Report
on

Processing of Hot Drink Cups

Prepared For:

City of Toronto

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EXECUTIVE SUMMARY

- Approximately 358 million hot drink cups and the same number of lids available for recovery in the City of Toronto each year. Of these, it is estimated that Toronto would have access annually to about 197 million cups and the same number of lids (or 45% of available) at its MRFs.

- Optical sorters:

  - are able to recognize PS lids, but may have difficulty identifying dark brown and black lids – one supplier says it is not a problem, two say it currently is a problem
  - currently have difficulty identifying and separating hot drink cups (paper based) from ONP, since the cups replicate OBB.

- Neither of Toronto's current MRFs has space to accommodate the mechanical and manual processing infrastructure that might be needed to separate cups and lids from the SSRM.

- If space were available (and assuming optical sorters were able to identify the products), the estimated annual cost of sorting hot drink cups and lids is ~ $1.76 million, not including the cost of associated transfer conveyors, chutes, storage bunkers and product baling.

- Optical equipment suppliers have offered to undertake trials to test and improve the sorting capabilities of their equipment to recovery these materials. Issues regarding the ability of optical sorters to separate paper based cups and dark lids will not be fully resolved without further testing.

- Even if optical sorting capabilities improve, a key concern is the amount of cups and lids that would be "lost" in the fibre products:

  - many of the cups and lids (estimated 5%-10%) would be buried in the volume of ONP produced at the MRF (i.e. not visible to either manual or optical sorters)
  - paper markets are already complaining about contamination of delivered products being at or over the limit of acceptability.
  - regardless of the improvements to current sorting methods, contamination of ONP would likely increase with the introduction of hot drink cups and lids as a designated SSRM.

It is recommended that:

- the City of Toronto **not** include hot drink cups and lids in the SSRM program at this time.
- the City consider recovery of separately collected hot drink cups and lids (from open space bins) on a dedicated commercial sorting line in any future MRF. In this manner, they would not be combined with SSRM in the MRF.
- Toronto work with the suppliers of optical sorting equipment to test and improve their ability to identify and sort hot drink cups and lids.
- Toronto work with cup and lid suppliers to see if design changes are possible to improve the ability of the MRFs to recover more cups and lids.

1.0 INTRODUCTION

1.1 Background

On December 1-2, 2008, Toronto City Council considered the In Store Packaging Report, which looked at plastic bags, take-out food containers, plastic water bottles, toxic waste (batteries), and hot drink cups. In particular, it looked at how to source reduce these items and make them compatible with the City's recycling system.

Staff recommended that starting June 1, 2009, all hot drink retailers must provide a 20¢ discount to a customer that uses a ceramic mug, to offset the use of paper or plastic cups. They also recommended that such a change be supported by signage and noted on the cash register receipt. Staff recommended that any cup not compatible with the City of Toronto's recycling system by December 31, 2009, would be banned.

Recommendations for hot drink cups were not considered by City Council on those dates, and instead were referred back to Staff and the Hot Drink Cup Taskforce for further consideration. Staff were asked by City Council and the Public Works and Infrastructure Committee (PWI) to meet with hot drink retailers and seek a resolution to achieve both source reduction and compatibility. Staff met with a smaller group of stakeholders in December and asked them to convene a larger group of stakeholders, including hot drink retailers/brand owners, material suppliers, material converters, distributors/wholesalers, and trade organizations.

A stackholder taskforce was formed in January 2009 in addition to a number of smaller steering groups set up to consider certain components of the hot drink cup issue. The purpose of convening these sessions is to seek input from stakeholders and to inform stakeholders on where the City is headed. If the group were able to reach a consensus on how to proceed, that would strengthen staff's revised recommendations.

The subcommittees included those dealing with:

- Research and Policy Support
- Processing
- Market Assessment, and
- Food Safety.

1.2 Hot Drink Cups and Lids

Hot drink cups are sold in Toronto in a variety of sizes and material types. The majority of cups are made from high quality bleached paperboard fibre with a thin polyethylene interior liner that acts as a liquid barrier. Some cups are made of polystyrene foam and some of these foam cups are manufactured so that the exterior of the cup feels soft and "fuzzy" to the touch. Another cup on the market is made from PLA (polylactic acid) resin. These cups are 100% compostable and biodegrade over time.

In addition to the type of cup sold, very often a kraft sleeve is placed on the outside of the cup to protect the user from the hot liquid inside. Each of these cup characteristics are important when considering how the cup might be sorted in a recycling facility.

The vast majority of lids are made from rigid polystyrene, although some are made from polystyrene foam. The colour of the lid may also impact identification and sorting in a MRF.

1.3 Entec Consulting Ltd. Workscope

Entec Consulting Ltd. was engaged by the City of Toronto to investigate options for processing hot drink cups and lids. In broad terms, the scope of work included:

MRF Site Visits - visits to Toronto's Dufferin MRF and the Metro Waste MRF to observe cups throughout the current processing system, to discuss the issue with MRF staff, and to review potential options for incorporating additional optical sorting or other processing options at the MRFs.

Survey of Other Municipalities - other municipalities (e.g. Hamilton, Essex-Windsor, Owen Sound, York Region, etc.) are often cited as recycling hot drink cups and lids. A telephone survey of these programs will be conducted to review specifics of how these products are handled, problems encountered and potential barriers for application of these measures in Toronto.

