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PROCESSING:

The lynchpin of recycling success

The goal of processing facility design must be to preserve the quality of the recovered material for use in manufacturing new, high-value products, as well as maintaining the integrity of the total recycling system.

by Susan Kinsella and Richard Gertman

Enthusiasm for single-stream recycling results, largely, from collection efficiencies and the resulting financial savings, but single-stream collection dramatically alters the requirements for processing the recovered materials, as well. Many recycling program managers have not recognized that most of the savings on the collection side of the program now must be shifted to processing. Instead, processing has become the weak link, jeopardizing the future of the recycling system.

While commingling all types of recyclables simplifies collection, the mix of materials makes processing much more complex. Material recovery facilities (MRFs) handling commingled materials are responsible for separating what is collected mixed together. Without investments in high-quality processing, single-stream programs may collect more, but ultimately recycle less than source-separated programs. The result may support only a narrow mix of recycled product options, instead of integrating recycling into a wide range of products that could maximize resource conservation.

Out of sorts

Once upon a time, recycling was an add-on to a municipalities' waste management responsibilities. Today, the focus of recycling is more clearly shifting to becoming a resource management system; its function increasingly directed to providing manufacturing feedstocks to high-tech production facilities.

Ironically, just as manufacturers need higher quality materials to meet ever-tighter customer specifications, many processors have been moving away from sorting to meet high-quality specs. Some markets, particularly exports, have been willing to buy poorly sorted materials, leading too many processors to assume that quality is unnecessary. If foreign mills are able to make products from poorly sorted materials, why do better?

In reality, the recovered materials have to be sorted somewhere. Each type of paper mill, for example, needs a specific type of fiber. While certain types of products can be made with commingled fibers, many cannot. Plastics processors cannot incorporate glass or paper into their products, and paper mills cannot use glass, plastics and metals. Glass bottle and fiberglass manufacturers cannot risk using poorly sorted glass. If North American processors do not do a good enough job, someone else has to do it.

North American manufacturers have added expensive sorting and cleaning systems onto the front-end of facilities, but still damaging contaminants cascade throughout the systems. Mills in China are no different. While many Chinese mills may be newer and built to anticipate poorer quality inputs, they, too, must re-

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process material from U.S. MRFs before it goes into their production systems.

These added costs are driving the cost of producing many recycled products beyond that of virgin products, and further jeopardizing recycling production in the U.S. and Canada. Recycled-product manufacturing capacity that closes in North America is not always replaced elsewhere; many products revert to only virgin materials options, which also means losing the robust environmental benefits recycled content provides.

Requiring manufacturers to take on the job of sorting the recovered materials bought for feedstocks is an indictment of the current state of recycling processing. Even with expensive, high-tech equipment in a processing facility, MRF costs are very minor compared to those of many recycled-product manufacturers. A typical MRF may cost considerably less than $10 million, while a moderate-sized newsprint mill is likely to cost several hundred million dollars. The appropriate site for processing is the MRF.

Designing the processing system

Processing facilities must be designed to match characteristics of the local recycling program it serves. To match these characteristics, several key questions must be asked:

- What materials will be processed?
- How much volume is expected?
- What markets are available for the sorted materials?
- What are the markets' requirements?
- What are the contractual requirements of the communities using the MRF?
- What price can the sorted materials return?

The key to designing a new processing facility, or evaluating whether an existing facility will meet a municipal recycling program's needs, is to begin with the end of the process in mind.

The processor and program managers should interview representatives of all available markets to determine the quality standards being required. This interview should include the actual manufacturers that will use the materials, not just the brokers who sell the materials. Recycling program managers should tour the manufacturing facilities as well, to better understand the role of their materials.

The processor's ability to properly prepare materials for use by manufacturers is critical to the vitality of recycled product manufacturing. That vitality, in turn, assures continued strong markets for materials recovered by community recycling programs. Discussions with market representatives should be ongoing throughout the life of the contract to ensure that the standards are being maintained.

The ideal opportunity to match the best processing system to a single-stream recycling program is when a new MRF is being designed. The processing design can optimize specific goals and characteristics of the program and its markets, as well as incorporate the most up-to-date equipment.

Often times, though, many single-stream programs must either retrofit an existing multi-stream MRF or share a processor with other municipal recycling programs. In that case, the municipal collection program may need to be designed to match the MRF's capabilities. Sometimes a processor can install new equipment or change the design configuration to accommodate the municipal program, but this is not always possible. Whether the single-stream program will use a new MRF or an existing processor, considering a number of key issues will help evaluate how best to handle the program's recovered materials.

