will have limited impact. The PRA determined that the best opportunity for paper cup recovery efforts would be through existing residential recycling programs, whether curbside or drop-off.

FPI's research showed that paper cups were treated differently than other types of paper foodservice packaging in residential recycling programs. While pizza boxes, paper bags, and molded fiber trays were generally accepted by most recycling programs, paper cups were usually explicitly excluded. Emmet County, Michigan started an initiative to collect and recycle cups in 2009, becoming the first location in the US to do so.

Emmet County provides a unique example of several key elements coming together at the right time. The county started by identifying end markets first. The local Materials Recovery Facility (MRF) was already sorting polycoated aseptic and gabletop cartons and marketing these to a tissue-producing mill in a nearby county. After discussion with the county, the mill agreed to experiment and try using cups along with the cartons. In order to get the community involved, the county developed educational materials about cups and added these to grocery store shelves where aseptic and gabletop cartons were sold. A local artist developed a series of sculptures composed of recycled materials that were available on request for public and private events, creating substantial word-of-mouth publicity that paper cups could now be recycled. Emmet County was initially hesitant to add cups to local programs because of limited space at the MRF, but ultimately interest from the purchasing mill provided enough encouragement to continue. The county now collects cups through residential curbside, business curbside, schools, and special events.[2]

Other early adopter cities such as Seattle and New York City followed suit, introducing paper cups into residential recycling in the 2010-14 period.[3] San Francisco added cups to residential recycling programs in 2017.[4]

FPI continued to improve understanding of the potential for paper cup recovery from the residential stream by conducting a variety of studies on contamination, MRF material flow, and bale composition. With the additional knowledge generated, it was evident that paper cups could be a viable target for recovery through residential recycling programs. FPI understood that identifying end markets for recovered cups was the first step and began discussion with mills across the US to explore their ability to process paper cups.

With end markets under development, the next step was to expand 'supply.' FPI developed a program called Community Partnerships that engages local communities, encouraging them to include foodservice packaging in curbside recycling. The program will help communities:

- Conduct outreach to stakeholders such as MRFs, waste haulers, and end market buyers;
- Collect data on recycling stream composition and other metrics; and
- Develop communications and messaging to complement education and outreach done by the community.

Communities are also eligible for grants to assist with resident education on the additions to the program, as well as reducing contamination. This program indirectly benefits local MRFs that receive materials from the curbside programs, and ultimately end market buyers.[5]

Since 2017, FPI's Community Partnerships program has added paper cups to curbside recycling programs for approximately four million households, in the following locations:

- Washington, D.C. (launched 2017)
- Louisville, KY (launched 2017)
- Chattanooga, TN (launched 2017)
- Denver, CO (launched 2018)
- Sioux Falls, SD (launched 2019)
- Clark County, IN (launched 2019)
- Kent County, MI (launched 2020)
- St. Lucie County, FL (launched 2020)
- Athens-Clarke County, GA (launched 2020)
- Lansing, MI (launched 2021)
- East Lansing, MI (launched 2021)
- Atlanta, GA (launched 2021)
- Dekalb County, GA (launched 2021)
- Detroit, MI and surrounding metro area (launched 2021)
- Madison, WI (launched 2021)

Successful Community Partnership programs have developed a knowledge base that is used to support new programs in other communities. Active programs share insights on communications campaign development, data collection, reducing contamination, and the like as new communities incorporate paper cups into their curbside recycling programs.[6]

Residential Paper Cup Recycling in Canada

Ontario, the largest province in Canada (40% of total population) was home to one of the first curbside recycling programs in North America, the Blue Box program, launched in 1981. Since 2002, recycling in Ontario has been based on a stewardship approach where the cost of recycling programs is a shared between producers and municipalities.[7] Municipalities are required to accept a shortlist of recyclables but can also add items of their choice, which has led municipal programs that vary widely across the province. For example, while the City of Toronto did not accept paper cups in September of 2021, the cities of London and Waterloo did.[8]

In June 2021 Ontario finalized legislation to implement a full Extended Producer Responsibility (EPR) program that will bring a number of changes to recycling in Ontario. It will standardize the items collected across the province; provide recycling in small communities and rural areas that have not had access to date; and will expand the types of buildings to be served by recycling programs (to include multi-family and retirement residential, schools, and public areas). Items accepted will be expanded to include many

single-use foodservice items such as paper cups, paper plates, stir sticks, and the like. The transition to the new program will start with select municipalities in 2023 and is expected to be complete by 2025.[9,10]

The province of British Columbia was the first in Canada to initiate a full EPR program in 2014. This led to the addition of many types of packaging to curbside recycling, and programs were made consistent across all jurisdictions in the province. As a result, polycoat items such as paper cups and aseptic and gabletop cartons have all been accepted in curbside, multi-family, and drop-off locations for some time.[11]

Commercial Paper Cup Recycling

Starbucks, the US's second largest quick-serve chain, may have been the first to start thinking about how to make single-serve beverage cups more sustainable. As early as 2006, Starbucks began working with the US Food & Drug Administration (FDA) to allow 10% post-consumer recycled fiber in food contact paper cups. Between 2009 and 2011, Starbucks held several large "Cup Summit" symposiums to generate new ideas and initiate change, in order to meet an internal goal that all of Starbucks cups should be reusable or recyclable by 2015. The symposiums included representatives from all parts of the paper and plastic cup value chain, from municipalities and raw material suppliers through cup manufacturers, and retail and beverage businesses.[12]

At that time, Starbucks implemented in-store recycling in 18 markets and initiated three recycling pilot programs across the country. Starbucks tested the compatibility of post-consumer cups in paper recycling operations at a number of paper mills and demonstrated that used paper cups can be recycled into new paper cups. Eventually, collection efforts from stores were discontinued, however, as contamination was a significant problem and costs were higher than expected. At this point, Starbucks publicly supported FPI's activity in paper cup recycling and encouraged other foodservice organizations to get involved via FPI. Starbucks then began to invest in a broader approach to recycling, focusing on all foodservice packaging including cups, and committed to rolling the program out in stores across North America.[13]

The buzz generated by Starbucks activity during this period encouraged other organizations to take action. In 2010 Green USA's 'Coalition for Resource Recovery' (CoRR) began a pilot project in Manhattan with the objective of recycling paper cups and fast food packaging. CoRR collaborated with the Pratt Institute and The New School, collecting foodservice packaging from The New School's café and paper hot beverage cups from seven Starbucks' stores in Manhattan. The educational institution designed collection bins and implemented consumer education in the form of posters and tabletop signage. While this effort did not progress beyond the pilot project, it did generate valuable learning regarding the technical aspects of repulping and recycling paper cups due to the volume of material that was collected.[14]

Canada's largest coffee chain, Tim Hortons, tried an alternative approach to paper cup recycling in 2011. Using Nova Scotia as a test region, Tim Hortons began to collect paper cups at over 150 stores in the province. A partnership was developed with a regional molded fiber producer that tested methods to turn paper cups into molded fiber take-out trays. The "Cup-to-Tray" program had some success in the region and Tim Hortons became the first quick-service restaurant in Canada to 'close the loop' and recycle used cups into another product.[15] Since that time, Tim Hortons has implemented a number of other initiatives to collect and divert cups from restaurants across the country.

Early efforts at commercial recycling of paper cups were well received by consumers at the time. Though many did not survive long term, the ground work was laid for more recent advances. In December 2018, a Denver-area hauler and MRF operator announced they would begin accepting cups generated by coffee shop customers in the area in the commercial recycling stream.

In early 2020, the City of Vancouver, Canada initiated a pilot study in which coffee cups are collected in specially designed bins in commercial buildings in downtown Vancouver. The pilot is part of an existing recycling program in BC called 'Return-It' that recovers 12 types of beverage containers, along with a range of other hard-to-recycle products.[16] The pilot has been on hold as a result of the

pandemic, but the city plans to relaunch the program in the spring of 2022.[17]

Currently most global foodservice organizations, including many FPI members, are actively working to reduce waste and improve the sustainability of single-use packaging. The current packaging sustainability goals of several of the largest US foodservice organizations are outlined in more detail below.

2. Processing Cups at the Materials Recovery Facility (MRF)

Recovered Paper Grades and Cups

The vast majority of paper cups on the US market are made from solid bleached sulfate (SBS) white paperboard fibers with a polyethylene (PE) coating. Wax coated cups are virtually extinct and while new types of coatings that may be more readily recycled by mills are starting to emerge, market penetration of the new coatings is very low in the US (coatings are discussed in more detail below).[18]

Post-consumer cups may be found in several of ISRI's (Institute of Scrap Recycling Industries) standard grade designations, including:[19]

- #37 Sorted Office Paper (SOP)
- #52 Aseptic Packaging and Gabletop Cartons (Cartons)
- #54 Mixed Paper (specifically Residential Mixed Paper (RMP))
- #56 Sorted Residential Paper & News (SRPN)

Comparison of the annual ***production volume*** of each of these grades in the US in 2020, relative to cups, shows the following:[20]

- #54 Residential Mixed Paper 4,055,000 tons
- #37 SOP 2,555,000 tons
- #56 SRPN 1,961,000 tons
- #52 Cartons 630,000 tons
- Post-Consumer Cups 683,000 tons

After collection in the residential recycling stream, used cups, cartons, and other paper products are transferred for sorting at a MRF (Materials Recovery Facility). The easiest pathway for cups to follow at the MRF is through the paper line to the Mixed Paper grade. The vast majority of MRFs that accept cups pack them in Mixed Paper, although small quantities may end up in SOP or SRPN. Anecdotally, at least one MRF has occasionally directed cups to SOP bales. A few MRFs pack a carton bale which, when cups are included, becomes described as a 'mill specific polycoat' bale, a bale that is not standard, but specific to a particular mill end-user.[21]

Since 2018, a number of larger mill companies that do not buy grade #52 Cartons have announced they will accept cups in Mixed Paper. Among the small number of US and Canadian mills that buy cartons, several have indicated that they will accept cups in the carton bale. In effect, cups are similar to other paper-based polycoated food packaging such as ice cream tubs and frozen food boxes in that they are a good source of high quality SBS for mills, when the mills can handle the poly coating. It is possible that in future, a 'polycoated paperboard packaging' grade could be developed and paper cups could be included in that grade.[22]

Flow of Paper Cups through the MRF

When a MRF is interested in adding a new item such as paper cups to its list of explicitly accepted materials, there are a number of issues to consider. A successful cup recovery effort will have at least 3 elements. First, demand from an end market buyer for the targeted paper grade must be assured.

Second, in order to maximize potential volume, the MRF needs to partner with the local municipality and provide public education to develop awareness about the opportunity to recycle a new item such as cups through residential programs. Finally, the MRF must anticipate how the new item will flow through sorting operations to become part of a recovered paper grade, taking size and shape of the targeted material into account as well.[23]

In the past, conventional wisdom held that when cups were 'sorted' at the MRF, flattened cups would remain in the paper stream while 3-dimensional cups would flow to the container line. Numerous flow studies have now shown that while paper cups may move through the MRF in different ways, the vast majority of cups actually flow to the container line. Percentages vary with MRF practices and equipment, but recent studies have shown that typically around 70% to 90% of 3-dimensional cups flow to the container line, while around 60% to 80% of flattened cups do so.[24]

The destination success rate is influenced by the fiber/fines screening technology in place at the MRF, but size and weight of the cup may be more important than whether it is 3-dimensional. Once a cup is on the container line, it can easily be identified and sorted to be included in mixed paper, cartons, or other paper grades. Alternatively, cups can be intercepted along with other fiber on the container line and redirected to the paper line.

MRFs have begun to invest in optical sorting and robotics in order to improve their ability to sort paper cups, foodservice packaging, and other smaller volume types of paper packaging. Technology investment has been gradual to date, and primarily focused on optical sorting, due to low Mixed Paper prices at this time and the need to develop end markets that accept polycoated paper packaging such as cups. With much improved prices for Mixed Paper (and Old Corrugated Containers) in 2021, growing investment in optical sorting as well as robotics is expected.

