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RESOURCE RECYCLING

IT'S IN THE MIX

The material mix is changing and the implications for material recovery facilities will be far-ranging. A manager with Ontario's innovative Continuous Improvement Fund describes what the changes mean – and how to plan for the future.

BY MIKE BIRETT

Today, more than ever before, materials recovery facility (MRF) operators processing residential recyclables face significant challenges. Chief amongst these is the ongoing struggle to adapt to an ever-changing material mix while competing in an industry demanding low-cost, high-throughput production and consistent quality.

Herein lies the dilemma. Increasingly, MRF operators are turning to automation as a means of increasing throughput while limiting, if not reducing, labor costs. Automation does, however, tend to require an operator to commit to a vision of how processing lines will function. Unlike staff and bins, that can be moved at will, once a major capital investment is bolted to the floor, an operator is stuck with that decision. Capital investments are strategic business decisions that cannot be taken lightly. A significant purchase without careful consideration of the implications of long-term market trends can leave a facility burdened with high capital overhead costs of limited value and potentially compromise the long-term viability of a MRF's operation.

Underpinning this discussion is the fact that operators processing residential materials have a fundamentally different material mix to manage compared with their counterparts processing commercial recyclables. Municipal curbside recyclables frequently vary in the variety of materials collected, contamination level – including unsolicited materials and dirt, oils and moisture – and compaction rates. No MRF operator processing municipal materials can afford to automate their facility only to find that it is incapable of efficiently handling tomorrow's material mix. Understanding the trends in consumer paper and packaging and their implications to efficient MRF operations is critical to maintaining a competitive position.

Fiber trends

Anyone processing fiber is aware that newsprint volumes continue to decrease. There is no question that the 2008 recession, as with past recessions, has had a temporary impact on the amount of advertising in the average newspaper. Of greater concern is the very clear trend towards electronic media sources. This shift has resulted in old newspaper (ONP) volumes declining at an average rate of almost 5 percent per year in some communities. Not only does this trend have significant implications to municipal diversion efforts, but it also adversely affects the overall profitability of a facility if the current contract is based on a cost per processed metric ton for the basket of goods received at the facility. Next to glass, newsprint is

Rolling residue rates down

With governments trying to outdo each other by setting extraordinary – and arguably impossible – waste diversion targets, production loss is not only hurtful to the bottom line but increasingly a point of political concern. For many municipalities, every percentage point of diversion is critical to the success or failure of their overall diversion efforts, and with residue rates of up to 25 percent, many municipalities are starting to focus on MRF production loss as a means of improving their diversion rates.

Analysis of curbside collection data gathered from Ontario's municipal recycling program between 2007 and 2009 revealed an average residue rate of 7 percent in dual-stream, and 14 percent in single-stream programs, respectively. This residue included both production losses (recyclables lost during processing) and unsolicited contamination (non-recyclable materials, contaminated recyclables and recyclables not solicited in a program). While production losses and contamination levels can vary significantly between programs, it is not uncommon for them to be close to equal to each other proportionally in well run programs and MRFs. A reduction in production losses is, therefore, a relatively easy way to increase a program's diversion rate by as much as 7 percent in a single-stream program.

In Ontario, several single-stream MRF operators have made modifications to existing residue return lines to include simple sort stations focused on capturing the aluminum and paper fiber inadvertently lost in the residue stream during processing. Payback on the basic capital costs and additional labor is often as little as six months (i.e., savings of between $85,000 to $170,000 per year). The low burden depth found on these lines also makes them suitable for installation of eddy currents and overhead ferrous magnets where conveyor set up and elevations permit.