Identify Potential Processing Options - potential options to process hot drink cups and lids will be identified and defined. It is anticipated that optical sorting may be a viable option at MRFs that process Toronto's recyclables. Even if this equipment offers a technical solution to the problem, the MRFs may not have sufficient space to accommodate the required equipment. Budget capital and operating costs for technical solutions will be estimated as well as the timeline impacts of implementing these measures.

Summary Report - results of the research and analysis will be presented in a Project Report summarizing the study findings.

2.0 CURRENT MRF PROCESSING OF CUPS AND LIDS

2.1 Background

Toronto's Single Stream Recyclable Materials (SSRM) are currently processed at one of two MRFs:

- the Dufferin MRF, owned by the City of Toronto and operated under contract by Canada Fibres, and
- the Metro Waste Paper MRF, owned and operated by Metro Waste Paper under contract to the City.

Both MRFs are single stream MRFs, accepting fully commingled household recyclables collected from Toronto households, as well as a variety of other recyclables such as office paper, cardboard and recyclable container materials collected from commercial and institutional sources. In addition to Toronto MRFs processing SSRM, Turtle Island Recycling, under contract to Tim Hortons, processes hot drink cups collected from numerous city retail locations in its own MRF.

Before assessing the ability to process hot drink cups, it is necessary to understand how the processing facilities currently operate and how recyclables (and particularly hot drink cups and lids) flow through the processing system.

2.2 Dufferin MRF

Dufferin MRF currently processes about 42% of Toronto's SSRM or about 87,000 tonnes/yr. Most of the SSRM are delivered directly from collection vehicles, although some of the recyclables are delivered in transfer trailers arriving from Toronto's transfer stations.

SSRM are offloaded on a large tipping floor and are stored there until fed into the processing system. A schematic showing basic processing steps in the Dufferin MRF is presented in Figure 2.1. The red lines show the movement of cups and lids through the existing process.

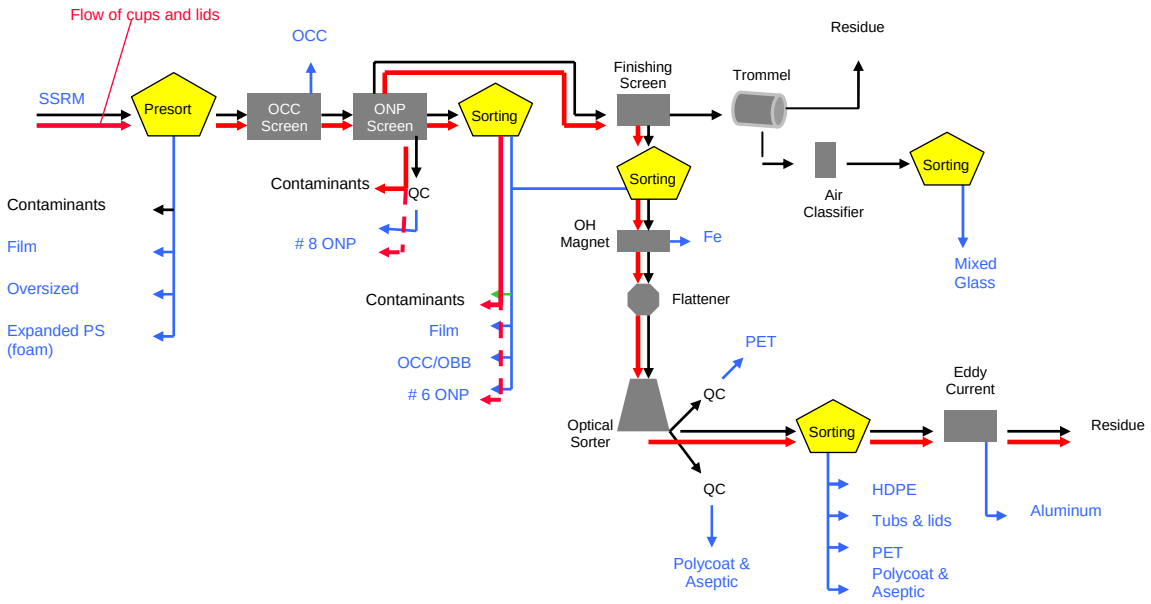
A number of materials are manually removed at the presort station including contaminants, large pieces of film plastic and plastic bags, polystyrene foam and oversized materials (e.g. cardboard) that might cause jamming of equipment. Recyclables then pass through an OCC screen while cardboard (OCC) passes over the screen. Most recyclables then pass through newspaper (ONP) screens while ONP moves over the screen. Most cups and lids will move with the container stream at this point in the process (estimated about 80%) with the remainder lost in the fibre products (estimated 10% over the screens in the ONP and 10% in the paper that goes through the screen). Manual quality control sorting is done on the final paper products to remove any plastic film, flattened plastic bottles or cans, OCC

and OBB, etc. that are visible. In both of these sorting systems, very few cups or lids are presently removed, since sorters focus on larger, more visible contaminants.

The container mix moves on through a finishing screen (for a further separation of smaller paper from containers). Smaller materials passing through the screen (primarily glass, bottle caps, grit, ceramics, etc.) are sent on to an air classifier where lighter materials are separated from heavier material (primarily glass).