In Mixed Paper, cups account for a small percentage of the bale, typically less than 0.5% of the bale by weight. To decrease the number of cups going into Mixed Paper, a handful of MRFs have decided to positively sort cups by picking them from the fiber and/or container line and re-directing them into the carton bunker. Cups that are positively sorted into a carton bale will typically account for 10% to 25% of the bale of combined polycoated paperboards.[25]

Challenges in Paper Cup Recycling

As with all recovered paper grades, a higher quality bale improves value and marketability. In the past, many MRFs were opposed to accepting cups and other foodservice materials due to concern about food contamination. More recent observation has shown that by the time the cup makes it to the MRF, liquids are usually gone. Cups may be accompanied by plastic lids, straws and stir sticks, but plastic components are also present on other types of paper packaging. MRFs have improved processes to remove more plastic from the paper stream, and mills are able to handle the small volume of such plastic items in recovered paper.[26]

In most of the US, the decision on what to include in curbside recycling is up to local municipalities. As manufacturers and legislators look to improve sustainability in packaging and expand recycling of small volume package types, these policies are expected to evolve over time in favor of including cups and other polycoated packaging in curbside recycling. A few states in the Northeast, such as Massachusetts, Rhode Island, and Connecticut, have recycling guidelines that do not include cups and other polycoated paper packaging (such as aseptic and gabletop cartons) on the list of mandatory materials that must be collected in curbside recycling. Municipalities ultimately make the final decision however. Many encourage recycling of other items such as cartons, #3 through #7 plastic containers, telephone books, textiles, and discarded mail.[27]

MRFs may generate cups from commercial or residential sources: some combine the streams for sorting while others sort the streams separately. Either way, the volume of cups is low enough that MRFs are unable to measure the volume of cups from either source, or attach a cost to sorting and baling cups specifically. MRFs with greater volumes of cups may sort cups as a separate grade or as part of a carton/cup bale. Ultimately, which grade to target is a business decision made by the individual MRF. When there is a positive business case, MRFs may aggregate cups and sell as a higher-value grade. [28]

3. Technical Considerations in Paper Cup Recycling

SBS fibers are among the highest quality paper materials available for recycling. As recovery rates for all paper grades continue to rise in the US, while supply declines, cups could be an excellent additional source of high-quality fibers for the paper industry. In particular, as the supply of printing and writing paper declines, reducing supply of recovered paper for tissue mills, demand for fiber from cups in Tissue & Towel production will likely increase.[29, 30]

Cup Construction – Coatings

There are two types of paper cups with PE coating: 'poly 1-side' cups have the poly coating applied only to the inside of the cup only and 'poly 2-side' cups have the coating is applied on both sides of the paper substrate before it is made into a cup or container. Poly 1-side cups are typically used for hot beverages. Poly 2-side cups are often used for cold beverages so that the coating on the outside of the cup prevents condensation from softening the cup wall during use. The vast majority of paper cups are poly 1-side cups used for hot beverages. Hot cups are typically made using a PE coating because it can withstand high temperatures without breaking down.

The challenge for mills in using cups and other polycoated paper packaging has always been the time required in the hydro-pulper to remove the paper fiber from the poly layer. A poly 1-side paper cup requires considerably less time for separationfrom the fiber and creates less waste in the pulping process in comparison to a poly 2-side cup.[31]

Innovation in Cup Coatings and Materials

With the growing importance of sustainability in packaging, the pace of innovation in all types of packaging is increasing. In an effort to produce a more sustainable 'to-go' cup, many alternative types of cup materials and barrier coatings have emerged. In 2018, Closed Loop Partners initiated a competition, the Next Generation Cup Challenge, to accelerate the process of cup innovation. By early 2019, 28 candidates with innovative cup ideas had been selected and 12 winners were announced. Of the 12 winning designs, 3 companies proposed reusable cup systems and several in Europe offered new bio-degradable, plant-based materials for cup construction. One of the US winners produces cups and other foodservice packaging made from molded fiber. The remaining participants proposed alternative barrier coatings to PE that are more easily recyclable and/or compostable.[32]

The most common alternatives to PE coatings are polylactic acid (PLA) and water-based aqueous coatings. PLA is a 'bioplastic' made from plant-based materials such as sugar, corn starch, cassava, sugar cane, and sugar beet. When selected as a cup coating, the rationale is usually that it is derived from renewable biomass, not fossil fuels, and may be compostable and/or biodegradable. Yet recycling is a higher and better use than composting because the long fibers in the cup are recycled and used in a new product.

Aqueous coatings, or water-dispersed emulsion polymer coatings, can be used when the barrier layer does not require structural integrity on its own. Aqueous coatings are easier for mills to repulp and recycle than PE coatings because water is part of the paper-making process.[33] US packaging producers continue to develop new substrate materials and coatings for cups and other foodservice packaging that are marketed as more sustainable and environmentally-friendly. However, market penetration is likely still very low as no data appears to be available to measure this trend.

4. End Markets for Recovered Cups

End Markets in North America

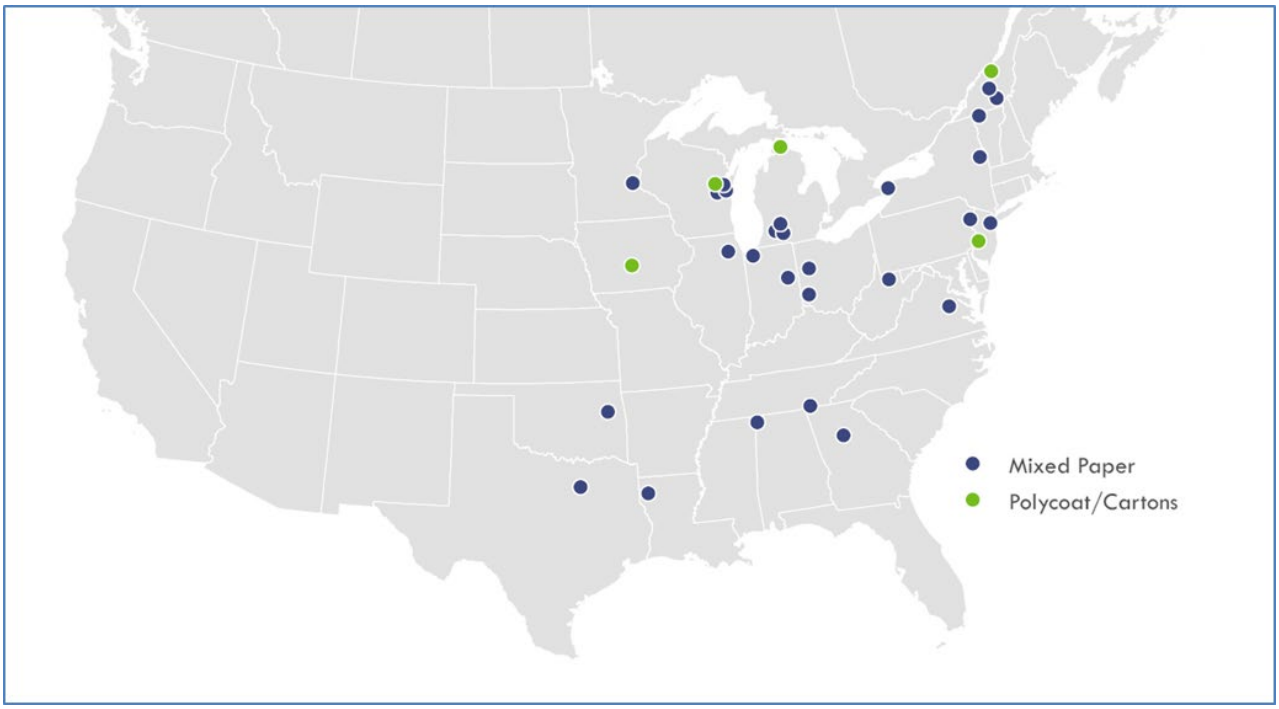
The end market mills accepting paper cups include producers of:

- Tissue and towel products
- Recycled paperboard (food and other goods packaging)

- Containerboard (for brown corrugated boxes)
- Recycled market pulp

Prior to 2018, very few North American mills explicitly accepted cups in Mixed Paper. Given FPI's long-standing focus on developing domestic end markets for foodservice packaging, it engaged in several years of outreach and dialog with US mills and provided data and material to mills for testing. Numerous mill trials were conducted. As a result of FPI's efforts, individual mill commitments, and the growing interest across the value chain in more 'circular' packaging alternatives, paper cups are currently accepted at 31 North American mills that consume Mixed Paper bales, and 5 domestic end markets that consume polycoated bales. (see Figure 1 below)

Figure 1: End Markets for Paper Cups in North America, 2022



Source: FPI, 2021

In December 2021, a group of prominent paper mill companies that buy recovered paper signed a "declaration of acceptance" and announced their commitment to increasing the recycling of paper cups. The companies involved include Essity, Georgia Pacific, Graphic Packaging International, Great Lakes Tissue Company, ND Paper, Pratt Industries, Sustana Fiber, and WestRock. This group accounts for 75% of Mixed Paper demand in the US and Canada and represents 31 paper mills that now actively accept cups in Mixed Paper. Senior executives acknowledge that cups provide high quality fiber.[34]

Appendix A provides several case studies of mills that accept paper cups, describing the volume of material processed and the grades that cups go into. Appendix B contains a list of mills that accept paper cups, and indicates the relevant recovered paper grades for cups. As is the case with all recovered materials, it is necessary to check with mills within the shipping range of any specific MRF in order to determine the status of paper cup acceptance at any point in time.

As is typical for all recovered paper grades, the larger the quantity of material a MRF produces on a

regular basis,the more interested mills will be in the material. This is an area where brokers can be very useful as they frequently accumulate recovered paper from multiple sources in order to ship larger quantities to mills. A list of brokers who deal in recovered paper grades that may contain paper cups is provided in Appendix C

Export Markets

Exports have always been an important part of the US market for recovered paper. In 2020 almost 34% of recovered paper collected in the US was exported to Mexico, Canada, Asia, and other parts of the world, down from 37% in 2019. Exports of recovered paper are declining overall, and Mixed Paper exports in particular are declining at a faster rate. In 2019, 39% of Mixed Paper was exported relative to the 37% for total recovered paper. In 2020, 34% of both total recovered paper and Mixed Paper are exported. This suggests the importance of developing US markets for Mixed Paper which includes polycoated paper packaging such as cups.[35]

Mexico and Asia are the most important export markets for recovered paper grades containing paper cups, with Korea, India, and Thailand the largest country buyers in Asia. Although the volume of Mixed Paper exported is still substantial, it is particularly important that exporters to Asia ensure the receiving country allows bales that contain post-consumer paper cups.

The primary use of recovered paper cup-containing grades in Asia is for tissue and towel, but in India they are used for printing and writing papers. In Mexico, the primary users are tissue mills, but some paperboard mills are exploring use of the grade.

Export of recovered paper is a specialized part of the paper recycling business and a large percentage of it is handled by export brokers. There are a number of export brokers that handle poly-coated paperboards and have expressed an interest in handling recovered paper cup grades. A list of these brokers and their contacts appear in Appendix C. Although none are headquartered on the west coast of the US, they all operate in that region as well as throughout the US. In addition to export, these companies are also domestic brokers that can be helpful with sales in the US.[36]

5. Looking Ahead

As consumers and activist groups pressure large chain restaurants and consumer packaged goods brands to make packaging more recyclable, there is growing interest and activity in paper cup recycling. Foodservice organizations, communities, and consumers alike have expectations that more types of single-use packaging should be recycled more often in future. The response from many restaurant brands and other foodservice operators has been to develop sustainability goals for the organization, in which packaging plays a major role. Sustainability goals relating to packaging, including cups, are shown below for some of the largest foodservice operators in the US:[37]

- ***McDonald's:*** Goal to source 100% of guest packaging from renewable, recycled or certified sources and to recycle guest packaging in 100% of McDonald's restaurants, by 2025.
- ***Starbucks:*** Working to reduce waste and promote reusability, Starbucks will be testing recyclable and compostable cups in select cities worldwide in 2022. Starbucks currently uses 10% post-consumer fiber in hot cups, as well as recycled content in paper shopping bags, napkins and cup sleeves.
- ***Restaurant Brands International (Tim Hortons, Burger King, Popeye's):*** Working with suppliers to innovate and reduce the use of packaging, transition to more sustainable materials, and help guests to reuse and recycle.
- ***Inspire Brands (Dunkin'):*** Majority of packaging currently has one or more sustainability attributes. 100% of packaging is recyclable where facilities exist, 30% of packaging is made with recycled content, 35% is compostable, and 30% is biodegradable.

- ***Delaware North (hospitality & foodservice management):*** Goal is to source 100% of single-use packaging products in the US from materials that are recyclable, renewable, compostable or contain post-consumer content, by 2025. Will prioritize products with environmentally sound certifications such as Forest Stewardship Council or Biodegradable Packaging Institute.

