MRF optimization:

Cutting the costs of recycling

by Daniel Lantz and Dr. Fred Edgecombe

Facilities can improve performance by implementing these recommended cost-cutting strategies.

Increasing efficiencies and reducing the operating costs of materials recovery facilities (MRFs) are increasingly important aspects of municipal recycling efforts. Although part of the answer may lie in furthering education at the consumer level, a large, as-yet-untapped area may lie within the facilities themselves.

The Environment and Plastics Industry Council (formerly the Environment and Plastics Institute of Canada and now a council of the Canadian Plastics Industry Association) has long been committed to helping recycling programs achieve better efficiencies when it comes to handling plastics. Throughout the last few years, EPIC has funded several key studies just for this purpose. It co-sponsored the *Recycling Collection Cost Model* in 1992 and its update in 1996, the *Materials Recovery Facility - Processing Cost Model* in 1993, and the *Plastics Sorting Optimization Guide* in 1994. (For more information on the MRF-PCM, see "Changing your MRF? Here's a new tool" in the July 1995 issue.)

The guide gave MRF operators a theoretical look at facility procedures, policies and performance assessments. To follow up the theory and see how it actually worked in the field, EPIC applied the guide's industrial engineering practices to the actual operations of six Canadian MRFs. The study found, through a combination of on-site observations and measurements, and mutual discussions with MRF operators, sorting staff and management, that there were several productivity improvements, product quality improvements and cost-cutting measures that could be made. In fact, more than 30 recommendations were acted upon by five facilities. These changes will result in more than $1 million ($CN) annually in reduced processing costs.

Table 1 Plastics managed in each of the MRFs studied

	PET	HDPE	PP/HDPE tubs	PS	Plastic film	Mixed rigid plastic containers	PVC
1	✔	✔	✔		✔	✔	
2	✔	✔	✔		✔		✔
3	✔	✔		✔	✔		
4	✔	✔			✔		
5	✔	✔				✔	
6	✔	✔	✔	✔			

Source: Environment and Plastics Industry Council, 1997.

Study overview

One facility was chosen in each of six provinces across Canada. Four of the facilities processed an average of 110 to 120 metric tons of material per day, of which between two and five metric tons were plastics. One facility processed an average of 10 metric tons per day, of which between 0.4 to 0.6 metric tons were plastics. The sixth MRF processed approximately 40 metric tons per day, of which up to 1.5 metric tons were plastics. The range of plastics managed is outlined in

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Table 1.

Each MRF underwent a review for health and safety, labor and equipment resource requirements, line balancing and cost evaluation for the management of plastics. The study involved the following steps:

- establishment of a baseline (included a one-day in-MRF review)
- identification of productivity improvement, product quality improvement and cost reduction opportunities
- development of MRF action plans for improvement
- implementation of identified opportunities for improvement (included a two- to three-day in-MRF review)
- measurement of the impact of the changes.

The outcome of the study has been divided into two parts. This article focuses on the observations from the study, outlining common points where operational problems occurred within the MRFs and where changes were or should be (i.e., in the long-term) made.

Observations

An important aspect of the project was to take what was learned in the review of one MRF and, wherever possible, apply the knowledge to other facilities. Outlined in Table 2 are 12 operations areas which impacted on productivity, product quality and/or operating costs in two or more of the MRFs examined.

The three problems that have the highest impact on productivity, product quality and/or program cost are examined here.

Study objectives

- ✔ determine that productivity and product quality can be improved measurably through the application of sound industrial engineering practices
- ✔ determine the impact of MRF design on plastics sorting rates
- ✔ obtain a greater level of understanding of benchmark sorting rates for different types of plastics under varying operational setups
- ✔ assess the impact of product quality requirements on plastics sorting rates
- ✔ determine the range of plastics sorting costs

Problem: Sorting conveyor belt

One problem facilities shared was that the sorting conveyor belt was moving too quickly. The two most common reasons given for this were to increase throughput and to spread out the material so sorters could better see the material. MRF operators theorized that if the materials were not getting adequately sorted in the time allotted, by speeding up the sorting conveyor belt, sorters would be forced to work faster. However, in reality, having the sorting conveyor belt moving too quickly leads to a number of problems in the MRF, including:

- a high residue or contamination rate of the negatively sorted material (if it is decided not to recirculate the negative sort)
- a requirement to re-sort the negatively sorted material (i.e., the material that falls off the end of the line) in order to increase the recovery rate
- a high contamination rate in the sorted material (as sorters overthrow materials and they end up in the wrong bunker), resulting in downgrades on materials and revenues received
- having to add more sorters to handle the material as it travels along the sorting line, or having to sort the re-sort, thereby increasing costs.

To achieve benchmark sorting rates for specific materials, it is imperative that the motions of the sorters be limited to picking materials from the belt and not having to pull

materials back in front of them when they pass by too quickly. Slowing down the sorting conveyor (not the in-feed conveyor) increases the times that the sorters have available to sort individual materials.

In general, in those MRFs where the conveyor belt was slowed by 20 to 40 percent, productivity immediately increased by up to 40 percent, residue rates decreased by up to 50 percent, and/or the time required to sort the same quantity of material decreased by up to 33 percent.