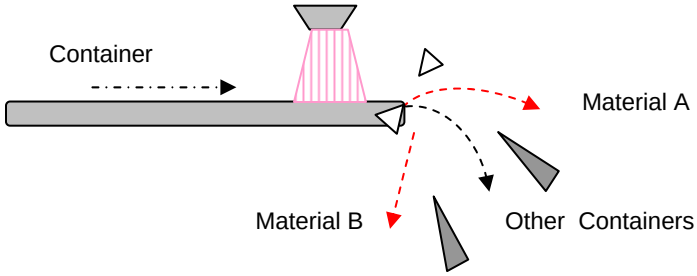
Remaining containers (consisting primarily of cans, plastic bottles, tubs and lids, juice and drink cartons) pass through a manual sorting station (where any remaining pieces of larger fibre are removed and returned to the paper sorting lines), a magnetic separator (for removal of ferrous cans) a flattener and then travel on to an optical sorter.

Figure 2.1: Schematic of Dufferin MRF Processing



The optical sorter consists of a high speed acceleration conveyor (to spread material out before passing under the sensors) the optical scanners and ejection jets that blow the detected material away from other containers. The optical sensors scan the near infrared part of the electromagnetic spectrum of each object. The scanner analyzes the reflected spectrum to identify each object's signature. Each of the targeted objects is thus identified as is its position on the conveyor. When the item reaches the end of the conveyor, compressed air releases from programmed air jets to eject the targeted materials. A schematic of an optical sorter is presented in Figure 2.2 to illustrate this process. One set of air jets eject the first material upward while a second set ejects the second material downward. The "pass" portion falls between the two. Further detail regarding optical sorting technology is presented in Section 3.5.1.

Figure 2.2: Schematic of Optical Sorter



The Dufferin optical sorter is programmed to eject two materials: PET and; polycoat and aseptic cartons. While most cups and lids remain in the "pass" portion of the materials (i.e. not ejected but passing through the optical sorter), some are caught in the ejected streams. Manual quality control sorting for the ejected materials removed the majority of the non-targeted materials. The remaining materials pass though one final manual sorting station for removal of HDPE, tubs and lids, aluminum foil, and any remaining polycoat and aseptic cartons and PET. The "pass" material (containing the majority of the cups and lids) then travels over an eddy current separator where aluminum cans are removed. The remaining material is considered residue and is sent to disposal.

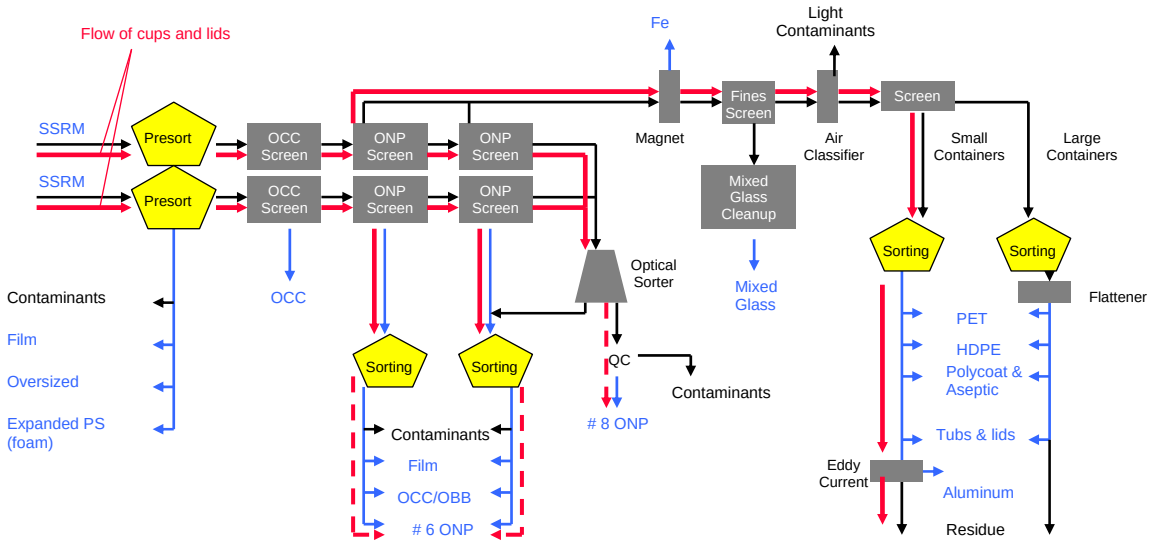
2.3 Metro Waste Paper MRF

A Metro Waste Paper MRF processing schematic is presented in Figure 2.3. The MRF processes approximately 120,000 tonnes/yr of SSRM for the City of Toronto.

Incoming recyclables are primarily delivered to the MRF from Toronto's transfer stations and received on the tipping floor. Two infeed conveyor lines take the SSRM through a presort station where, as at Dufferin, contaminants, large film plastic and oversized materials are removed, as well as expanded polystyrene foam. Large cardboard is removed by the OCC screens. All material falling through the screens then passes on to two sets of ONP screens. Here, paper is separated into two primary grades: mixed paper that still contains quantities of other materials, and; #8 ONP. The #8 ONP then passes through an optical sorter, where many of the non-paper items are removed. A final manual quality control sort removes any large, visible items missed by the optical sorter.