The impact of meeting the goals outlined on foodservice packaging is something that will develop and will be monitored over time. Another factor that has impacted recycling over the past two years is the pandemic. We know that residential waste collection volume has increased substantially since spring 2020 while commercial volume has declined due to the surge in 'working-from home' (WFH) among office workers. With more residents at home all day, and greater use of take-out restaurant meals vs. dine-in, the volume of foodservice packaging being disposed at home may well have increased. In addition, consumers may have heightened awareness if their curbside programs do not include foodservice and paper cup recycling.

The increase in WFH trend is expected to gradually diminish over the next year or two as workers return to the office, however, it seems likely that not all will return to the office. The percentage who continue to WFH will most likely stay higher than it was pre-pandemic, implying that volumes of residential waste will remain at higher levels than pre-pandemic. This suggests a potential increase in the volume of cups available from residential sources – unless home workers have switched from take-out beverages to making their own. No data is available yet to determine the impact of many factors on cups in the residential recycling stream, however, if WFH remains high, past estimates of cup residential recycling potential may need to be revised upwards. At the same time, when workers do begin to return to the office, the opportunity to discover the types of recovery processes that work best in restaurants and workplaces will open up.

6. Conclusions

While developing the processes needed to recycle paper cups from the curbside recycling has taken considerable time and research, FPI has now built a solid foundation and will continue to expand this initiative. In the last 2-3 years, significant progress has been made in adding cups to residential recycling programs, and identifying end-markets at mills. At least 20 residential curbside programs across the US, representing hundreds of communities, now explicitly accept cups. A total of 31 individual paper mills, plus 1 building product manufacturer, now accept cups. This suggests a significant opportunity to continue the expansion of cup recovery through residential recycling programs.

At the majority of MRFs, cups currently go into Mixed Paper bales, while a small number of MRFs do a positive sort into a carton and cup bale. The growth of optical sorting is helping to reduce the cost of positive sorting, but the most challenging issue at the MRF is the length of time it takes to build a bale, given the low volume of cups and similar material such as cartons. An opportunity to improve volume through development of a polycoated bale grade is apparent.

As the use of alternative barrier coatings to PE begins to expand, cups and other polycoated packaging will eventually become easier for mills to manage. Market share of alternative coatings for cups is too low for measurement in North America at present, but the growth of more easily recyclable coatings and cup materials in Europe suggests there is potential for widespread adoption in the long term.

APPENDIX A:

CASE STUDIES OF MRFs ACCEPTING CUPS

WestRock Recycling, Chattanooga, TN

End market: WestRock Chattanooga paper mill, who accepts paper cups in Mixed Paper bales

Plant size: Medium (4,000 to 7,500 tons per month range)

Paper grade sold: #54 Mixed Paper

Sorting method: Manual sorting on the paper line. Sorting paper cups and other SBS food service paper containers.

Residential / Commercial inbound material: 40% residential, 60% commercial, which is higher than normal on the commercial side. However, paper cups are primarily originating from the residential single stream program.

Other observations: Currently cup volume is not measured due to limited volume. Investment in sorting automation would be considered if the volume could increase to the 50 tons/month range.

WestRock Chattanooga is very unique, having the end market and processing facility located in the same city. This is a great example of how to start small and grow using the resources and synergies within a major paper company.

GFL – Alpine Recycling, Denver, CO

End market: Domestic paper mill

Plant size: Large (7,500 tons per month or more)

Residential / Commercial inbound material: 65% residential, 35% commercial. Paper cups are coming from their residential single stream program.

Paper grade sold: #52 Aseptic Packaging and Gable Top Cartons

Sorting method: Mechanical sorting using robotics through artificial intelligence

Other observations: GFL Denver avoids typical foodservice containers due to high contamination concerns, but does include aseptic packaging (Tetra Pak), clean ice cream cartons, and clean popcorn tubs.

Millennium Recycling, Sioux Falls, SD

End market: Domestic paper mill

Plant size: Small (2,000 to 4,000 tons per month)

Residential / Commercial inbound material: 65% residential, 35% commercial. Paper cups are coming primarily from their residential single stream program.

Paper grade sold: #54 Mixed Paper

Sorting method: Manual, leaving paper cups in the Mixed Paper stream. On the processing side, they leave any clean paperboard products including SBS cartons, paper cups, and plates in the Mixed Paper stream.

Other observations: Two critical components for the MRF's success were establishing a consistent sales market through WestRock's St. Paul, MN mill and working with the local Sioux Falls municipality to add paper cups to the recyclable material list. Adding paper cups to the Mixed Paper stream did not add cost to the MRF and was a simple and effective solution. Millennium Recycling is proactive in its resident communication, utilizing its website, blog, and social media. The MRF makes a commitment to ongoing education regarding acceptable recyclables, including paper cups.

APPENDIX B:

North American Paper Mills/Manufacturers that Accept Paper Cups

Paper Mills:

Cascades, Ashland, VA – Mixed Paper (opening in 2022)
Cascades, Niagara Falls, NY – Mixed Paper
Cascades, Kingley Falls, QC – Mixed Paper

Essity, Barton, AL – Mixed Paper
Essity, Menasha, WI – Mixed Paper
Essity, Middletown, OH – Mixed Paper
Essity, South Glens Falls, NY – Mixed Paper

Georgia-Pacific, Green Bay, WI – Mixed Paper
Georgia-Pacific, Muskogee, OK – Mixed Paper

Graphic Packaging International, Battle Creek, MI – Mixed Paper
Graphic Packaging International, East Angus, QC – Mixed Paper
Graphic Packaging International, Middletown, OH – Mixed Paper
Graphic Packaging International, Kalamazoo, MI – Mixed Paper

Great Lakes Tissue, Cheboygan, MI – together with Aseptic Packaging and Gable-Top Cartons

Green Bay Packaging, Green Bay, WI – Mixed Paper

ND Paper (sourcing via ACN), Fairmont, WV – Mixed Paper

Pratt, Conyers, GA – Mixed Paper
Pratt, Shreveport, LA – Mixed Paper
Pratt, Staten Island, NY – Mixed Paper
Pratt, Valparaiso, IN – Mixed Paper
Pratt, Wapakoneta, OH – Mixed Paper

Sustana (Breakey Fiber), Levis, QC – together with Aseptic Packaging and Gable-Top Cartons
Sustana (Fox River Fiber), DePere, WI – together with Aseptic Packaging and Gable-Top Cartons

WestRock, Aurora, IL – Mixed Paper
WestRock, Battle Creek, MI – Mixed Paper
WestRock, Chattanooga, TN – Mixed Paper
WestRock, Dallas, TX – Mixed Paper
WestRock, Eaton, IN – Mixed Paper
WestRock, Missisquoi, VT – Mixed Paper
WestRock, St. Paul, MN – Mixed Paper
WestRock, Stroudsburg, PA – Mixed Paper

Building Materials:

Continuus Materials, Des Moines, IA – together with Aseptic Packaging and Gable-Top Cartons

APPENDIX C:
Export Broker Contacts

Ekman Recycling Group
Wall Township, NJ
Brian Heckel
brian.heckel@ekmangroup.com
732-202-9500

Federal International
St. Louis, MO
Sam Still
samstill@federalinternational.com
314-721-3377

GP Recycling (Georgia Pacific)
Jericho, NY
Mike Belus
mike.belus@gapac.com
516-770-1030

The Paper Tigers, Inc.
Schaumburg, IL
Nick Halper, President
NHalper@papertigers.com
847-919-6500

Wilmington Paper
Pine Brook, NJ
Brett Lurie
BML@WPCRMS.com
973-445-2382

FOOTNOTES

[1] Amy Duquette, "Pros & Cons of Post-Consumer Cup Recycling Panel", *Paper & Plastics Recycling Conference*, Oct. 24, 2018

[2] Emmet County, personal communication

[3] Brenna Houck, "We're Buried in Starbucks Cups, What are They Doing About It?", *EaterDetroit*, March 28, 2018

[4] "Municipalities form partnership for beverage cup recycling efforts", *American Recycler*, January 2019

[5] FPI website: https://www.recyclefsp.org/community-partnership-program

[6] FPI, personal communication

[7] Jonathan Cocker & Denise Mertiri, "Full producer responsibility: Ontario releases final Blue Box regulation", *BLG law firm newsletter,* June 11, 2021,

[8] Websites for each city's recycling program, September 2021.

[9] Jeff Gray & Deborah Baic, "Ontario proposes recycling expansion as it hands system to private sector", *Globe & Mail*, October 19, 2020

[10] Alex Kamczyc, "Ontario announces rollout of full EPR legislation", *Recycling Today*, June 9, 2021

[11] *Recycle BC annual Report*, 2020

[12] Scott Seydel, "Starbucks' Cup Summit: Does the Cost of Recycling Runneth Over?", *GreenBiz*, May 15, 2009

[13] Chris McFarlane, Starbucks, personal communication, December 2021

[14] Anne Marie Mohan, "Pilot program tackles hot-beverage cup recycling", *Packaging World*, April 22, 2010

[15] https://company.timhortons.com//us/en/corporate/news-release.php?id=5847

[16] Deanne Toto, "British Columbia to pilot coffee cup recycling in commercial, public buildings", *Recycling Today*, February 7, 2020

[17] https://www.return-it.ca/about/coffeecuprecycling/

[18] https://en.wikipedia.org/wiki/Paper_cup

[19] https://www.isri.org/recycling-commodities-old/scrap-specifications-circular

[20] Moore *& Associates* internal database

[21] RRS

[22] Moore *& Associates*

[23] RRS

[24] RRS

[25] RRS

[26] Moore *& Associates*

[27] https://portal.ct.gov/DEEP/Reduce-Reuse-Recycle/Recycling-Its-the-Law

[28] Moore *& Associates* interviews, 2021

[29] Jen A. Miller, "Procuring sustainable coffee cups presents a blend of challenges", *Supply Chain Drive*, Sept. 27, 2021

[30] Moore *& Associates*

[31] Press Release, North American paper mills and end markets sign declaration of acceptance and commitment to increase recycling of paper cups", December 18, 2021

[32] https://www.closedlooppartners.com/nextgen/impact/packaging-innovations/cup-challenge/

[33] Oliver Kalmes, "Recycling at Paper Mills: The Benefits of Water-Based Barrier Coatings", *Paper 360*, Jan./Feb. 2021

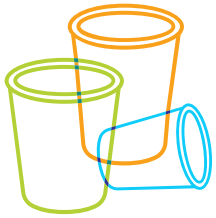
[34] Press Release, "North American paper mills and end markets sign declaration of acceptance and commitment to increase recycling of paper cups", December 18, 2021

[35] AF&PA, *Annual Statistical Summary of Recovered Paper Utilization*, June 2021

[36] Moore *& Associates*

[37] Courtesy of FPI

We Want Your Paper Cups!



OUR COMMITMENT TO RECYCLING

We, the undersigned organizations, are committed to increasing paper cup recycling. With the ever-increasing need to accelerate the recovery of foodservice packaging, we have taken many foundational and intentional steps to increase the viability of paper cup recycling and ensure end market acceptance.

A HIGHLY DESIRABLE RECYCLED MATERIAL

Paper cups are made with long, bleached fiber that are highly desired by paper mills because it adds strength and quality to new products made with recycled fiber. To date, there are 28 paper mills across eight companies in North America that accept residential mixed paper bales with paper cups included. Additionally, there are 5 mills/facilities across three companies that accept paper cups into bales of aseptic and gable top cartons ("Grade 52" bales). Participating paper mills have performed pulpability testing and/or mill trials to determine their ability to successfully recover fiber from paper cups and use the fiber in their furnish.

MAKING NEW EVERYDAY PRODUCTS

To provide a liquid barrier to the fiber, paper cups have a coating either on the inside (for hot drink cups) or on both sides (for cold drink cups). The pulping systems in use at our mills can separate the coatings from the fiber and recover the fiber as a feedstock for new products. Yield from the cup is in the 70 to 90 percent range, depending on whether the cup has a single or double sided coating and the pulping system in use. These fiber products go on to be made into a variety of everyday items such as cereal boxes, facial tissues, corrugated boxes, and new paper cups!

ADDING PAPER CUP RECYCLING

Material recovery facilities (MRFs) can add paper cups to their accepted material list. Communities can advocate for the inclusion of paper cups in their recycling stream by working with their waste haulers and MRFs.

A list of mills that accept paper cups and a map are on the next page. You can also find them on an interactive map **here**.

JOIN THE PAPER CUP RECYCLING MOVEMENT

Many of us are members of the Foodservice Packaging Institute, which provides industry-funded grants to MRFs, waste haulers, and communities that expand paper cup recycling access, increase current recovery capabilities, and educate residents on new paper cup recycling programs. If you are interested in partnering with FPI to add paper cup recycling to your recycling program, visit **www.recyclefsp.org** or email **recyclefsp@fpi.org**.