Table 2 **Common points where problems occurred and changes were or should be made, and level of impact on productivity, product quality and program cost**

Category of change	Level of impact: Productivity	Product quality	Program cost
MRF equipment and configuration			
Sorting conveyor belt speed	High	High	High
Screen placement	Medium	Medium - High	Medium
Material storage	Medium	Medium	Medium
In-feed belt angle	Medium	Low - Medium	Medium
Materials movement	Low - Medium	Low - Medium	Low - Medium
Sorters/sorting function			
Plastic film removal	High	High	Medium - High
Re-sort	High	Medium	High
High-volume to low-volume order	Medium	Medium	Medium
Backsplashes	Medium	Medium	Low - Medium
Picking ergonomics	Medium	Low	Low - Medium
Administration			
Training investment in MRF	Medium	Medium	Medium
Full-time vs. temporary workers	Medium	Medium	Medium

Source: Environment and Plastics Industry Council, 1997.

Problem: Plastic film removal

In those programs that accept materials set out at the curb in plastic bags, the removal of materials and management of the plastic bags are problems. If the plastic film is left on the sorting conveyor, it is very difficult for the sorters to remove their assigned materials because the film covers material or holds the materials inside the bag. This reduces the capture rate for the ma als on the belt and decreases overall so rates because the sorters have to move n

rial around, searching for their assigned materials. If steel containers remain inside plastic bags, the ferrous magnet will pick up the container, as well as all other materials inside the bag. This results in either high contamination rates for the steel fraction for which a reduced revenue is received, or additional sorting time has to be devoted to removing the contaminants.

In some market areas, plastic film in recovered material bales will result in downgrades or render the materials unmarketable.

All plastic film must be removed before reaching any of the sort stations assigned to specific containers or specific fibers. The first sort station(s) should debag the material and remove the plastic film. For those facilities managing a high degree of bag-based collected materials, several bag openers are available in the marketplace.

An effective approach implemented in one facility was to place a chain across the in-feed conveyor approximately three feet above the floor. This loose chain grabs the plastic film for a long enough period of time that one person can effectively remove more than 80 percent of the film at that point. This change replaced two people removing film at the first sort station who were able to remove only approximately 50 to 60 percent of the film.

By removing more of the plastic film at the floor sorting station, the overall rate of each of the sorters increased by approximately 40 percent, as it became much easier to see the material. Also, residue rates were greatly decreased and, when combined with slowing down the sorting conveyor belt speed, the need to re-sort the residue materials was eliminated.

Public education on how to set out materials at the curb

is still one of the most important tools available to the MRF operator to increase the efficiency of the facility. Instructing residents to not tie off the tops of bags can increase the rate at which the fibers or containers can be debagged at the MRF. Picking up the material, but having reminder tags to place in curbside containers asking residents to not tie bags or containers (e.g., milk jugs tied together) can help to educate the public. This will increase sorting rates for each of the sorters and decrease contamination rates.

Problem: Re-sorting

There are two types of re-sorts that occur in MRFs. One is the recirculation of the negatively sorted materials from off the end of the sorting conveyor. This material is retransported to the in-feed conveyor to be sent back up the sorting conveyor for another attempt to capture more material.

The second type of re-sort is where two or more materials are placed in one bunker (e.g., PET and HDPE), only to be sorted later into two separate streams.

Both types of re-sorts cause problems for the MRF, including:

- capacity lost by having to take time to re-sort instead of sorting new material
- increased labor and operating costs to pick up the material and circulate it back from the end of the conveyor to the in-feed conveyor
- increased labor and operating costs to sort the materials to increase the capture rate
- increased wear on the conveyor belts that rerun broken glass (as applicable).

There are a number of ways to reduce or eliminate re-sorting:

Examine the conveyor belt speed. Assuming that the sorters are trained in their jobs and are working to a reasonable level (e.g., using both hands to sort), the primary reason seen for the sorters not being able to get everything on the first pass is the conveyor belt moving too quickly. The missed materials have to be recirculated from the negative sort.

Review the sort order. The sort order for the materials and contamination hindering the sight of the assigned materials should be examined and changed to improve the sorting rates (i.e., high-volume to low-volume).

Eliminate planned double sort. The MRF should be configured to eliminate the double handling of material (e.g., placing PET and HDPE into one bin to be re-sorted later).

To increase recovery rates and to eliminate re-sort, in all instances in all MRFs included in the study, the conveyor belt speed was reduced between 20 and 40 percent. In two facilities, the sort order was changed and, in another, the management of plastic film was improved.

Conclusion

This article examined three of the 12 biggest factors affecting the productivity, product quality and overall cost of operating a MRF.

In the June issue, the second article will outline what the impacts of the changes were in the MRF. Productivity increases and cost decreases will be detailed by material type. Included at the end of that article will be an operational checklist which will allow MRF operators to review their own facilities. If the MRF operator, supervisor and upper level management ask the questions on the checklist, it is estimated that they will identify between 60 and 80 percent of the same problems that the study team identified across the MRFs in the study. **RR**

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For a copy of the full report, *Plastics Sorti Optimization Guide*, contact Sonia Cassim-Smi at the Environment and Plastics Industry Counc (905) 678-7748.

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Notes

A metric ton equals 2,204.6 pounds.