Material matters

A MRF designed for a specific range of materials may not be able to add new materials without compromising the quality of the commodities being produced, which makes determining what materials the collection program will deliver very important. Part of the system may need to be redesigned, new equipment may need to be installed or the facility simply should not receive additional categories of materials.

In addition to determining which materials will be delivered, understanding the percentages of each material type, and what forms those materials will take, can ensure a MRF has enough sorting stations, storage bunkers and staff to properly separate each of the recyclable materials into marketable grades and remove contaminants.

Beyond the materials to be delivered, a program must estimate how much daily volume can be expected. The quantity of materials expected on an average day, and the difference expected on peak days, is critical in determining if the MRF's systems can handle the volume. A new MRF should be designed for greater capacity than initially expected, both to allow for future expansion and to prevent overburdening the system.

Existing MRFs simply should not receive volumes that exceed its capacity ratings. In fact, sorting equipment capacity ratings tend to be overly-optimistic. Volumes should always be below rated capacity to consistently achieve the highest quality.

Additionally, loads that vary by time of day, day of the week or source may affect tipping floor area requirements, storage capacity, worker schedules and the amount of rolling stock (loaders) that will be needed. Where more than one community recycling program uses the same processor, communities should require that processors provide details about what will be received at the MRF.

Contamination nation

Residents frequently want to recycle more material types than the program is designed to handle. For example, participants likely will include all plastics, instead of only plastic containers, so the facility must be designed to remove both film plastic and non-container, rigid plastics.

The condition of materials when they arrive at the MRF also will contribute to contamination and residue rates. High truck-compaction rates will make it harder to separate the mix of materials back into marketable commodities and may result in more broken glass. Materials generally are not processed as soon as they arrive at the facility, but rather are unloaded from the truck and, most often, dumped directly onto a concrete tipping floor. Then, loaders push the materials up into a big storage pile to provide adequate space for other loads to be added. The way these steps are handled can improve or reduce the recovery rate and the quality of the processed materials.

As the pile of delivered recyclables grows higher and more materials are pushed into it, cylindrical items, such as cans and bottles, are more likely to roll back down and be crushed under the loader's wheels. Additionally, the more the loader crushes the glass, the more likely it is to be ground so small that it will end up in the paper shipped to market, or in the facility residue being sent to a landfill.

Best practices in single-stream recycling

The Single Stream Recycling Best Practices Manual and Implementation Guide, developed by Conservatree and Environmental Planning Consultants, can be downloaded at www.conservatree.org. The manual highlights many ways to rethink recycling operations, focus on more targeted goals and adapt innovations in ways that benefit the whole system, not just discrete parts of it.

To develop these recommendations, Conservatree and EPC interviewed, visited and received feedback from hundreds of North American participants in all sectors of the recycling system, from collection and processing to manufacturing and recycled product purchasing. The manual focuses on single-stream programs because that is where the greatest discrepancies currently appear. However, because single-stream programs are not suitable for every community, the recommendations also are intended to benefit the many other types of recycling programs that exist as well, including dual-stream and multi-stream programs.

Loaders that drive back and forth over the materials in a pit can produce the same effect. Processing materials as close to their arrival time as possible can reduce these problems.

Three types of residue are common at processing facilities:

- Contaminants are not recyclable, and were not supposed to be set out for collection as recyclables (e.g. prohibitives, such as garbage).
- Process residue is recyclable, but not recovered by the MRF. This material is typically discarded to the landfill due to insufficient sorting. Process residue can also be materials that were recyclable when set out for collection, but were badly contaminated during collection and processing.
- Market residue is material that is shipped to a manufacturer that cannot use it. These materials are not discarded by the MRF, but are discarded by a secondary processing facility or a manufacturing facility. The extent of this residue should be included in quality reports from the manufacturer back to the processor and community program managers.

Often, much of the residue is broken glass, including fines and glass that is too contaminated to be used by glass container or fiberglass insulation manufacturers. Increasingly, residue also includes shredded paper, as residents become more concerned about personal security. Processors must plan for the increased burden of shredded paper, and recover it rather then sending it to landfill.

Communities should require that processors receive reports from the markets that purchase their recyclables, and provide copies of these reports to the recycling program managers. The reports should include the amount of prohibitives or millage loss – materials that were not appropriate for the process and were discarded – received by the mill. These tonnages should then be calculated as part of the MRFs residue rate.

Man versus machine

To achieve high-quality sorting and processing, a MRF must establish a ratio of equipment and manual labor. Few processing facilities in North America rely heavily on manual labor anymore, as high labor costs make processing too expensive. Sorting machinery, while initially expensive, ultimately lowers the cost of processing per ton of materials when used for the appropriate volume of materials processed. But, the correct mix of manual labor to machines is still essential for a processing facility to operate with best practices.