Additional information about paper cup recycling may be found at: **www.recyclepapercups.org**.

Cascades

essity

GP PRO Georgia-Pacific

Graphic Packaging INTERNATIONAL

Great Lakes Tissue Company

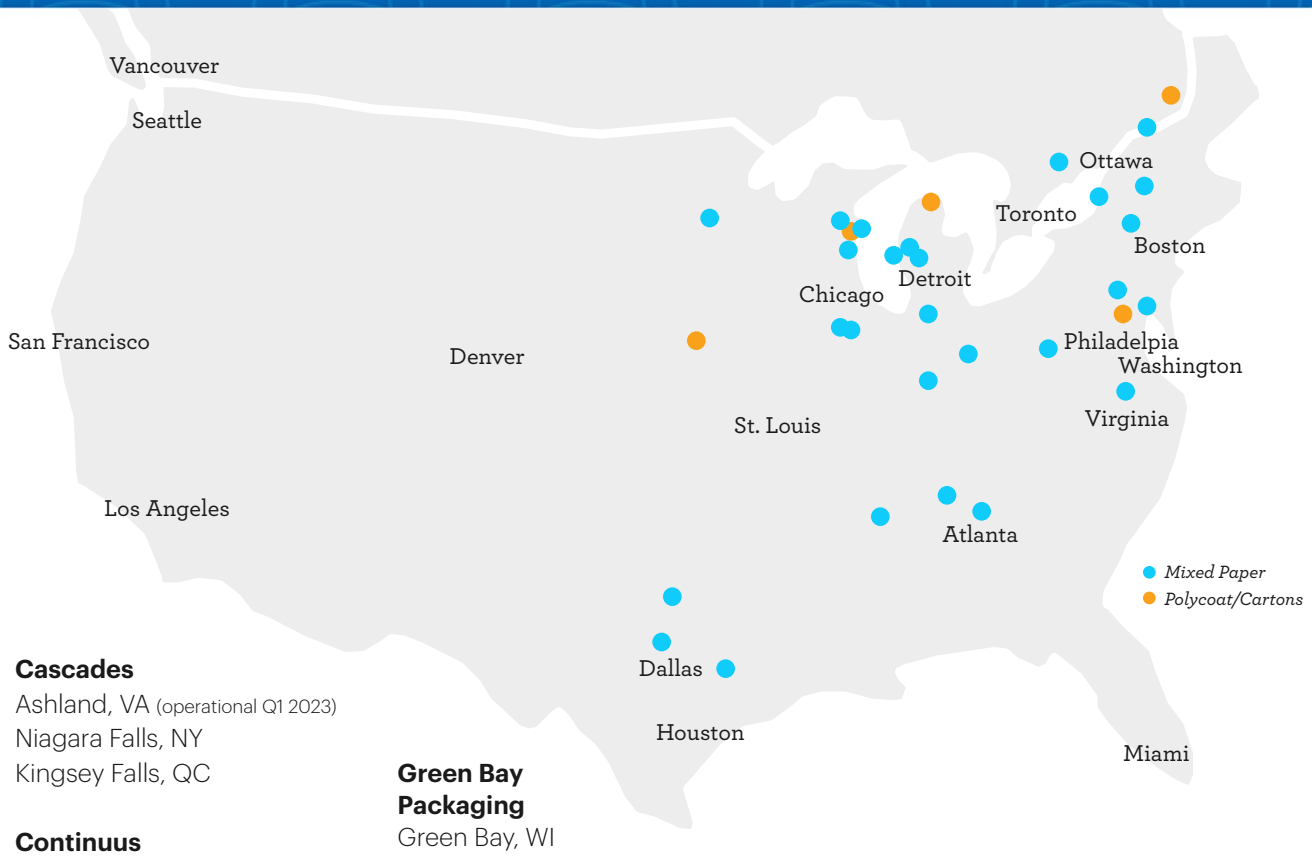
ND PAPER

U.S. MANUFACTURER OF RECYCLED PAPER · PRATT 100% RECYCLED · DEDICATED TO SUSTAINABLE PACKAGING

SUSTANA FIBER

WestRock

We Want Your Paper Cups!



Cascades
Ashland, VA (operational Q1 2023)
Niagara Falls, NY
Kingsey Falls, QC

Continuus
Des Moines, IA
Philadelphia, PA

Essity
Barton, AL
Menasha, WI
Middletown, OH
South Glens Falls, NY

Georgia-Pacific
Green Bay, WI
Muskogee, OK

Graphic Packaging International
Battle Creek, MI
East Angus, QC
Middletown, OH
Kalamazoo, MI

Great Lakes Tissue
Cheboygan, MI

Green Bay Packaging
Green Bay, WI

ND Paper
Fairmont, WV

Pratt
Conyers, GA
Shreveport, LA
Staten Island, NY
Valparaiso, IN
Wapakoneta, OH

Sustana
Levis, QC
DePere, WI

WestRock
Aurora, IL
Battle Creek, MI
Chattanooga, TN
Dallas, TX
Eaton, IN
Missisquoi, VT
St. Paul, MN
Stroudsburg, PA

THE MIXED PAPER MILLS ON THIS LIST REPRESENT:

of the U.S./Canadian mixed paper demand (% by quantity consumed)

of the U.S./Canadian mills consuming mixed paper (% by mill count)

Generators should contact end markets directly or via their broker to determine specifications and terms.
*as of 1/2022

FAQs ON RECYCLING PAPER CUPS FOR PAPER MILLS

As paper mills consider whether to accept bales containing paper cups, mills may have a variety of questions. Below are answers to some of the most anticipated questions:

Why should I accept bales with paper cups?
Paper cups are typically made with long, virgin fibers, something all mills find valuable. And, at a time where traditional sources of fiber – like newsprint and office paper – are in decline, mills may be looking for new sources of valuable fiber. In addition, cup fiber may lend strength to short fiber.

What materials are found in a typical paper cup?
Paper cups typically consist of bleached white virgin fiber with a thin polymer coating. Often, this coating is made from polyethylene (PE), but sometimes polylactic acid (PLA) is used. While wax may have been a common coating in the past, this is not true today. They also don't include wet strength chemicals, as they are not needed when a poly coating is used. Cups may contain low levels of starch.

Cups for hot liquid applications typically have one polymer layer on the inside of the cup, while cups for cold applications have two polymer layers, one on the inside and one on the outside. This coating provides insulation and helps prevent leaks. The coating ranges from roughly 5 to 12 percent by weight of the finished cup, depending on whether it's a cold or hot cup, and whether it has a PE or PLA coating.

While polymer coatings are used on almost all cups today, new repulpable water-based coatings are entering the market that can replace the traditional poly coatings.

Hot cups have printing ink directly on the fiber, while cold cups have ink on the exterior polymer coating. This is an important distinction, considering not all mills have deinking capabilities.

What happens to the poly coating after the pulping process?
That depends on the mill. In most cases, the poly will be sent to a landfill with any other residuals. In other cases, a mill may be able to recycle it or send it to a waste-to-energy facility. The industry is also working on processing innovations. For example, an emerging technology utilizes heat and pressure to extract usable fiber from polycoated and food-soiled packaging.

In which bales can I expect to see paper cups?
Based on the findings of a MRF flow study conducted several years ago (highlights found here), paper cups typically end up in mixed paper (ISRI grade #54) or carton bales (ISRI grade #52). They may also be sorted into other bales, like sorted office paper. Incoming material, operational considerations and preferences of paper end markets are factors used by the MRF to determine which bales will contain cups.

What fiber yield can I expect when recycling paper cups?
Yield correlates closely to the percent fiber versus polymer by weight, therefore fiber yields can be expected in the roughly 88 to 95 percent range. Yield may be higher with new repulpable coatings.

Won't my mill be flooded with paper cups if I decide to accept them?
While paper cups are part of our busy lives, the reality is that they are a very small part of the recovered fiber stream. According to industry estimates, there are roughly 600,000 tons of paper cups produced annually in the U.S. That is less than one percent of all paper and paperboard produced in the U.S. in 2018.

Research sponsored by the Foodservice Packaging Institute found that if the paper cups are included in a mixed paper bale, you can expect less than 0.5 percent of that bale to be paper cups. This is based on industry estimates as well as bale audits of residential mixed paper from two cities (New York City and Seattle) that accept paper cups for recycling.

If the paper cups are directed to a carton bale, you can expect 25 percent of that bale to be paper cups, based on industry estimates. According to one mill currently accepting bales with cartons and cups, cups represent about 10 to 20 percent of the bale. Adding cups to this bale provides additional volume, which may be desirable given that cartons are another low-volume commodity.

Aren't cups too contaminated with food to be recycled?
No. Cups and other foodservice packaging items are no more contaminated than commonly recycled food-contact items like bottles, jars or cans. This assertion is based on two studies done in Boston and Delaware that examined food contamination found in curbside recycling programs. And, in both studies, the majority of the samples of foodservice packaging was rated as low-residue (1-2 on a scale of 1-5). Read more about the studies here or watch the webinar on this topic here.

Since cups are used to contain liquids, the contents are easily emptied (and residents are likely to empty the cups before recycling to avoid spills in the home). In addition, any liquid left in the cups when recycled is expected to drain out during transport to the MRF.

Will I be able to process bales with paper cups?
That depends. All mills are different. As mill equipment and capabilities vary, it is recommended that mills conduct trials before accepting cups. Some mill experience suggests that the polymer coating can separate readily during pulping in both continuous and batch pulping processes. Mill cleaning systems enable the removal of the separated polymer strips from the pulping process. However, other mills have reported challenges with effectively separating the polymer coating in their pulping processes and/or cleaning systems.

If my mill wants to run a trial first, what should I consider?
If you're interested in running a trial, first know that we are here to help! Having helped other mills with trials, here are a few considerations:

- *Sourcing cups:* If you need help sourcing paper cups, or bales with paper cups, please let us know. It's up to you whether you want to run a trial with just pre-consumer cups, or post-consumer in a bale of your

choice. You may want to start with pre-consumer, and if that's successful, move to post-consumer bales. We can also help you determine the quantity of cups to include in the trial, based on the expected volumes of cups in the marketplace that are available or expected to be recycled.

- *Metrics:* You probably have metrics you'll want to track, but be sure to note the following (applicability may vary depending on whether you are running a trial with pre- or post-consumer cups):
    - Whether fiber is being consumed or is part of the tailings coming out of the pulper
    - Amount of poly in the pulper
    - Acceptability of polycoat (as a percentage)
    - Yield of typical bales containing paper cups
    - Yield loss
    - General contamination level in bales
    - Non-fiber material in bales
    - Storage issues: degradation of bales while in storage; storage time; storage requirements
    - De-trashing composition
    - Odor and insect/rodent presence
    - Residue

- *Length of trial:* This is for each mill to decide, but it's assumed that it will be for a finite period of time, providing the mill an opportunity to better understand the processing capabilities in mill operations, including the pulpability and yield of this material. A minimum of eight hours is recommended.

What's the next step if I decide I'd like to accept post-consumer paper cups in my mills?
First, let us know in which fiber grades/bale types you'll accept cups. Ideally, you're willing to communicate this acceptance publicly and be placed in our online end markets map (found here) and list (found here). But, if you prefer a less public approach initially, we'll work with you to find a suitable one. For example, you can communicate this via your buyers to your existing suppliers. We can also help by letting MRFs in your region know of your willingness to accept bales with paper cups (feel free to reach out directly, too!).

Finally, if you really want some added exposure, we're always looking for paper mills to highlight successful paper cup recycling. Just let us know and we'll contact you regarding future articles, speaking opportunities, etc.

Produced by the American Forest & Paper Association and FPI's Paper Cup Alliance.

FSP MIXED PAPER BALE AUDITS (2014-2022)

BACKGROUND AND PURPOSE

The Foodservice Packaging Institute's Paper Recovery Alliance (PRA) and Plastics Recovery Group (PRG) are working to increase the recovery of foodservice packaging by overcoming real and perceived barriers. One of the barriers for paper foodservice packaging was concerns expressed by mills and materials recovery facilities (MRFs) about adding these items to standard commodity bales such as mixed paper.

Over the past decade, multiple mixed paper bale audits have been conducted to better understand the prevalence of paper foodservice packaging (FSP), paper cups, and other polycoated paper materials within residential mixed paper recycling streams. These studies were designed to provide "real-world" data to complement earlier desktop projections developed by PRA.