The mixed paper leaving the ONP screens proceeds through a manual sorting station to remove any identifiable contamination, film plastic, OCC and OBB before the paper falls into a floor level storage bunker.

Figure 2.3: Schematic of Metro Waste Processing



The container mix leaving the ONP screens passes under an overhead magnet where ferrous cans are removed. The remaining material passes over a fines screen. Smaller material passing through the screen (primarily glass) moves on to a cleanup system where glass is separated from other non-glass material. The rest of the containers pass through an air classifier (for removal of lighter paper, film, etc.) and then through another screen used to separate large and small containers. The larger containers are flattened (to reduce storage space) and both container lines then pass on to manual sorting conveyors, where any remaining plastic and polycoat and aseptic containers are removed. The final step is removal of aluminum cans by an eddy current separator. The “pass” material is sent for landfill disposal.

Visual observations and conversations with MRF staff indicated that approximately 90% of hot drink cups and lids in the current SSRM flow to the small container sorting line. Although not visible, it is estimated that about 8% of existing cups and lids end up in #6 ONP and about 2% in #8 ONP.

2.4 Turtle Island Recycling

Turtle Island Recycling collects and processes recyclables packaging (including hot drink cups) from approximately 170 Tim Hortons retail outlets in the Greater Toronto Area (GTA). Customers are requested to place empty cups and lids (separated) into designated” recyclables” bins at these locations. The bagged “recyclables” are removed from the bins and placed in carts awaiting collection. The collected bags are taken to the Turtle Island MRF where the contents are mixed with other grades of paper on the tipping floor. The material is then sent through a manual sorting process where contaminants, film plastic and

large cardboard are removed. Depending on source of incoming material and the final markets, the mixed paper may be processed once more further separate higher grades of paper such as office paper. The mixed paper grade containing hot drink cups is typically exported.

2.5 Other Ontario Recycling Programs

Over the past few months, a number of other Ontario recycling programs have been referenced as recycling hot drink cups and lids., including Hamilton, Essex Windsor, York Region and Owen Sound.

Green Bin Programs

Hamilton, Durham Region, Halton Region and Ottawa Valley all collect hot drinks cups as part of their green bin organics program. This application is not representative of the type of recycling system that Toronto is studying.

Blue Box Recycling

Essex Windsor, York Region and Owen Sound all include hot drink cups as designated recyclables in their Blue Box programs.

Essex Windsor – collect curbside recyclables in two streams: containers in a blue box and fibre in a red box. Hot drink cups are requested (without lids) in the red box. The cups are not separated during processing. The majority end up in the mixed paper product and are designated as an "outthrow" in that product. To date, markets for the mixed paper have not had an issue with contamination levels.

York Region – has a single stream curbside collection program that accepts not drink cups (without lids). The cups are not separated during processing. Staff think that the majority of the cups end up in the mixed paper product. The cups are designated as an "outthrow" in that product. To date, markets for the mixed paper have not had an issue with contamination levels.

Owen Sound (6,200 households) – has a 3-stream curbside blue box collection program consisting of:

- containers in a blue box
- paper, magazines, directories, etc. contained in a paper or plastic bag
- cups, boxboard, juice cartons, egg cartons, etc. contained in a paper bag or cardboard box (i.e. a "hardpack" mix).

The "hardpack" mix is bulked at the Miller Waste MRF without sorting and marketed to Canada Fibres. It is not clear whether further sorting is done on this mix or whether or not the cups are considered a contaminant by the final market.

3.0 ESTIMATED GENERATION AND RECOVERY OF CUPS AND LIDS

3.1 City of Toronto Generation of Cups and Lids

Table 3.1 shows assumed generation and distribution data for cups and lids in the city. Toronto staff estimate that 1 million hot drink cups and lids are used in Toronto each day. Transportation survey results showed that in 2001, trips into the city from outside its boundaries exceeded trips leaving the city for surrounding areas by 185,025. In the absence of more accurate survey data, it is therefore reasonable to assume that this information is still current and that there are approximately 185,025 cups travelling outside of the city with these commuters are approximately equal to those coming into the city. Therefore, the net generation of cups within the city remains at about 1.184 million for a typical weekday.

Table 3.1: Generation of Cups and Lids in the City of Toronto

Generation					
Estimated CoT generation of cups & lids				1,000,000	per day
Trips out of city				-152,858	
Trips into city				336,883	
Net daily CoT generation of cups & lids				**1,184,025**	
Weekday generation	250	days @	100%	296,006,250	
Weekend generation	104	days @	50%	61,569,300	
Total				**357,575,550**	/yr
Cup Weight					
Average Wt of cup (large)	12	g			
Total wt generated				4,290,906,600	g/yr
				4,290,907	kg/yr
				4,291	**tonnes/yr**
Lid Weight					
Average Wt of cup (large)	2	g			
Total wt generated				715,151,100	g/yr
				715,151	kg/yr
				715	**tonnes/yr**

Assuming weekend generation of cups and lids is about 50% of weekday generation, approximately 357.6 million hot drink cups and lids are generated each year in the city. Based on the measured weight in the MRF of a large paper cup (12g) and lid (2g), the annual generation of cups and lids is about 5,000 tonnes/yr.