Some processors have found that mechanical sorting produces a more consistent quality than manual sorting, although not necessarily a higher quality. Mechanical sorting is not as dependent on having a full complement of workers, nor on those workers performing to the same standards all the time. At the same time, MRFs cannot run effectively without enough manual labor for equipment maintenance and hand-sorting some materials.

Highly mechanized MRFs also require more highly skilled workers than low-tech facilities. While mechanization may reduce the need for manual labor, it increases the need for workers skilled enough to maintain the equipment.

Without investments in high-quality processing, single-stream programs may collect more, but ultimately recycle less than source-separated programs.

The key to effective sorting is avoiding overloading the processing equipment. If material on the sort line is too deep, or if too much material passes by picking stations or equipment too quickly, then it will not be sorted properly.

Optical sorting equipment is playing an increasingly important role in sorting recyclables. By measuring light waves, transparency or color, optical scanners can sort paper into different grades, plastics from other containers, plastics into different types and glass into different colors. The scanners work best with materials already presorted into fewer categories and separated from each other. For example, while some scanners can sort paper and others can sort glass, neither can sort glass from paper.

If too much material is coming in, or the MRF is racing to clear its floor, the equipment is likely to be run beyond its capacity, resulting in poor quality materials at the baler. Also, if the MRF cannot access the bottom of the pile of collected materials regularly, the quality of the materials may degrade before being processed. Every time the materials are moved, more of the glass bottles are broken, more glass fragments are embedded in the paper fiber and plastic bottles, and the recyclable materials degrade.

Sufficient storage space can help prevent the urge to overburden conveyor belts and other equipment, allowing for consistent, high-quality processing, at times when truck deliveries are much heavier than at others. The facility should have sufficient protected space for types of materials that are more difficult to process when wet, such as paper.

Managing end-markets

The intended markets for the recovered materials must be identified, so that the quality requirements can be determined in advance. Frequently, end-markets are based on transportation options. If the MRF is near a port, then export markets are a likely destination. If it has a railhead, then it may have access to more customers than if all its material were to be trucked to market. Local markets may allow the paper to be shipped loose, saving the cost of baling, plus identifying local markets improves the community's economic vitality.

Some MRFs have more than sales relationships with manufacturers. They may be owned by, or partners with, a paper mill; or they may have a long-term contractual relationship to supply a recycling manufacturer with its materials. Such relationships suggest a higher likelihood of the processor meeting the manufacturers' specifications. Communities should require details about their processors current market arrangements.

The devil is in the details

Material recovery facilities must be flexible and adaptable enough to handle unforeseen problems. The best-laid plans of mice and men often go awry. The MRF should be flexible enough to deal with these situations.

In the Portland, Oregon region, for example, residents were asked to keep glass separate from other recyclables, in an otherwise single-stream collection system. But keeping the glass separate does not work for many residents and collectors, and as much as one-third of the glass received at the processing facilities arrives mixed with other recyclables. The MRFs were not originally set up to handle glass commingled with other materials, and have undergone difficult transitions to accommodate the lack of proper separation.

Commercial collection

Single-stream service started with residential curbside collection, but now some communities are expanding programs to collect commercial materials. The majority of materials from these sites often are homogeneous and close to the quality that a manufacturer would want (e.g., glass bottles from restaurants or office paper from businesses). Collecting this material separately is more effective, when a full load of a single material type can be collected in an efficient route.

Commercial recyclables should be processed separately, and not run with other materials, in order to minimize contamination and maximize quality and ease of marketing. Some facilities can deliver this type of uniform material to bunkers at the MRF, rather than adding it to commingled lines, or may process it on a separate line or

at a different time from the commingled materials.

For example, a screen for corrugated containers, which would not be used for a residential sort, may be necessary for commercial loads, or the system may need to slow down to deal with higher levels of glass from bars and restaurants or adapt to process shredded paper. However, even if source-separated materials are not collected from commercial waste generators, the single-stream commercial collection recyclables still should be processed separately from the residential materials because of the materials' composition differences.

Days gone by

The days of demand-side recycling economics are long past. Now that municipal programs churn out high quantities of recyclable materials without concern for specific markets, supply-side economics have put mills into a take-it-or-leave-it dynamic. The responsibility for properly sorting materials, cost-effectively, rests squarely with the MRFs. Optimal recycling system functioning requires MRFs to operate as reliable partners with manufacturers in order to ensure the highest quality and most competitive recycled products.

Recycling should be entering a renaissance, as people around the world increasingly recognize the critical need to reduce resource demand and production footprints, even as populations in developing countries are beginning to surge into the markets. To take its rightful place as a foundation for environmentally sustainable production, recycling must realign its processing design to better match manufacturers' needs. **RR**

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