THE STUDIES

To better understand the amount and types of paper foodservice packaging recovered through residential curbside recycling programs, teams led by RRS conducted bale audits of mixed paper sourced from multiple U.S. communities between 2014 and 2022.

Across all studies, mixed paper bales were collected from residential recycling programs that accept paper foodservice packaging and sorted to assess material composition. Bales were broken and sampled to obtain representative subsets, which were then manually sorted by trained staff using defined material categories (e.g., paper cups, polycoated packaging, cartons, and contaminants). Materials were identified primarily through visual inspection based on format and coating type, then weighed to determine their share of the overall bale.

2014 BALE AUDITS

In October 2014, six mixed paper bales from New York City and Seattle were audited to evaluate the amount and types of paper foodservice packaging recovered through residential curbside recycling programs. The study evaluated hot drink cups, cold drink cups, takeout containers, paperboard pizza boxes, cup sleeves, takeout bags, beverage carriers, and egg boxes.

All eight targeted material categories were listed as accepted materials by the New York City and Seattle recycling programs at the time of the study.

2021 BALE AUDITS

In July 2021, an audit of mixed paper bales was conducted to provide an updated look at the prevalence of hot and cold paper cups in mixed paper bales and to gather data on the prevalence of other (non-foodservice) polycoated paper items. Samples were taken from five mixed paper bales, sorted into designated categories, and weighed. Though the specific community was not publicly disclosed as part of the study, it is a major U.S. city that had been accepting paper cups for several years.

2022 BALE AUDITS – CHATTANOOGA, LOUISVILLE & CHICAGO

In 2022, expanded mixed paper bale audits were conducted across three additional markets:

- Chattanooga, TN – three mixed paper bales
- Louisville, KY – three mixed paper bales
- Chicago, IL – three old newspaper (ONP)/mixed paper bales

In addition to hot and cold paper cups, the study evaluated a broader range of polycoated paper materials and related contamination categories.

Table 1: Study Material Categories by Audit Year

Material	***2014 Study***	***2021 Study***	***2022 Study***
Hot Drink Cups	*X*	*X*	*X*
Cold Drink Cups	*X*	*X*	*X*
Takeout Containers	*X*		
Paperboard Pizza Boxes			
Cup Sleeves	*X*		
Takeout Bags	*X*		
Beverage Carriers/Fridge Packs	*X*		*X*
Egg Boxes	*X*		
Polycoated Food Contact Packaging (Non-FSP)		*X*	*X*
Cartons			*X*
Rigid Paper Cans			*X*
Pringles Cans			*X*
Wide Diameter Rigid Paper Cans			*X*
Unwound Spiral Cans (Dough/Juice)			*X*
Cup-Related Plastics			*X*
Cup-Related Contamination (“Ride-Alongs”)			*X*
Other Contamination (plastics, metals, residue)	*X*	*X*	*X*

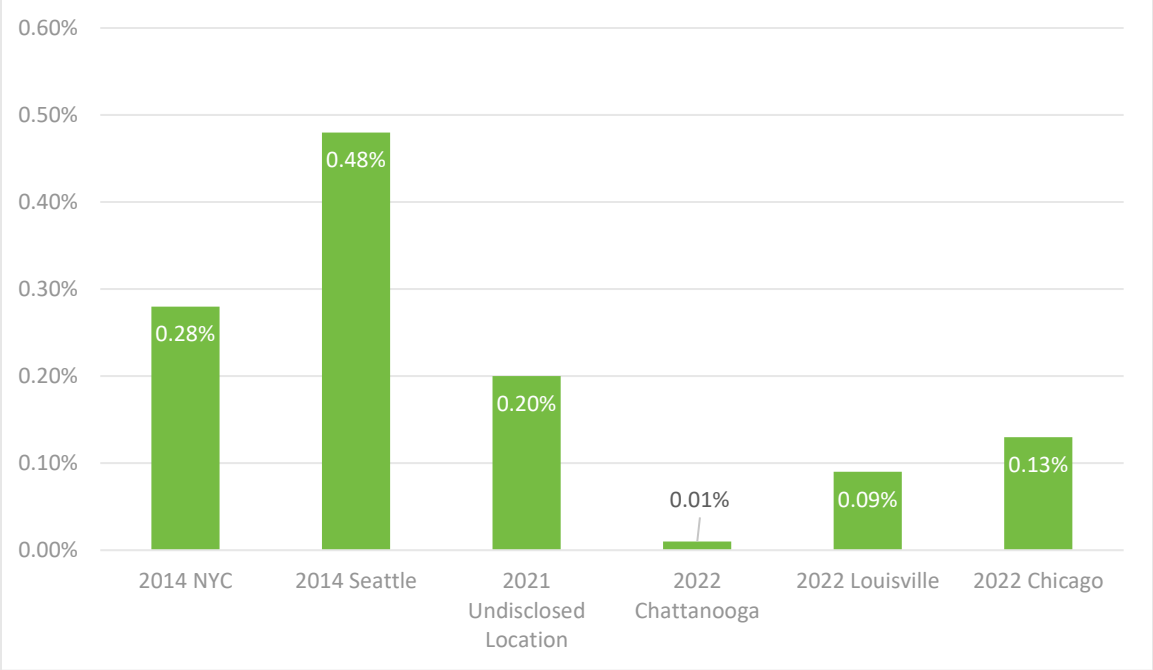
RESULTS

OVERALL PRESENCE OF FOODSERVICE PACKAGING

Across all studies, foodservice packaging was consistently found at low levels in mixed paper bales:

- **2014**: Less than 0.5% of bale weight on average (0.28% NYC; 0.48% Seattle).
- **2021**: Paper cups comprised an average of 0.2% of bale weight.
- **2022**: Paper cups were consistently less than 0.5% of bale weight and often below 0.25%, with total paper cups ranging from approximately 0.01% to 0.13% by bale.

Figure 1: Paper Cups as a Percentage of Bale Weight



MATERIAL COMPOSITION TRENDS

Paper Cups:

- Paper cups consistently represented a very small fraction of the bale across all studies.
- In both the 2014 and 2021 audits, cups represented well below 0.5% of bale composition.
- The 2022 study similarly found that total paper cups generally represented less than 0.25% of bale weight across all audited cities.
- Hot cups were found at particularly low levels in the 2022 study, especially in Chattanooga and Louisville, while cold cups were more prevalent across all audited markets.

Polycoated Materials (total):

- Broader categories of polycoated paper materials represented a larger share of bale composition than foodservice packaging alone.
- In the 2022 audits, total polycoated materials averaged approximately 2.5% to 3.2% of bale weight across the three audited cities.

Other Fiber Packaging:

- The results suggest that many non-foodservice fiber packaging categories comprise a substantially larger portion of mixed paper bales than foodservice packaging items.

Contamination:

- Across all studies, the majority of bale composition consisted of recoverable fiber, with contamination representing a relatively small but variable portion of total bale weight.
- The 2022 study found that contamination, including plastics, metals, residue, textiles, and other non-fiber materials, averaged approximately 4.6% to 7.7% of bale weight, depending on the city audited.
- Variation in contamination levels between cities may reflect differences in recycling program design, resident education, collection practices, and local processing conditions.

VARIABILITY ACROSS LOCATIONS AND STUDIES

Differences in FSP prevalence and composition were observed across cities and time periods, influenced by:

- Local consumption patterns
- Different packaging mix due to local foodservice market shares and regulatory landscapes (polystyrene foam has been banned in Seattle since 2009)
- Availability of composting (e.g., Seattle)
- Seasonality (e.g., fewer hot cups observed in summer audits)
- Evolving recycling program policies and education (e.g., addition of cups in some cities)

CONCLUSIONS

Across nearly a decade of bale audits, findings are consistent:

- Foodservice packaging, including paper cups, makes up a very small portion of mixed paper bales, typically under 0.5% by weight.
- Polycoated materials overall are present at modest levels (~2–3%) but are still lower than many other fiber packaging categories.
- Contamination represents a larger share of bale composition than foodservice packaging materials, which remain a very small fraction by weight.

These results suggest that:

- Concerns about large volumes of foodservice packaging in mixed paper bales are not supported by field data.
- Low recovery rates and participation likely limit FSP presence more than material acceptance does.
- Opportunities remain to improve recovery through education, program design, and further evaluation of sorting and end-market considerations (e.g., coating types).

End Markets for Post-Consumer Paper Cups

FPI has assembled a list of US and Canadian end markets and brokers that have confirmed their acceptance of post-consumer poly-coated (i.e., PE-coated or PLA-coated) paper cups in commonly traded commodity bales.

This listing is provided for reference only. Generators should contact end markets and brokers directly to determine specifications and terms.

Mixed Paper Markets

The following mills purchase residential mixed paper bales containing paper cups. Some also accept other paper foodservice packaging.

Cascades, Ashland, VA
Cascades, Kingsey Falls, QC
Cascades Greenpac Mill, Niagara Falls, NY
Essity, Barton, AL
Essity, Menasha, WI
Essity, Middletown, OH
Georgia-Pacific, Green Bay, WI
Georgia-Pacific, Muskogee, OK
Georgia-Pacific, Rincon, GA
Graphic Packaging Int'l, Kalamazoo, MI
Graphic Packaging Int'l, Waco, TX
Green Bay Packaging, Green Bay, WI
Greif, Milwaukee, WI
ND Paper, Biron Mill, Wisconsin Rapids, WI
Newman Paperboard, Philadelphia, PA
NORPAC, Longview, WA
Ox Industries, Aurora, IL
Ox Industries, Eaton, IN
Ox Industries, White Pigeon, MI
Paperworks Industries, Wabash, IN
Pratt, Conyers, GA
Pratt, Henderson, KY
Pratt, Shreveport, LA
Pratt, Staten Island, NY
Pratt, Valparaiso, IN
Pratt, Wapakoneta, OH
Smurfit WestRock, Battle Creek, MI
Smurfit WestRock, Dallas, TX
Smurfit WestRock, Missisquoi, VT
Smurfit WestRock, Stroudsburg, PA
Sonoco, Chattanooga, TN
Sonoco, Hartsville, SC

Sorted Office Paper (SOP) Markets

The following mill purchases SOP bales containing paper cups.

Resolute, Menominee, MI

Polycoat/Carton Markets

The following mills purchase bales containing paper cups along with aseptic and gabletop cartons.

Sustana (Breakey Fiber), Levis, QC
Sustana (Fox River Fiber), DePere, WI

If you would like to suggest an end market or broker for addition to this list, please contact recyclefsp@fpi.org. An interactive map of end markets for other commodities and additional resources on recovery of foodservice packaging are available at: www.recycleFSP.org.

March 2026

End Markets for Post-Consumer Paper Cups

Brokers

The following brokers purchase bales containing paper cups into various domestic and export markets. Please refer to their commodity listing for specific bale types.

America Chung Nam
(supplier for ND Paper)
Mixed Paper, OCC
Kevin Liu, 201-232-9944
KevinLiu@acni.net

CellMark
Mixed Paper with Paper Cups, Cup/Carton Bales, PS#52, OCC, SOP, Poly Kraft Bag, DLK, and SWL.
Robert Pirrello, 203-856-3006
robert.pirrello@cellmark.com

Continental Paper Grading Inc.
PS#52, Paper Cups/Aseptic Carton Bales, SOP, OCC, Mixed Paper, DLK
Miro Seperic, 519-404-7330
mseperic@cpgco.com

GP Recycling
Mixed Paper, SOP, OCC
Adam August, 516-236-9890
adam.august@gapac.com

Greif Recycling
Mixed Paper with Paper Cups, OCC, Bulk Grades, De-ink Grades, Pulp Subs
Bill Theado, 937-603-1072
bill.theado@greif.com

Midland Davis
Mixed Paper w/ Paper Cups, SOP, OCC, DLK,
ONP, and high-grade paper
Leonard Zeid, 314-255-6451
Leonard.Zeid@midlanddavis.com

Omnisphere
PS#52, Cup/Carton Bales with or without Poly, Poly Food Board (All in Bales)
Alex Valdes, 305-609-7733
avaldes@omnisphere.net

Padnos
Mixed Paper, OCC, Cup/Carton Bales, DLK, SOP
Justin Jungman, 248-444-9755
justin.jungman@padnos.com

Pioneer Industries International
Mixed Paper w/ Paper Cups, SOP, OCC, DLK
Tamara Mayberry, 414-287-9733
tmayberry@pioneerintl.com

ReMM Group
Mixed Paper, OCC, Residential News, Poly-coat/Aseptic Cartons
Duane Maladecki, 734-751-7932
duane@remm.ca

SDX International Inc, USA
PS #52, Cup/Carton bales, Mixed Paper w/ Paper Cups,
OCC, Kraft Bags, DLK, Poly/Foil Kraft, Poly/Foil SBS,
Pulp sub, Books, PWE, CBS, Mixed Rolls
Vipul Dholakia, 484-515-6911
vipul@sdxinternational.com

Source One Ventures
Mixed Paper, OCC, Cup/Carton Bales, Poly Food Board, SOP, DLK, SWL
Parthiv Chauhan, 519-521-5709
info@sourceoneventures.ca

Storelli Recycling
Mixed Paper, SOP, OCC, DLK, SWL, News, Paper Cups, Aseptic Cartons
Paul Storelli, 954-650-0113
paul@storellirecycling.com

Wilmington Paper
Mixed Paper with Paper Cups, OCC, SOP, Cup/Carton
Brett Lurie, 973-445-2382
blurie@wilmingtonpaper.com

If you would like to suggest an end market or broker for addition to this list, please contact recyclefsp@fpi.org. An interactive map of end markets for other commodities and additional resources on recovery of foodservice packaging are available at: www.recycleFSP.org.