3.2 City of Toronto Distribution and Collection of Cups and Lids

The distribution of cups and lids within the city after consumption is very difficult to establish. Some cups are purchased on the trip to the office and end up in an office recycling or garbage bin, some are consumed while walking and deposited either in public space recycling or garbage bins, some are consumed in cars or trucks and taken home at the end of the day and some may be deposited in bins at retail locations where they were purchased.

Table 3.2 shows the assumed daily distribution of cups and lids after consumption within the city. It is thought that if cups and lids were added to the City's designated recyclables list, only 10% would travel home with commuters to Toronto households, 25% would be deposited into waste receptacles (at any location), 45% would be deposited in public space bins and the remaining 20% would end up in retail or office recycling bins that would be privately collected.

Packaging for recycling is currently collected by Turtle Island Recycling from retail and other commercial recycling locations within the city. The city currently provides a separate collection service for all 12,000 public space recycling containers. Toronto MRFs would therefore have access to all recyclables collected from the public space bins and collected from city single family and multi-residential households, or about 55% of the hot drink cups and lids available within the city.

Based on the previous data and assuming an average cup and lid weights indicated previously, 2,360 tonnes of cups and 393 tonnes of lids each year would potentially be delivered to Toronto MRFs.

3.3 Flow of Cups and Lids Through Toronto's MRFs

The Dufferin MRF currently processes about 42% of Toronto's SSRM, while the Metro Waste Paper MRF processes the remainder. Assuming the total estimated quantity of cups and lids that might be delivered to Toronto's MRFs, Table 3.2 shows the assumed distribution of the number and tonnages of cups and lids to be processed each of Toronto's MRFs.

Table 3.2: Estimated Distribution of Cups and Lids in Toronto

Assumed Cup Distribution for Collection					
Retail outlets &Private Collection	20%			858	tonnes/yr
Street bins to MRF	45%			**1931**	**tonnes/yr**
Households to MRF	10%			**429**	**tonnes/yr**
Refuse	25%			1073	tonnes/yr
	100%				
Toronto MRFS			**Operating hrs/yr**	**kg/hr**	
Dufferin MRF	42%	992	3500	283	
Metro Waste MRF	58%	1368	3500	391	
		2,360			

Assumed Lid Distribution for Collection					
Retail outlets &Private Collection	20%			143	tonnes/yr
Street bins to MRF	45%			**322**	**tonnes/yr**
Households to MRF	10%			**72**	**tonnes/yr**
Refuse	25%			179	tonnes/yr
	100%				
Toronto MRFS			**Operating hrs/yr**	**kg/hr**	
Dufferin MRF	42%	165	3500	47	
Metro Waste MRF	58%	228	3500	65	
		393			

Assumed Cup Distribution for Collection				
Retail outlets &Private Collection	20%		71,515,110	units/yr
Street bins to MRF	45%		**160,908,998**	**units/yr**
Households to MRF	10%		**35,757,555**	**units/yr**
Refuse	25%		89,393,888	units/yr
	100%		357,575,550	units/yr
Toronto MRFS			**Operating hrs/yr**	**units/hr**
Dufferin MRF	42%	82,656,957	3500	23,616
Metro Waste MRF	58%	114,009,596	3500	32,574
		196,666,553		

Assumed Lid Distribution for Collection				
Retail outlets &Private Collection	20%		71,515,110	units/yr
Street bins to MRF	45%		**160,908,998**	**units/yr**
Households to MRF	10%		**35,757,555**	**units/yr**
Refuse	25%		89,393,888	units/yr
	100%		357,575,550	units/yr
Toronto MRFS			**Operating hrs/yr**	**units/hr**
Dufferin MRF	42%	82656957	3500	23,616
Metro Waste MRF	58%	114009596	3500	32,574
		196,666,553		

3.4 Manual Sorting of Cups and Lids in Toronto's MRFs

Recovery and cups and lids in Toronto's MRFs can be accomplished either through the use of manual sorting, or through the use of optical sorting equipment. This section considers estimated manual sorting requirements at the MRFs.

3.4.1 The Container Streams

In both of Toronto's MRFs, the majority of tubs and lids flow through the process with the container stream, as discussed in Section 2.2. Table 3.3 shows the estimated number of cups and lids flowing through the Dufferin MRF in each of the material streams.

Table 3.3: Estimated Manual Sorting Requirements for Cups and Lids at Toronto's MRFs

Dufferin MRF		**Estimated Cup Distribution**				
		kg/hr	**Cups/hr**	**Cups/min**	**Sorter picks/min**	**# Sorters**
# 8 ONP	10%	28.3	2,362	39	45	0.9
# 6 ONP	10%	28.3	2,362	39	45	0.9
Container residue	80%	226.7	18,893	315	45	7.0
	100%	283.4	23,616	394		**9**
		Estimated Lid Distribution				
		kg/hr	**Lids/hr**	**Lids/min**	**Sorter picks/min**	**# Sorters**
# 8 ONP	10%	4.7	2,362	39	45	0.9
# 6 ONP	10%	4.7	2,362	39	45	0.9
Container residue	80%	37.8	18,893	315	45	7.0
	100%	47.2	23,616	394		**9**
Metro Waste MRF		**Estimated Cup Distribution**				
		kg/hr	**Cups/hr**	**Cups/min**	**Sorter picks/min**	**# Sorters**
# 8 ONP	2%	7.8	651	11	45	0.2
# 6 ONP	8%	31.3	2,606	43	45	1.0
Small containers	90%	351.8	29,317	489	45	10.9
	100%	390.9	32,574	543		**13**
		Estimated Lid Distribution				
		kg/hr	**Lids/hr**	**Lids/min**	**Sorter picks/min**	**# Sorters**
# 8 ONP	2%	1.3	651	11	45	0.2
# 6 ONP	8%	5.2	2,606	43	45	1.0
Small containers	90%	58.6	29,317	489	45	10.9
	100%	65.1	32,574	543		**13**
					Total	**44**