Analysis of the unsolicited contamination in the residue stream is also a worthwhile exercise for MRF operators and promotion and education staff. Clues to sorter performance and curbside performance issues are often readily apparent in the MRF residue. Whether it's the presence of bagged recyclables in a non-bagged-based program, newspapers in plastic sleeves from rural routes or shrink-wrapped cardboard from cases of beverage bottles, they are issues that can easily be resolved with minimal supplementary communications to residents and can take recyclables otherwise destined for landfill and redirect them back towards meeting a municipality's diversion goal.

one of the least expensive materials to process since it is typically negatively sorted. Replacing these lost tons will, by necessity, require operators to process significantly more high-cost materials, such as lightweight plastics, to make up the difference.

Moreover, a steady reduction in newsprint volumes also has significant market impacts. Single-stream MRFs have enough problems trying to produce a true all-newspaper bale and the downstream impacts on North American paper mills is readily apparent as noted in Fig 1. However, as the quantity of newsprint declines, the percentage of out-throws – paper items that are not newspaper – in finished bales increases proportionally. This situation is further exacerbated by a slow-but-steady increase in cardboard (OCC) and boxboard (OBB) quantities at the curb as a result of the growing online or home shopping industry. So, what does the future hold?

In Ontario, Canada, several efforts were made to explore the use of optical sorters to improve the removal of out-throws and prohibitives – non-fiber contaminants – from the ONP stream. These efforts unfortunately met with limited success, achieving capture rates of, on average, only 25 percent for OBB, and 55 percent for OCC with recognition of non-brown OCC and OBB being a key stumbling block.

While improvements in the design of optical sorters, the two-dimensional nature of fiber with its related overlapping issues, and inability for equipment designers to be able to rely on fiber color as a basis for sortation, makes this option very challenging. Some would suggest a switch in focus to positive sortation of ONP may address this matter. However, it remains unclear whether the quality requirements of domestic newsprint mills are technically achievable and financially sustainable in the long term. Ensuring fiber lines are not overburdened, performing regular screen maintenance and ensuring staff recognize improper disk screen adjustment will certainly remain key to maintaining fiber quality. If, however, this growing issue cannot be resolved, will MRF operators processing municipal recyclables be consigned to producing a poorer-quality bale destined for China? Or will the ONP require reprocessing at a specialized-fiber MRF in order to achieve the required quality specifications? Increasingly, it seems there is a growing argument to support the latter, but time will tell.

And what of the impacts of declining ONP on MRF design? Fiber decks are a standard complement in any single-stream operation and are sized to meet appropriate throughput requirements. It seems inevitable that the ONP decks will become increasingly underutilized over time as the volume of ONP declines and a growing emphasis is placed on managing the long term growth in OCC and boxboard quantities. The only good news in this reality is that this trend will reduce overburdening of ONP screens and potentially lead to cleaner material.

By comparison, shredded paper remains a growing problem as more and more programs encourage residents to shred their confidential documents. Just as film bags and glass are serious problems in MRF operations, shredded paper needs to be removed as early as possible in the process. The Continuous Improvement Fund has funded the installation of several new-generation, in-line air classifiers in MRFs to aid in the separation of plastic film and shredded paper with good results.

Container trends

If the difficulties MRF operators face with fibers are not difficult enough, the growing complexity of the container stream presents its own unique challenges. As the prevalence of single-serve containers and lightweight packaging continues to increase, MRF operators are having to sort increasingly larger numbers of containers to produce a ton of recyclables compared with their counterparts two decades ago. If

PET is an indicator, since 1995, the number of bottles required to make a pound of recyclables has more than doubled. Moreover, with the rapidly growing mix of multi-laminant containers, intelligent packaging and variants of primary resins including biodegradables, the days of easily recognizing plastics by their resin codes seem to have gone by the wayside. Therefore optical sorters are quickly becoming the norm as a means of handling the large quantities of small containers and myriad of plastics present in today's curbside bin.

Despite showing average savings of almost $10 per metric ton (all currency in Canadian dollars) over manual labor, optical sorters on the container line are not without their own challenges. As containers become smaller in size, the amount of surface area devoted to labelling increases proportionally, leaving less surface area available to an optical sorter to read. Misreads from paper and full shrink labels (primarily PVC and PETG) routinely impact optical accuracy. To put this issue into perspective, recent analysis of PET bales is showing that a full 3 percent of the bale by weight is just full shrink labels.