March 2026

RRS

416 LONGSHORE DRIVE | ANN ARBOR, MI 48105 | 734.996.1361 | RECYCLE.COM

MRF MATERIAL FLOW STUDY

FINAL REPORT | APRIL 2015

COMISSIONED BY

Carton Council RecycleCartons.com

American Chemistry Council

NAPCOR

APR

FPI FOODSERVICE PACKAGING INSTITUTE

PREPARED BY RRS IN CONJUNCTION WITH:

Reclay StewardEdge Product Stewardship Solutions

MOORE RECYCLING ASSOCIATES INC.

INTRODUCTION

The famous Greek philosopher Heraclitus captured the essence of the recycling industry over 2,500 years ago when he penned the phrase, "Nothing endures but change." The march of packaging innovation and technology, and the persistently changing habits of consumers continue to dictate the changing mix of materials that enters a material recovery facility (MRF). Over the past decade, there has been a continual decline in the once dominant materials including newspaper, glass and metal cans. At the same time, a host of other packaging types have emerged, presenting new recovery opportunities. Recycling programs throughout the country have responded by expanding the list of materials accepted for recycling, notably including a wide range of plastics and cartons. For the MRFs that receive the material, it is not always easy to keep sorting technologies and techniques on pace with this expanding mix.

STUDY OVERVIEW

Packaging companies have an interest in ensuring that the packages they produce or sell their products in have the opportunity to be recycled. The ability to recycle the package can be a consumer's deciding factor in the purchase of a particular product. This, and the desire to minimalize environmental footprints, are the drivers behind the recently completed MRF Material Flow Study.

MRFs are the intersection between consumers, residents and the industrial infrastructure that creates the products and packaging we use every day. To better understand the recyclability of their packaging, five diverse associations – the Carton Council, Foodservice Packaging Institute (FPI), American Chemistry Council (ACC), National Association for PET Container Resources (NAPCOR) and the Association of Postconsumer Plastics Reprocessors (APR) – joined together to study how numerous materials flowed through the MRF. They contracted with RRS, Reclay StewardEdge (RSE) and Moore Recycling Associates to develop a standard methodology and execute it at five MRFs.

KEY CONCLUSIONS

In studying the performance of specific materials through different MRF environments, a number of general takeaways became clear. These conclusions could help to serve as guidelines to improve recovery across the recovery value chain – from residents and municipalities to packaging designers and MRF operators and engineers, and everyone else in between.

AUDIENCE	KEY TAKEAWAYS
Packaging Designers	• Form, material and rigidity have a significant effect on a product's "sortability" in the MRF • Light-weighting of plastics can decrease recovery in a single stream MRF due to loss to the paper streams
MRF Operators	• More equipment steps (disc screen decks or other separation equipment) can improve accuracy of splitting two-dimensional from three-dimensional materials • Properly maintaining the disc screens (cleaning and replacing discs) can significantly reduce loss of containers to the paper stream • Minimizing compaction to maintain the form/shape of incoming material improves separation • Continually training sorters to recognize a wide range of acceptable packaging is of growing importance
MRF Equipment Designers	• Further research and development is needed to improve consistency of behavior of non-bottle plastics in the MRF • Further testing and refining of optical sorter programming is needed to effectively optically sort a wider range of packaging
Municipalities	• Regular communications with local MRFs is critical to understanding behavior of materials currently accepted and identifying additional materials that could be added • As the list of acceptable materials grows, continual education for residents is essential to keeping contamination to a minimum • For single stream programs, education to the consumer to not crush materials can improve their recovery
Recycling Industry	• Continually evaluate and match MRF product quality and end market capabilities to ensure true recovery

ABOUT THIS REPORT

This study examined the behavior of numerous individual products in the MRF, yielding data on cups, clamshells, containers, domes/trays, bottles, tubs, lids, gable-top and aseptic cartons, and other materials. Funders of this study have gained a greater awareness of the opportunities and obstacles regarding the recovery of each of these materials and will apply this new knowledge to increase recovery.

While the detailed data on each material are not presented within this report, key findings regarding material flows, sorting technologies, and other sorting and design related considerations are explained, along with the study's methodology.

STUDY METHODOLOGY

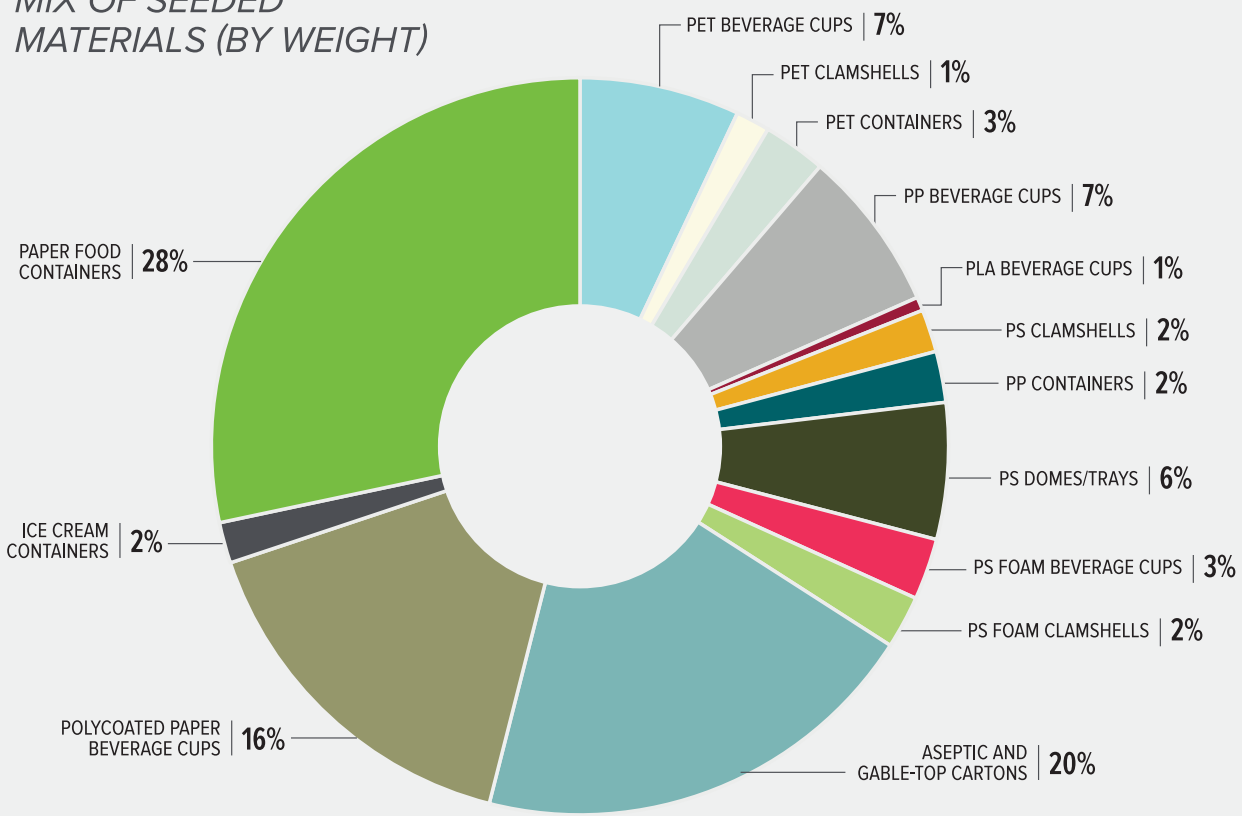
There were three stated goals of the study:

1. Learn how materials similar to the test samples and other study materials would flow through typical MRF environments;
2. Determine which of the study materials, not currently accepted by MRFs, could potentially be recycled using existing MRF infrastructure; and
3. Start to develop an understanding of what sort processes could be modified to allow effective recovery of sample materials

The study focused on a broad range of materials, many that are currently widely accepted and some that are very rarely included in recycling programs. Materials that are not commonly accepted for recycling were brought in and added, or "seeded", to the normal stream received by the MRF. To simulate a realistic recovery scenario, care was taken to add materials at levels that corresponded to their relative prevalence in the marketplace. In other words, more common materials were seeded in larger amounts (by weight) than less common ones.

The plastic materials studied included cups, clamshells, domes/trays, bottles, tubs, lids and other containers. Each was classified by resin identification code and in some categories including containers and tubs, by size as well. The paper products studied included cups, ice cream containers, gable-top and aseptic cartons, and take-out food containers. Figure 1 shows the representative mix of materials that was seeded.

FIGURE 1
MIX OF SEEDED MATERIALS (BY WEIGHT)



In each of the five MRFs that served as test sites for this study, a standard methodology was applied to analyze the flow of materials. This methodology was, in essence, quite simple and could be replicated for other materials or repeated in other MRFs.

- The MRF set aside enough inbound recyclable material to run their facility for 3 hours (between 30 and 100 tons). This represented the average material that the facility processes on a day to day basis.
- The study team worked with the MRF staff to mix the seeded packaging into the inbound material. In each facility, the seeded materials represented about 1% of the incoming stream by weight.
- Sort staff was trained on how to handle the seeded materials. In general, the materials were allowed to flow where they naturally did within the facility and sorters were instructed to not pick and dispose of the seeded materials as residue. However, each seeded package was given one or more target commodity streams and if, for example paper beverage cups flowed to the container line, the sorters were directed to positively sort them to the carton bale and if they flowed to the paper line they were allowed to stay in the mixed paper bale. Seeded materials therefore flowed to existing MRF products – new product grades were not produced for the seeded materials.
- The facility processed the material for 3 hours. During the processing, video cameras were set up to monitor the flow of materials and the actions of the sorters.
- Random samples of the main products were taken either as loose samples or from random bales. The target sample weight was about 600 pounds for each of the products and, where possible, multiple samples were taken of each product or the majority of the product was sorted.
- Each of the samples was sorted into 104 categories. The plastic sort categories were chosen to match other studies commissioned by ACC, APR, NAPCOR, and others.

Ideally, tests were run during a time that the facility was not planning to operate, so as not to hinder normal operations. MRFs operate on extremely tight timelines, and without careful scheduling a study could easily create problematic disruptions.