It is estimated that approximately 80% - 90% of the cups and lids flow with the container stream at the MRFs. The majority of these at Dufferin would be available for recovery following the manual sorting station after the optical sorter (prior to the eddy current separator). At Metro Waste, these would best be sorted at the small container line.

At a representative sorter productivity rate of 45 picks/minute, 7 sorters would be required at Dufferin and 11 sorters would be required for manual sorting of only cups. The same number of sorters would be required for manual sorting of lids.

3.4.2 The Fibre Streams

Manual sorting of cups and lids from the fibre product streams under current operating conditions would be challenging. Since paper is the largest component of the SSRM in the MRF, the final QC conveyor at each MRF is a high volume conveyor. For example, this conveyor at Metro Waste's MRF is travelling at a speed of between 2.5 to 3 m/s. Quality control sorters at this location need to be quick to remove larger contaminants that pass through the optical sorter, such as film grocery bags, pieces of OCC, etc. It would be even more difficult to remove smaller lids and cups that are lying flat on a conveyor.

The manual sorting requirements on the fibre products at both MRFs are therefore considered theoretical. In reality, additional sorters may be required on each of the fibre QC lines to remove cups and lids. For example, because of the width of the QC conveyors, it is not practical to use only one QC sorter on each line, since the sorter would not be able to reach the items on the far side of the QC conveyor.

3.5 Optical Sorting

3.5.1 General

The optical sorting process can be divided into three main parts: material preparation, identification (recognition) and separation (singulation). For best results, material must be presented to the optical sensors in a single layer and in order to spread material out, an accelerator conveyor is used prior to the sensor.

Paper and plastic items that are spread out on a conveyor belt in a single layer are illuminated by a halogen lamp which, because of the unique combination of wavelengths in the infra-red spectrum reflected by each, allows the materials to be identified individually. A computer analyzing the sensor's data is thus able to determine the type, shape, color and position of each item. Colour sorters for paper may involve CMYK camera technology, which detects the four primary colours – cyan, magenta, yellow and black. Infrared spectroscopy is used to differentiate among resin grades (e.g. PET from HDPE or PS) and to tell different paper fibres apart. When

sorting paper by grade or plastics by resin type, the sensor peers down on the material and analyzes the reflective light spectrum.

When the identified and targeted material reaches the end of the conveyor, air jets and the correct location and time eject the target material from the remaining mixture.

Optical sorting of any material from a fibre mix is inherently more difficult than from a container stream due to the size and nature of the paper. Flattened materials (e.g. PET bottles, film plastic, paper cups, etc.) tend to get mixed in with the paper during processing and are difficult to identify and to separate from the paper. While it is easier to separate non-paper items from the paper items, some are still missed and enter the fibre product as a contaminant. Optical sorting technology is not as well developed for fibre as it is for containers. For some optical sorter suppliers, it is still difficult to separate some paper products such as cardboard and boxboard from newspaper.

Typically, an optical sorter is used to replace manual sorters – the more sorters dedicated to positively sorting an individual material, the greater the justification for utilizing an optical sorter.

3.5.2 The Container Stream

Cups

On the container sorting conveyors at both MRF locations, the material mix would consist of cups, lids, aluminum cans, residual paper, any other recyclable containers missed by previous sorting efforts and non-recyclable contaminants that have travelled through the MRFs with the container stream. Theoretically, an optical sorter could be used at these locations to reduce the number of manual sorters required to capture hot drink cups. The sorter could be programmed to identify and eject “paper” from all other materials. Unfortunately, optical sorter equipment suppliers are not completely in agreement that that their sorting equipment is currently capable of isolating the cups from other paper on this conveyor. One supplier felt that his equipment could sort the cups and two others felt that recognition may be a problem, since the cups would likely register as humid boxboard, and it is difficult for the scanner to distinguish boxboard from ONP.

If all paper were ejected from the container stream, there would still be a requirement for manual quality control sorting to separate the cups from other paper, thereby offsetting any potential gain in reducing the number of manual sorters required. At this time, if cups are to be marketed as a separate material grade, manual sorting of cups at this location would be required.

Lids

A Near Infrared (NIR) optical sorter is able to identify and eject polystyrene (PS) from other resins and materials. All PS would be ejected – foam cups, lids, clamshells, etc.

At the present time, this mix can be sold to market as a mixed PS grade. Again, while it an optical sorter can identify and eject PS, opinion is divided as to the ability of the optical sorter to identify dark brown PS lids. One supplier stated that his equipment can sort the lids and two other suppliers were not convinced that their sorters could identify the dark lids. All suppliers requested an opportunity to do testing to see if the sensors could be programmed to identify the dark lids.

