Curbside collection: complete separation versus commingled collection

"To mingle or not to mingle?" That is the question many communities are asking as they design their curbside recycling collection program. Should recyclables be collected fully commingled in one container, or already sorted into different categories by the resident? Unfortunately, there is no convenient Delphic oracle or comprehensive program analysis to provide an unambiguous answer.

The experiences of several programs and some studies indicate that the truth lies somewhere in between these two collection systems. However, this limited experience strongly challenges the myth that commingled collection combined with processing at materials recovery facilities necessarily produces higher rates of resident participation and material recovery with overall lower program costs.

Types of curbside collection options
There are four simple models of source separation programs by which recyclables are recovered in curbside collection programs. Each model places the primary responsibility to complete the material separation on a different party, or involves a significantly higher degree of difficulty from another model.

Complete citizen separation is the original source separation model for recycling collection in which the resident completely separates recyclables into different material categories needed by the markets: newspapers, glass containers sorted by color, steel cans, aluminum cans and plastic milk jugs. The collection truck has a bin for each material. An example of this program is Freehold Township, New Jersey.

Truckside sorting places part, or all, of the sorting responsibility on the driver. Thus the collection vehicle will have more compartments than the number of household bins or bags that are set out. For example, the driver may sort the glass bottles from the other materials or sort the glass containers into different colors. Further separation at the processing center may or may not be necessary. An example of this type of collection program is La Mesa, California.

Fully commingled material collection, sometimes called site separation, puts the entire burden back on the processing facility. Recyclable materials are put out on the curb mixed together. A crew and a truck with one compartment for all materials provides the collection. This approach lends itself to semi-automated, as well as automated, collection systems with larger storage containers. A combination of manual and mechanical methods at a materials recovery facility (MRF) separate the mixed materials for sale to markets. An example of this collection system is the Rabanco Recycling program servicing south Seattle.

Co-collection involves the pickup of separated, bagged recyclables at the same time as garbage in a packer truck (see "New twist on curbside raises a stink," in the January 1990 issue). The recyclables are bagged to keep them separate from the garbage. The challenges and costs of separating the bags of recyclables from the garbage stream at a mixed waste processing center, then preparing the recovered materials for markets, are more involved than a materials recovery facility that just deals with commingled recyclables. An example of this collection program is Omaha, Nebraska.

The choice of a particular collection model also significantly shapes the design of the processing system, yielding a range of costs and materials handling sophistication. The term "MRFs" originally described a processing center that handles all commingled recyclables (no garbage), or at least a commingled stream of containers. No good term has evolved to distinguish processing facilities that handle separated recyclables, necessarily simpler in design and lower in cost, from MRFs.
San Diego’s truck scale, demonstrated sitting on the ground (1), has been mounted in its final position above five bunkers (2). Trucks can unload to the side, as well as through doors located in the scale platform. Conveyors move materials out of the bunkers for processing.

Issues in the debate

In looking at the different curbside recycling collection options, there are a number of issues and claims to frame the debate about which collection model is best. For example:

- **Material recovery.** Which model gets greater citizen participation and greater material recovery? How is scavenging minimized? What amount of recyclables set out by the resident is lost as a residue due to handling by the collection and processing system?

- **Material quality.** Which model results in less contamination of recyclables during handling and facilitates public education?

- **Material revenue.** Which model allows for higher use markets (i.e., cullet for bottle manufacturing) would be a higher use than as a replacement for sand in...
Eastside Recycle Service keeps glass containers separate from other commingled recyclables. The driver removes an insert tub with bottles from the curbside bin (1). While the bin is emptied, the driver sorts the glass into three colors (2). The glass bin is top-loaded into a front compartment (3).

Which model makes better use of existing processing capacity in the private sector? Which model can accommodate changes that will allow greater material recovery and financial success by the program: additional collected materials such as mixed paper and plastics, evolving technologies in collection equipment and processing systems, new markets, and changes in the ability of current markets to handle contaminants?

In response to these types of issues, actual program operations tend to blur the boundaries of the four models presented. The great majority of commingled collection programs are not fully commingled,
but require the resident to sort recyclables into two categories: old newspapers (ONP) and commingled containers of glass, metal and sometimes plastic. On the other hand, a compromise of less-than-complete separation by the citizen often includes collection of ONP, glass bottles and metal containers in three separate containers. Further separation would be done at a processing center.