DATA ANALYSIS

Based on the data collected, two analyses were performed. The first was characterizations of each of the product streams. These were completed for each of the samples of a single product and then averaged to get the product characterization. Product characterizations showed how much of that stream was composed of each sort category. An example is shown in Figure 2. The product characterizations are important for end

The MRFs at which this study was conducted were chosen to represent the wide diversity of facilities that currently process recyclables nationwide. Here are some of their key descriptors and differentiators:

- 1 dual stream and 4 single stream facilities
- Throughput range (tons per hour): 10 tph – 35 tph
- Four different equipment manufacturers
- Number of optical sorters ranged from 0 – 5
- Varying combinations of disc screens and other mechanical separation equipment

PRODUCT CHARACTERIZATIONS WERE CALCULATED FOR THE FOLLOWING STREAMS:

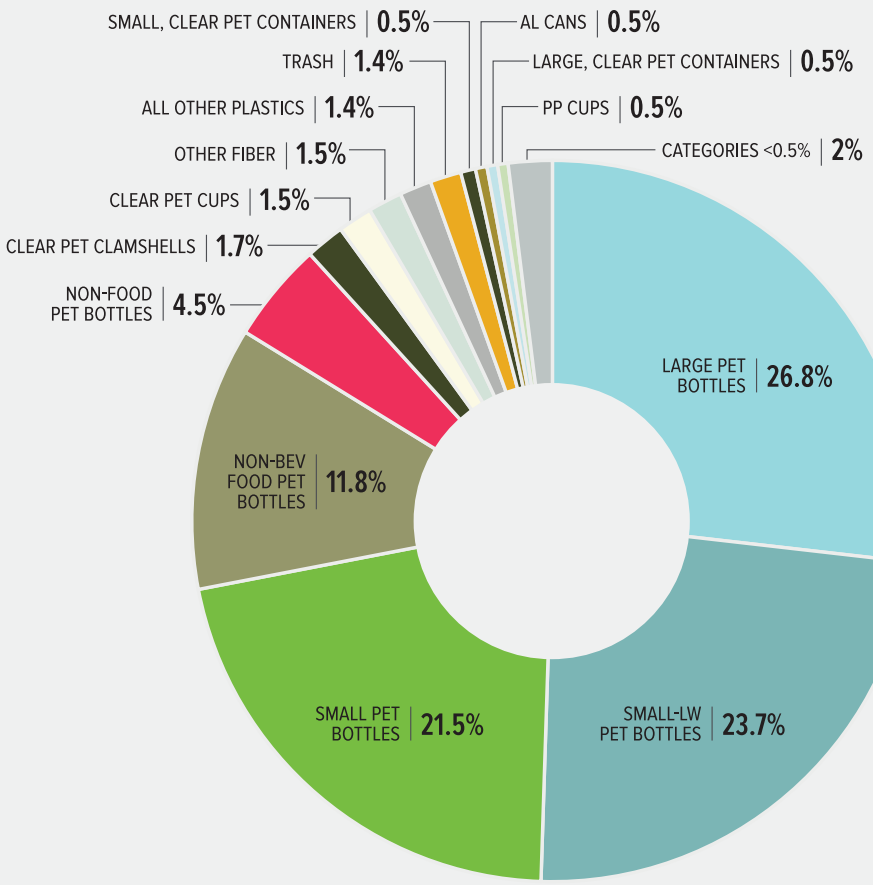
Mixed Paper	Mixed Paper/ Newspaper[1]	cHDPE
Newspaper	PET	nHDPE
Cartons	Mixed Plastics[2]	Residue

1 Some facilities only marketed one grade of paper
2 Also included a HDPE/PP Tubs and Lids grade

markets to understand the quality and composition of a MRFs products. For this study, it was important to see if the addition of seeded materials would increase contamination of existing product streams.

The second analysis used the characterizations to determine the destination of each of the study materials. For example, if 10,000 paper beverage cups were introduced into the MRF, how many would end up in the mixed paper, how many in the carton bale and how many in the residue and other categories. This analysis was the key to understanding how the materials flowed in the MRF environment. Examples of this analysis are shown in the Results section.

FIGURE 2
EXAMPLE PRODUCT STREAM CHARACTERIZATION: PET, AVERAGED ACROSS ALL 5 MRFS



RESULTS

While a diverse set of MRFs was chosen for the study, the results presented here are specific to the MRFs studied, as different results can be achieved by modifying equipment layouts, operating protocols and material streams.

Key findings are grouped by type of MRF, type of sortation equipment and material form and prevalence.

DUAL STREAM SYSTEMS

Two types of MRFs were included in the study: one dual stream and four single stream. While only one MRF was dual stream, one comparison about the difference between dual and single stream systems can be made.

Dual stream systems, which are declining nationally in favor of single stream systems, require residents to separate paper materials from metal, glass and plastic containers. As will be highlighted in the next section, dual stream systems offer the advantage of reducing loss of plastics and other containers to the paper streams. On the other hand, as the material mix has expanded to new packaging types, it isn't always well understood to by residents in which stream they should be included. For MRFs, it is more difficult to sort these containers from the paper stream than it is from the container stream, making this a real obstacle.

SINGLE STREAM SYSTEMS

While single stream systems allow for easier communication to consumers about how to recycle (and simplify collection systems), the difficulty in separating the materials is passed

onto the MRF. One of the key observations in this study is that there are wide variations in how effective single stream facilities are in separating paper from the containers. To accomplish this separation, single stream facilities use a series of disc screens and other equipment that all utilize the difference in shape between paper and containers. Flat materials (generally 2-dimensional) will travel to the top of the screen and to one series of conveyors, while bottles and other containers (generally 3-dimensional) will either fall through the screens or tumble to the bottom to a different series of conveyors.

There are numerous factors that affect the ability of single stream equipment to accurately separate the 2D and 3D materials. They include equipment design factors (such as screen design and angle), operation issues (such as overloading the screens, cleaning the screens, and wet material), maintenance issues (such as wear to discs) and collection issues (such as excessive compaction of the material by residents or collection vehicles). Further, the packaging design itself can also affect the flow of individual materials. All of these variables cannot be evaluated in one study, but general conclusions are possible.

BEST PRACTICES FOR ACCURATE 2D/3D SEPARATION IN SINGLE STREAM MRFS:

- Avoid loading screens past their design throughput
- Clean screens of material that are wrapped around the shafts
- Replace worn and damaged discs
- Minimize compaction of material by residents and collection trucks
- Keep material dry

SCREENS

In this study, plastics separation by screens was examined in depth and the analysis can act as a surrogate for other container material types, such as aluminum and steel. The amount of plastics (including bottles, containers, clamshells and cups) lost to the paper stream varied from 3% to 12%. The two MRFs that experienced a 12% loss of plastics to the paper stream were both medium sized single stream facilities (25-30 rated tons per hour (tph)) that had fewer screens than the larger two (35 tph). After seeing the screening effectiveness data from this study, both replaced worn discs in their disc screens and reported a significant improvement in the 2D/3D separation. The facility that experienced a 3% loss of plastic to the paper stream was a large MRF with an adequate number of screens for the incoming volume and material type (note: this facility was the top performer across the entire study). Interestingly, the facility with 8% loss was similar to the 3% facility, but it had two distinct operational issues that were not normal for their facilities: material was wetter than normal due to heavy snow storms, and space constraints on the tip floor caused by equipment failures resulted in handling of the material significantly more than normal (including driving over it with a loader). These results suggest that a well maintained facility with an adequate number of screens for the incoming volume and material mix, operating under normal conditions can achieve very low losses of containers to paper products.

Note: Both large single stream MRFs, which had better success than the medium single stream MRFs at separating the plastic containers from the paper, were equipped with 4 sets of disc screens: an OCC screen for separating cardboard or "old corrugated containers", 2 ONP screens for separating "old newspapers" and a polishing screen for cleaning up the mixed paper stream. The two medium MRFs had 1 less paper screen each. Depending on the facility, this study indicates that the extra screens can help improve the accuracy of the 2D/3D separation in single stream MRFs.

FORM

The form of a package had a strong influence on the loss of packaging to the paper streams. As can be seen in Table 1, the plastic clamshells had a much higher likelihood of flattening and moving with the paper streams. The rounder materials (including bottles, cups and containers) all had much lower loss rates, and less than 5% was lost at the top performing MRFs, Small, lightweight water bottles were more likely than other bottles to move with the paper with a loss rate of 15%. The cups, containers and clamshells still enter the MRFs in much lower quantities than bottles. They made up 11% of the plastics stream, even with the seeded materials. Aseptic and gable-top cartons had a higher average loss rate to the paper

streams, although it is interesting to note it was the only packaging type to have one facility with no loss to the paper stream. In all five MRFs, they marketed a Grade 52 for cartons and pulled them from the container line.

OPTICAL SORTERS

Another piece of equipment in MRFs that can help improve separation of materials are optical sorters. Optical sorters can recognize materials based on what they are made of along with their size and shape. All four single stream facilities had at least one optical sorter, and the two large facilities had 3–4. Optical sorter efficiency was difficult to determine from this study because for each optically sorted commodity there were one or more manual sorters for quality control, both on the material that was positively sorted and what was missed. Therefore a manual sorter could remove a PET cup that was positively sorted by the optical sorter into the PET bale or another could mistakenly sort a PP cup that resembled one from PET into the PET bale. However, there were two interesting cases that are worth noting with the optical sorters.

Many of the materials that were tested as part of this study are light weight, meaning a sorter (either human or optical) needs to handle more pieces in order to sort a ton. At the only single stream facility without an optical sorter for the cartons, the manual sorter who normally sorts cartons was asked to positively sort any paper beverage cups and ice cream containers. With the volume of cups and ice cream containers, the sorter was overwhelmed and the manager chose to add a second sorter to that station. This implies that as more lightweight materials are added to the MRF, either more manual sorters will need to be added or optical sorters may be able to help increase the sorting throughput.

Even for a trained manual sorter, recognizing the resin type for each item as it goes by on a conveyor is very difficult. The PP and PET cups that were seeded for the test were both clear plastic and very similar in style. Averaged across all five facilities, approximately 20% of the PP cups were found in the PET bales. This is likely due to manual sorters positively sorting them to the PET stream because they so closely resembled PET cups. As more diverse packaging, including different sizes, shapes, colors, materials and purposes, continues to enter the MRF, improvements in technology and training to keep bale quality high will likely be necessary.

Similarly at one MRF, the optical sorter was set to sort all HDPE and PP and manual sorters then sorted that stream into nHDPE, cHDPE and a HDPE/PP Tubs and Lids grade. The cHDPE bale at that MRF had a much higher percentage of PP (8%) than the other MRFs (less than 2%). This further emphasizes the sorting challenges facing MRFs.

MATERIAL PREVALENCE

MRFs have been designed to separate bottles and cans from magazines and newspaper. During this study, extensive data was collected on the behavior of specific packaging types in the MRF environment. It shows that MRFs are doing quite well with these prevalent materials, although even these materials are not being correctly sorted at 100%. At best, the study showed a recovery of 93% of an individual package type, with much of the loss to other products and not to residue alone. Similarly for small (<1L), regular weight

TABLE 1

LOSS RATE OF PACKAGING MATERIALS TO THE PAPER STREAMS

FORM	AVERAGE LOSS RATE TO PAPER STREAM	LOSS RATE AT BEST PERFORMING SINGLE STREAM MRF
Plastic Bottles	5%	2%
Plastic Cups	10%	3%
Plastic Containers	12%	2%
Plastic Clamshells	29%	12%
Aseptic and Gable-top Cartons	18%	0%

PET bottles and all size cHDPE bottles, results are shown in Figure 3. Compare those figures to results for small (<10") PET non-bottle containers and cHDPE non-bottle containers as shown in Figure 4. Note that for all results, the data from each of the five MRFs was averaged to form a composite of the behavior across all facilities. According to RRS's database, approximately 50% of the material nationally is processed through the largest 20% of MRFs. Therefore, the larger MRFs were weighted more heavily than the smaller facilities when combining the data.