3.5.3 The Fibre Streams

Cups

Optical sorter equipment suppliers were again split in their ability to identify and separate hot drink cups from the product paper streams. One supplier was convinced that cups could be sorted from paper and the others expressed concern about the ability to recognize and isolate the cups. Even if the cups could be recognized and ejected, an optical sorter typically results in a "purity" rate of about 90% (meaning that the target material contains 10% of other materials that are blown off with the target material). Furthermore, even if an optical sorter were able to identify and eject paper cups, each optical sorter would be replacing only 2 manual sorters. Therefore, at the present time, manual sorting of cups would be the best alternative at each fibre QC line.

Lids

An optical sorter could be used on both the #6 ONP and #8 ONP lines to remove lids from the paper products (since at least one manufacturer is confident in the ability of the optical sorter to identify dark lids). Any lids under the paper on the conveyor would not be detected and although any lids on top of paper would be detected, the air jets would have trouble blowing the lid and may take the paper with the lid. Again with the lids, approximately 10% contamination (other materials) would be ejected with the PS lids, requiring further manual sorting of the contaminants.

Even if optical sorters were able to identify and eject cups and lids and quality control sorters were utilized, it is estimated that at least 5%-10% of the cups and lids would be "lost" in the volume of ONP processed (i.e. not visible to either optical or manual sorters). This would pose a major contamination issue for product ONP.

3.6 Summary

It is clear that sufficient issues and questions exist regarding the use of optical sorters to remove both the cups and dark lids from both the container and the fibre streams in Toronto's MRFs. It is likely that these issues will not be fully resolved without testing sorting of sample hot drink cups and lids using a variety of optical sorting equipment commercially available.

For the purposes of this study at this time, it will be assumed that lids can be optically sorted from the MRF container lines (since at least one manufacturer is confident that this

can be done). Quality control manual sorting will still be required on the ejected PS to remove any remaining contamination and other recyclables. Cups, however, will still need to be manually sorted from the container line. The sorting requirements for cups and lids on the MRF container lines are shown in Figure 3.1.

Figure 3.1: Schematic of Required Cup and Lid Sorting on the MRF Container Lines

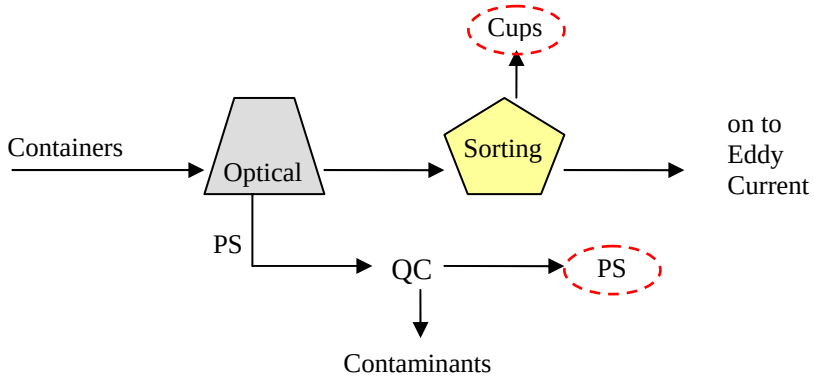
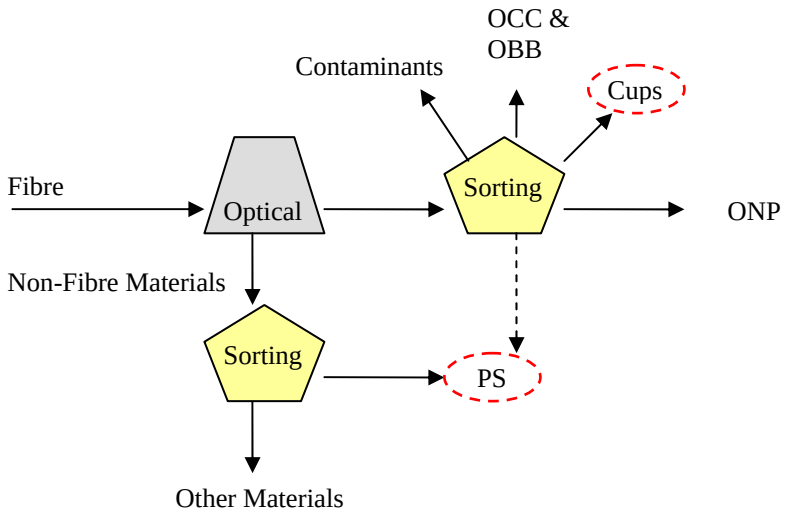


Figure 3.2 illustrates the proposed sorting requirements for the MRF fibre lines. An optical sorter would be used to separate non-fibre materials (film, plastic bottles, cans, lids, etc.). Lids would then be manually sorted from this mix (not sufficient sorters to justify a second optical sorter dedicated to PS). Manual sorting would then remove any remaining film or other visible contaminants from the paper products, such as OBB and OCC, and hot drink cups and lids. As previously mentioned, small items such as cups and lids would be very difficult to sort at this location, because of the speed of the discharge conveyor, their size and the fact that they are lying flat on the conveyor.