Material recovery rates and curbside design

Conventional wisdom says that commingled curbside programs yield greater material recovery, produce a higher material quality and cost less to operate than citizen separation programs. Not so, according to some of the studies and community experiences cited below.

One study by Scott McGrath, an environmental planner with Gannett Fleming, Inc., examined the monthly per capita recovery rates of glass, tin and aluminum containers for towns in Monmouth County, New Jersey in 1988 (see Table 1). ONP is kept separate in these collection programs. His analysis showed that complete separation of the containers into five categories resulted in an impressive 21 percent higher recovery rate than the commingled option. The case that each additional material sort by the citizen increases recovery is also suggested by the 1988 data.

In 1989, both commingled and complete separation options increased their recovery rates, but commingled showed a greater gain. Nevertheless, complete separation still achieved an 11 percent higher recovery rate over commingled. However, commingled recovery exceeded the recovery of programs with less-than-complete separation. In order to account for the different recovery rates for the towns in Monmouth

<table>
<thead>
<tr>
<th>Number of citizen material sorts</th>
<th>Commingled containers</th>
<th>Glass mixed, aluminum and tin mixed</th>
<th>Glass separate, aluminum and tin separate</th>
<th>Complete separation</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>April-December</td>
<td>7.22</td>
<td>7.94</td>
<td>8.37</td>
<td>8.71</td>
<td>7.90</td>
</tr>
<tr>
<td>1988</td>
<td>(22)</td>
<td>(7)</td>
<td>(5)</td>
<td>(15)</td>
<td>(49)</td>
</tr>
<tr>
<td>January-December</td>
<td>8.63</td>
<td>7.89</td>
<td>7.70</td>
<td>9.58</td>
<td>8.88</td>
</tr>
<tr>
<td>1989</td>
<td>(23)</td>
<td>(4)</td>
<td>(3)</td>
<td>(19)</td>
<td>(49)</td>
</tr>
</tbody>
</table>

N.A. = Not applicable.

(1) Four different systems are presented for the collection of glass bottles, tin cans and aluminum cans. Numbers in parentheses represent number of towns in each category. Four towns had collection systems that did not fit into this classification system.

County, several qualifications must be made. First, the figures do include containers generated by commercial establishments. In 1988, the commercial program was just getting started; a larger effect would be seen in 1989. Second, the figures reflect material collected, not materials marketed. Thus, the residue, particularly that experienced by commingled programs, is not subtracted from these data. Residue is usually 10 to 20 percent by weight of incoming materials for MRFs.

A third observation has to do with the population of the towns. Larger towns will have more commerce per capita, which means higher generation and recovery levels are possible. On the other hand, some of the smaller shore towns in New Jersey have large summer populations and a higher per capita concentration of taverns that generate more containers.

There was a clear preference for towns in Monmouth County with larger populations to opt for commingled collection; nine of the most populous 17 municipalities did, accounting for 43 percent of the population. On the other hand, the five in the top 17 that selected complete separation had only 14 percent of the county’s population.

Ten programs changed their requirements for citizen sorting in 1989. Three programs left commingled preparation for complete, or at least glass bottle, separation. None of the complete separation programs changed their program design. The greatest shift came from the programs in the middle: Four went to commingled and two to complete separation.

Although data exist for only two years, this study suggests that complete separation was favored by smaller communities, especially those under 10,000 population, and commingled approaches by the larger municipalities. The data suggest a higher recovery rate for complete separation; a difference that might grow larger if the commingled programs had their lost residues subtracted out. The data do not indicate how well complete separation performs for larger, denser population areas.

A 1987 survey of 39 curbside programs in Canada and the U.S. by Robert Sinclair, released by the Recycling Council of Ontario, used a statistical analysis to show that “the larger the number of categories [sorted by the resident] . . . the greater the diversion [recovery] rate.” Sinclair cautioned that “other factors might interact with this variable,” such as more frequent collection, simple preparation requirements and provision of special recycling collection containers.

A draft report submitted to one state government documented lower total (collection and processing) program costs for complete separation than commingled collection. These findings were based on field observations and case studies of a dozen communities.