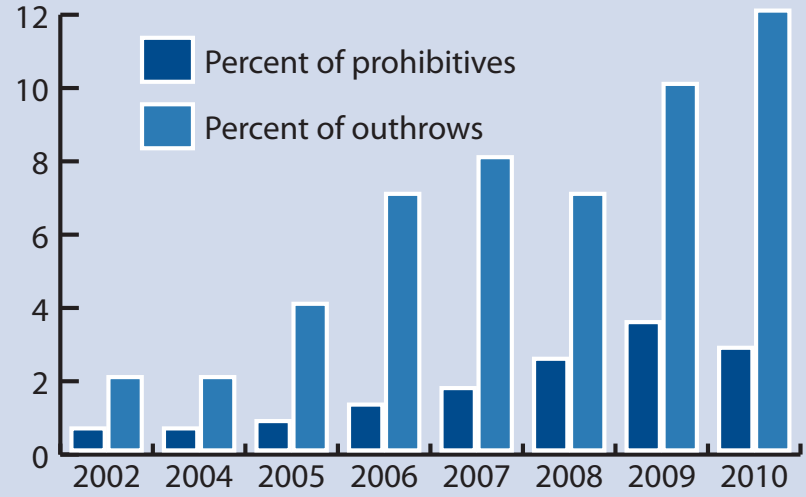
A far greater challenge for optical sorters and overall container processing efficiencies is the growing presence of thermoform containers at the curb. While many of these clamshell and serving containers are made from PET, a significant percentage are lookalike containers made of PS, PLA, PETG and even PVC, making hand sorting extremely difficult. Thermoform PET containers also have a different i.v. index or viscosity than bottle grade PET, making them a potential contaminant in the PET stream. The current generation of in-service optical sorters cannot distinguish between PET thermoforms and PET bottles. Nor can they read black PET. As a consequence, optically-sorted PET bales are routinely found to be contaminated with thermoforms at levels of 10 percent of total bale weight or higher, and operators are losing black PET into their residue or other container streams. While the loss of black PET can be ignored if necessary, thermoforms, with a projected market share of 35 percent of the total PET stream, cannot.

The good news is that the National Association for PET Container Resources (NAPCOR) with funding and assistance from a number of stakeholders, including the Continuous Improvement Fund in Ontario, has made significant progress over the past two years in creating solutions to the processing of this stream. While the co-processing of these streams is appearing, increasingly, to be a long-term viable option, there remains a number of issues to be resolved. This includes, but is not limited to, variability in label adhesives and the very fact that most MRF container lines were designed to only handle bottles. This latter issue creates a number of secondary mechanical issues, such as transition point jam-ups, clumping and baling densities. MRF operators are, therefore, encouraged to leave flexibility in their operations to allow for separate sortation and baling if required. PETG remains a looming problem for all processors of PET and is already present in the PET stream at levels of up to 2 percent of consumer packaging. Optical sorters can, reportedly, reliably identify and separate this material from the PET stream, but the cost of a dedicated air block for this purpose would be difficult to justify for the average MRF operator at the current PETG market penetration level. To put this issue into perspective, PS thermoforms are present in larger quantities in manually sorted PET and present an equally serious problem to reprocessors.

In the long term, one of the more interesting trends to watch is the penetration of PP into the traditional HDPE, and to a lesser extent, PET market. With an average growth rate of 1 percent per year, PP has found favor with some brand owners because of its moldability, resin price point and environmental profile. The challenge for many MRF operators is the decision between maximizing diversion and profitability. Most large facility operators can allocate a spare bunker to PP and cover their extra labor costs with the revenues from capturing tubs and lids. For smaller facilities, production of a mixed 3-to-7 bale can be a viable alternative. Typically, this approach does not generate as much revenue, but permits municipal programs to capture a broader range of plastics at the curb while minimizing the increase in operating costs at the MRF.