Figure 3.2: Schematic of Required Cup and Lid Sorting on the MRF Fibre Lines



4.0 PROCESSING COSTS

4.1 General

Both the Dufferin MRF and the Metro Waste Paper MRF are currently operating at full capacity and both have no remaining space within the current buildings to consider modifications to allow for manual or mechanical sorting of hot cups and lids. Consideration of processing costs for this project would need to focus on future MRF requirements, either for their own Toronto MRF or for one that would operate under contract to process Toronto's SSRM.

4.2 Projected Processing Costs

The capital cost of a single eject optical sorter, including all associated equipment (accelerator conveyor, compressor, catcher hood, product conveyor, controls and wiring, etc.) is approximately $500,000 not including freight and installation costs of about $100,000. Amortized at 5% interest over a life of 7 years, the annual cost would be approximately $103,700 for each optical sorter.

The annual cost of a manual sorter at a MRF is approximately $30,000, taking into account the base salary, overheads and benefits.

Based on the sorting arrangement illustrated in Figure 3.1 and the sorter requirements indicated in Table 3.3, estimated processing requirements at each MRF and the associated costs are indicated in Table 4.1.

These costs do not include product storage bunker or silos (one for the cups and one for PS) any associated transfer conveyors and chutes required to direct the products into the bunkers and any engineering and installation costs. Furthermore, the cost of baling the products and supervision and training costs for the manual sorters required have not been included.

The foregoing costs are theoretical in nature, because the reality is that the existing MRFs do not have any space available to consider sorting cups and lids. Potentially, consideration might be given to extend the existing building shell at the Dufferin MRF to providing additional sorting. The cost of such an extension, even if it were possible, is considered prohibitive. It is not clear if such an extension could be considered at the Metro Waste Paper MRF. Estimating the cost of such modification is beyond the scope of this study.

Table 4.1: Summary of Estimated MRF Processing Costs

	Item	Qnty	Estimated Capital Cost	Estimated Staff	Estimated Annual Cost	Comment
Dufferin MRF						
Containers						
Lids						
	Optical sorter for PS	1	$ 600,000		$ 103,700	
	Maintenance				$ 20,000	
	QC for PS			2	$ 60,000	
Cups						
	Manual sorting			7	$ 210,000	
Fibre Lines						
Lids	Optical sorters for non-fibre	2	$ 1,200,000		$ 207,400	one for each fibre product line
	Maintenance				$ 40,000	
	Manual sorting			2	$ 60,000	
Cups	Manual sorting			4	$ 120,000	need one sorter on each side of product conveyor
	Total Dufferin Cost		**$ 1,800,000**	**15**	**$ 821,100**	
Metro Waste MRF						
Containers						
Lids						
	Optical sorter for PS	1	$ 600,000		$ 103,700	
	Maintenance				$ 20,000	
	QC for PS			2	$ 60,000	
Cups						
	Manual sorting			11	$ 330,000	
Fibre Lines						
Lids	Optical sorters for non-fibre	2	$ 1,200,000		$ 207,400	one for each fibre product line
	Maintenance				$ 40,000	
	Manual sorting			2	$ 60,000	
Cups	Manual sorting			4	$ 120,000	need one sorter on each side of product conveyor
	Total Metro Waste Cost		**$ 1,800,000**	**19**	**$ 941,100**	

5.0 DISCUSSION AND RECOMMENDATIONS

Investigations for this project have identified a number of key issues related to the processing of hot drink cups and lids at Toronto MRFs:

- virtually all cups and lids are separated by the time they are fed to the initial in-feed conveyor in the MRF process, and the mast majority of paper cups are flattened.

- considering the current MRF designs, 80% of cups and lids are estimated to flow with the container stream.

- paper cups with the thin polyethelene resin wet strength liner cannot be identified by an optical sorter as a "polycoat" product – the resin is only visible on a flattened cup at the rim.

- there is not a clear consensus as to the ability of current optical sorting equipment to sort cups and lids:

  - dark PS lids may pose an identification problem – one manufacturer says the lids can be identified and two others say that their sorter may have a problem

  - paper cups with the thin resin wet strength liner cannot be identified by an optical sorter as a "polycoat" product – the resin is only visible on a flattened cup at the rim

  - paper cups appear like boxboard (OBB) to an optical sorter and the sorter has difficulty distinguishing OBB and ONP - one manufacturer is confident that the cups can be identified and two others say that their sorter may have a problem

  - all optical sorter manufacturers would like an opportunity to test samples of material to see if the scanners can be trained to identify the target products.

- the existing Toronto MRFs do not have any available space to accommodate the projected number of sorters and equipment considered necessary to recover cups and lids.

- even if optical sorters were able to effectively identify and sort and sort hot drink cups, many would still be buried in the ONP (estimated 5%-10%), leading to increased product contamination.

- paper markets are already complaining about contamination of delivered products being at or over the limit of acceptability. Further contamination of ONP could jeopardize the city's largest SSRM revenue generator.

With these points in mind, it is recommended that:

1. Toronto **not** add hot drink cups and lids to the SSRM program at this time.

2. Any future Toronto MRF be designed to isolate the processing of recyclables collected from public space bins so as to minimize the potential for ONP contamination. This could be done either by processing this "commercial" material through conventional processing equipment during designated hours, or through the design of a separate dedicated processing line.

3. The city should work with cup manufacturers and optical sorter suppliers to improve the ability of the MRF to recover hot drink cups and lids.