Why do bottles flow more consistently to the proper bale than tubs and other non-bottle containers? There are many likely reasons for these results. The first, and likely most important, is relative amount of material. During the tests, there were greater than 20 times more regular weight PET bottles than small PET containers (by weight). Including all types of PET bottles and both large and small containers, there were greater than 30 times more bottles (by weight). Although not as pronounced, there were still 8 times as many colored HDPE bottles as containers and tubs. Package types that are more prevalent in the stream are more likely to be targeted by manual sorters if they are missed or misdirected by the optical sorters or disc screens, thereby increasing their recovery. In addition, the equipment is tuned to increase the recovery of the

FIGURE 3

DESTINATION OF SMALL, REGULAR WEIGHT (< 1L) PET BEVERAGE BOTTLES (TOP) AND ALL CHDPE BOTTLES

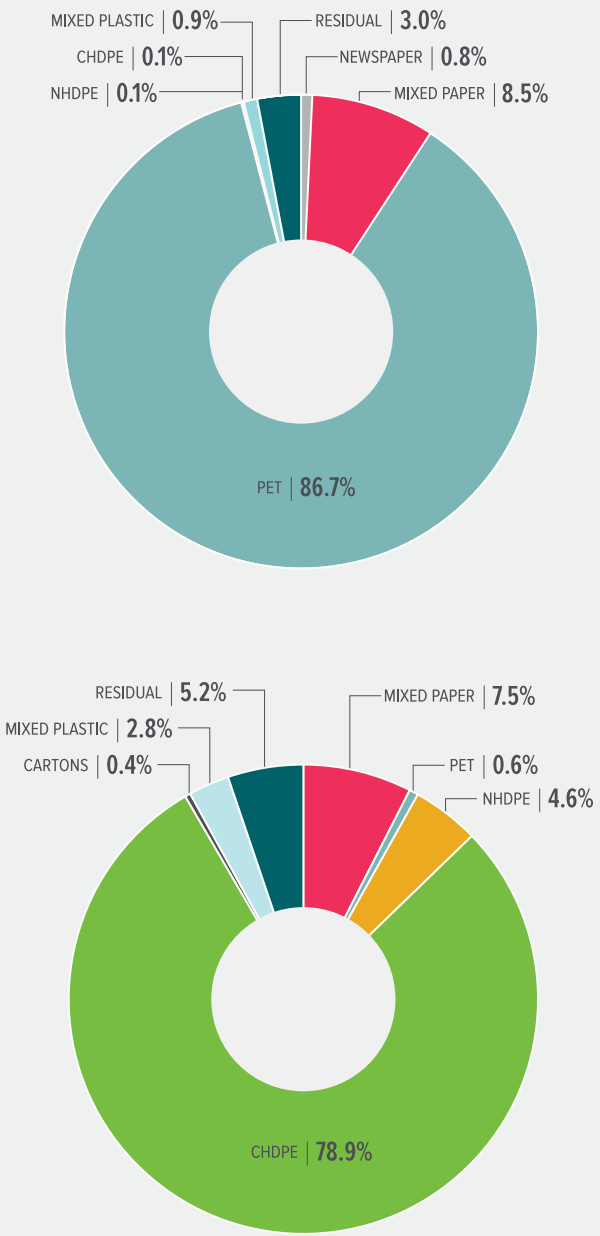


FIGURE 4

DESTINATION OF SMALL PET CONTAINERS (TOP) AND CHDPE CONTAINERS (ALL NON-BOTTLE CONTAINERS & TUBS, < 10" DIAMETER)

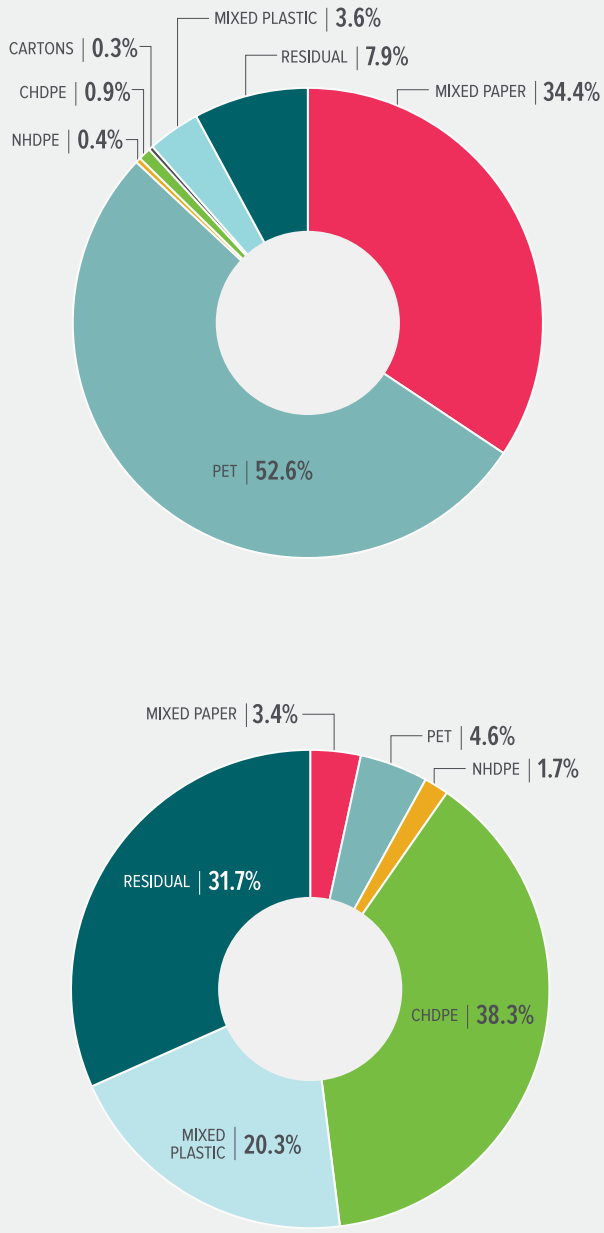
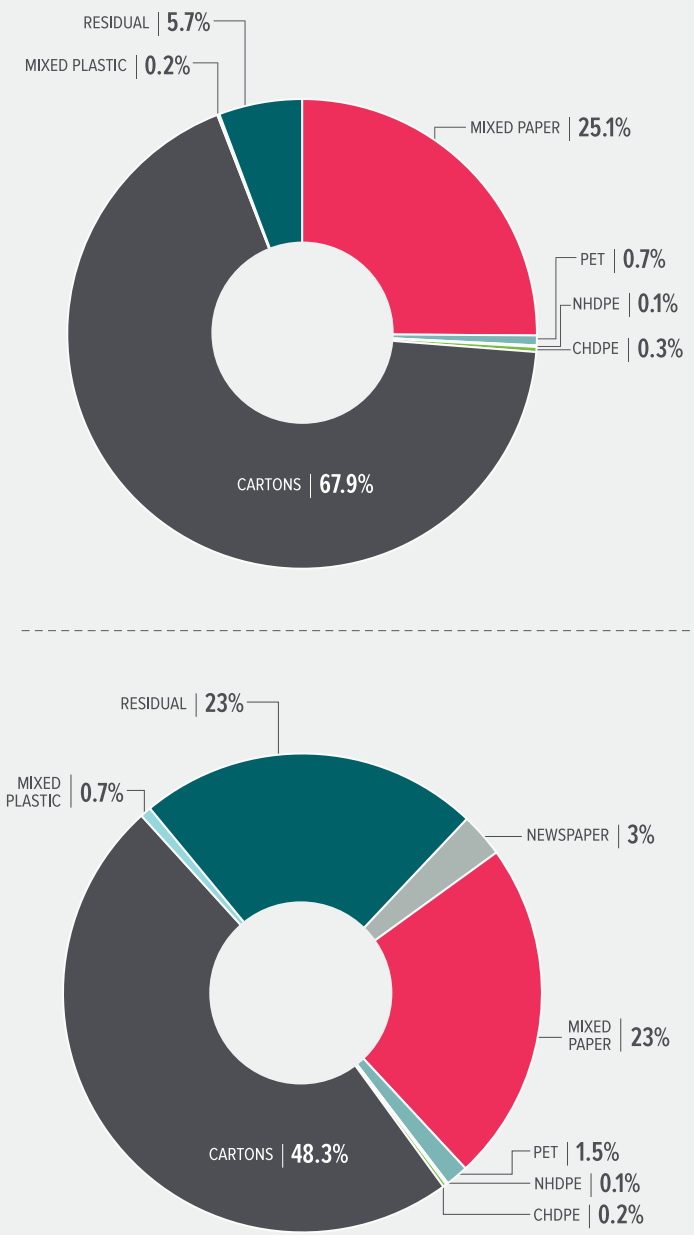


FIGURE 5
DESTINATION OF CARTONS (TOP) AND PAPER BEVERAGE CUPS



most common materials and may not perform as consistently on less common package types.

Secondly, to target the PET and cHDPE non-bottle containers would take two different strategies. The majority of the PET containers not in the PET bale are lost to the paper stream. However, very little of the cHDPE containers were in the paper stream, but most of the loss was to the residue stream, likely because they were not captured from the container line either by the optical or manual sorters. Finally, the size and shape of the containers can be quite varied in comparison to the bottles, with many containers being flatter and having open tops, which reduces the ability to hold the shape during handling and sorting. This will continue to cause less consistency on the disc screens and other equipment.

ADDING NEW MATERIALS

The study also specifically assessed the MRF "sortability" of some packaging materials that are not currently accepted extensively by recycling programs nationwide but are in fact growing in many communities, including: paper beverage cups, ice cream containers and polystyrene foam cups and clamshells. Figure 5 compares the behavior of aseptic and gable-top cartons to paper beverage cups.

As one example, the paper beverage cups had a strong tendency to flow to the container line (similar to cartons and plastic cups). A higher percentage were lost to residue which, based on review of the test setup and sorter training, was most likely from the container line. This could be due to manual sorters being less familiar seeing them or being overwhelmed when the optical sorter didn't catch them. Further study could be done to better understand the effectiveness of optical sorters on different types of cups and if programming could be improved to recognize them.

CONCLUSIONS

This study demonstrates the power of examining a material's inherent behavior in a MRF environment. Understanding how that material will flow allows for informed, operational actions to maximize recovery of that material. It is a useful exercise, as was done here, to look at not only new materials (that aren't currently accepted) to see which MRF end-products they can be a part of, but also to see how currently accepted materials, both prevalent and not, are being recovered. Recycling is a complicated system of consumer behavior, collection programs, sorting at MRFs and end markets. All stages of the value chain need to be similarly examined to create a full picture of recyclability. As shown in this study, examining and solving material processing challenges at the modern MRF is a necessary step in achieving success for the recycling industry of the future.

RRS

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FOOD RESIDUE STUDY

NOVEMBER 2022

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FOODSERVICE PACKAGING INSTITUTE®

Overview of 2022 Food Residue Study

Background

The Foodservice Packaging Institute's Paper Recovery Alliance and Plastics Recovery Group have been working on overcoming barriers to recovery of foodservice packaging. One of the often-cited reasons foodservice packaging is not accepted for recycling is the concern about increased levels of food contamination.

The Study

To address this concern, a study was conducted to learn whether foodservice packaging (such as take-out containers, cups or pizza boxes) set out for recycling were more contaminated than food contact packaging (such as peanut butter jars, cans or pasta boxes) that has traditionally been accepted at single-stream material recovery facilities (MRFs). This study took place at a MRF in Michigan (Nov 2022) and served as a follow-up study to the previous two studies conducted in Boston, Massachusetts (Sep-Oct 2013) and in Milford and New Castle, Delaware (July 2014).

The process for the study included sorting 13 200-pound samples of randomly selected residential curbside recyclables from recently tipped loads at the MRF. For all recycling samples, corrugated packaging, paper and paperboard, molded fiber, plastic containers, and aluminum cans and trays/plates were sorted into two categories: foodservice packaging or packaging in contact with food (e.g., jars, tubs, cans and boxes from prepackaged grocery store items). The sort team used a visual rating system to assess individual packages in each of the selected categories to record the impact among foodservice vs. food contact packaging, utilizing a rating scale from 1 to 5, where packaging found to be clean was rated 1 and packaging found to be highly contaminated was rated 5.

The Results

The study found that the vast majority of foodservice and food contact packaging in the recycling stream are relatively clean and were rated as a 1 or 2, a finding similar to the previous two food residue studies conducted in 2013 and 2014. For paper and paperboard and plastic containers, both food contact and foodservice categories had similar, and extremely low rates of significant residue (ratings of 4 and 5 totaled 0% for paper and paperboard, and 2% for plastic containers regardless of foodservice/food contact).

The packaging types that contained the most food residue included both food contact and foodservice items, and were peanut butter jars, plastic salad clamshells, ice cream cartons and pizza boxes. Across all materials and uses, the only categories that had more than 10% of packages with significant residue (ratings of 4 and 5) were Corrugated Foodservice Packaging with 17% and Molded Fiber Foodservice with 23%. All of the other categories had 7% or less of packages with significant residue (ratings of 4 and 5 together).

The category with the largest difference in food residue between food contact and foodservice packaging was molded fiber, with the foodservice subcategory significantly more frequently observed to contain food residue. This is both due to some common foodservice molded fiber applications being prone to residue, as well as the most common food contact application (e.g., egg cartons) being exceptionally clean. Molded Fiber Foodservice packages rated a 1 or 2 were typically a drink cup holder, and those rated a 3 or 4 were typically a clamshell or a

plate with food residue. The only Molded Fiber Food Contact packaging observed was egg cartons, which occasionally had minimal food residue but was typically clean, and overall had the lowest average rating of all sort categories.

Other Notes

As part of the sorting process, samples were initially characterized in terms of total foodservice, total food contact, other recyclables and trash, by weight. An average of 13% of the sampled material contained contaminants consisting of trash or other items that are not accepted by the MRF. This low contamination rate is an indicator of strong education programs, presumably making it less likely that residents would deposit highly contaminated packaging into their recycling carts.

Conclusions

With the exception of molded fiber items, the percentage of foodservice and food contact items within the sorted material categories (OCC, plastic containers, aluminum, etc.) containing significant amounts of food residue is roughly the same.

Additional studies will be needed at varying locations to develop a robust dataset, though all three studies conducted to date have provided similar conclusions.

More information on FPI's recovery work is available at www.recycleFSP.org.