In general, optical sorters are here to stay. Perhaps the bigger challenge to ensuring their successful use on high throughput container lines is to fully understand the potential negative impacts of poorly controlled burden depth and presentation of containers on the in-feed acceleration belt. The current container stream is fast approaching a density of under one pound per cubic foot, so MRF design assumptions, which historically are calculated by weight, are becoming increasingly flawed. MRF operators need to start thinking in terms of volume and picks per minute. Wider belts in general are becoming the norm, but a number of operators are now placing eddy currents in advance of optical sorters. This action lessens burden depth to some extent but more importantly reduces aluminum can losses due to incorrect separation of materials by optical sorters operating at the upper end of their performance limits. Other important

Figure 1 | Average Ontario suppliers, out-throws and prohibitives



Source: Continuous Improvement Fund, 2011

considerations include allowing longer quality-control lines after the optical sorter to give manual operators a better chance to pull misdirected materials, and splitting belts and recirculating the container stream, where throughput levels permit, to allow multiple passes under optical sorters as a way to improve quality.

Glass and ferrous

As the glass and metal markets continue to be eroded by the successful penetration of plastics packaging into the container market, a growing trend is to remove glass earlier in the MRF process. As one respected operator put it, "allowing glass to go through your system is akin to sandblasting your disks and belts." The trend to early glass removal typically involves the use of glass breakers in the front end of MRFs, and preliminary data suggests it is achieving savings of up to 10 percent of projected wear on conveyor belting and baler floors. The consequence, of course, is the subsequent greater reliance on mixed-broken-glass reprocessors to clean this stream and make marketable products. Optical sorters are an alternative in handling glass, but are costly relative to the value of the output. Thus, a capital investment of this nature needs to be prioritized accordingly. At the very least MRF operators should endeavor to remove paper and metals from their glass where practical, leaving the plastics and ceramics to their glass reprocessor, who may be better positioned to justify the required optical sorter.

Film and polystyrene

While efforts have been made worldwide to reduce the use of single-use shopping bags, film remains a logical packaging choice in many applications and it is reasonable to assume that there will always be pressure to include it in curbside programs or to allow bagged-based collection where carts are not available. With an average incremental cost of almost $12 per metric ton to process recyclables in bags, the benefits, if any, of this collection mechanism must be carefully considered. For dual-stream programs wishing to collect film using the bags-in-a-bag approach, one of the more promising pieces of equipment to surface in recent years is Bollegraaf's film grabber. Field data on this unit is limited but appears to suggest that the grabber can capture as much as one-third of the film entering a typical container line, which is impressive given the challenges with burden depth and entrained container issues commonly encountered at the front end of these lines. Moreover, compared with average pick rates of between 250-to-1000 kilograms per hour, per sorter, for film (depending on whether bags-in-a-bag or loose film is being managed), automation can be reasonably cost effective in this application. Film collection in single-stream operations is inherently more difficult and costly, and is best managed with increased labor at the pre-sort if screen damage is to be avoided.

Expanded polystyrene (EPS) and its PET equivalent are also expected to be more prevalent at the curb, with the growth of on-line shopping. Whether collected at a depot or curbside, EPS, like film, presents handling and transportation challenges due to its low density. One good alternative for MRF operators to consider is the use of hot (shredder/extruder design) or cold densifiers (briquetter design) where sufficient volumes are being collected. These scalable pieces of equipment can achieve high volume reduction levels and many suppliers offer guaranteed markets for the end product of between 6 and 20 cents per pound, depending on quality.

Mixing it up

Curbside packaging and paper products are changing daily in response to consumer demands. Understanding the trends and making good capital investments in response to them is one way MRF operators can protect their throughput, quality and overall cost competiveness. RR

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