Experience of Seattle’s curbside vendors
In Seattle, two approaches to curbside recycling collection are being taken. In the southern part of the city, Rabanco provides monthly collection for ONP, mixed paper, glass bottles, metal cans and plastic containers, fully commingled, from a 90-gallon container. With service to 80,000 homes, this makes the company the largest curbside recycling operator in the Pacific Northwest, believes Steve Spence, general manager of Rabanco.

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Curbside collection
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One problem that has plagued the commingled approach of Rabaco is glass bottle breakage. According to Spence, about 50 percent of the company’s glass materials from curbside ends up as mixed-color cullet. Spence mentions that curbside represents only about one-third of their glass container sales due to large buy-back and commercial volumes.

One of Rabanco’s subsidiaries, Eastside Disposal, provides commingled service to unincorporated King County and other communities north and east of Seattle. Because of the problem with glass container breakage, the company ordered eight new custom-designed trucks last month. These trucks have a special compartment for three-color separation of glass bottles by the driver, while the other commingled materials are being emptied into the side-loader semi-automatically.

“This is definitely not a pilot project,” says Lolly Miller, vice president of recycling collection systems for Rabanco.

The company is distributing small plastic inserts that will fit into the 90-gallon bin and keep glass containers separate from other materials. The trucks have a three-section loading bin for the glass, which is top-loaded into the truck when full. Glass breakage now becomes an asset, instead of a marketing liability.

The company anticipates that collection times will increase but that the increased collection cost will be more than offset by reducing processing costs and higher revenues for the glass bottles.

Eastside also made one other adjustment that significantly improved recovery amounts. Last May, they went from monthly collection to biweekly.

This change may have relevance to the Seattle program. Tim Croll, recycling program development director for the City of Seattle, notes that a relatively larger proportion of South side residents, compared to those on the North side, fill their storage containers to overflowing, so that recyclable materials may be going into the garbage. The North side residents have approximately 120 gallons of monthly capacity with their three-bin weekly collection, while the South side has only one 90-gallon container. This may also account in part for a higher recovery in the North side program of 69 pounds per sign-up per month, 15 percent greater than the South’s recovery rate.

However, Croll feels that “there would have to be a much greater difference in the numbers before we would abandon one of the collection methods used in the city.”

While Rabanco is moving somewhat away from the fully commingled approach outside of Seattle, Seattle’s other vendor is heading away from more separation and to more commingling.

Waste Management sees commingling as the future
In the northern part of Seattle, Waste Management provides weekly collection for ONP, mixed paper and commingled glass, metal and plastic containers set out in three bins by households. While this is dubbed the separation approach, Bill
Moore, director of waste reduction for Waste Management of North America, notes that “this is really similar to the typical two-sort requirement for most commingled programs with mixed paper added as the third material.”

While Moore admits that every community needs to be treated differently, Waste Management believes the fully commingled approach is needed to maximize recovery from households. In 1990, 70 percent of the company’s 300 collection programs involved separation by the citizen or by the driver into three or more materials. Moore expects Waste Management will have 80 percent of its anticipated 8,000 curbside recycling collection programs requiring only one or two sorts by 1993.

One key element in this strategy was unveiled last month at the Suncoast Recycle America Center in Clearwater, Florida. The heart of Waste Management’s first fully commingled MRF is a BRINI classifier developed in Sweden for the refuse-derived fuel industry.

The BRINI is touted as being able to separate a light flexible fraction (e.g., paper and plastic film) from a rigid fraction composed of containers (e.g., glass, metals, plastics). This classifier has piano key-type fingers that drag flexible material up its incline, while containers roll back down. Small pieces less than two inches, such as glass shards, fall directly through the classifier’s fingers.

Moore is confident that the BRINI will remove one of the obstacles to a fully commingled approach – separation of the glass container shards from the paper fraction. However, he remains concerned about how to solve the market problem of mixed-color cullet.

“Philosophically I’m opposed to glass bottles going to a one-time use market such as glasphalt,” says Moore. He is optimistic that more palatable solutions to this problem will present themselves. Some ideas include a better technology for color-sorting broken glass bottles, more cushioning of the bottles in a fully commingled approach producing less broken glass, or new market development for glass containers such as the fiberglass industry. “Something has to give,” he says.

Researchers at the Center for Plastics Recycling Research at Rutgers University are already looking at one of these ideas. They recently completed a compaction test of mixed recyclables in the laboratory that achieved a 35 percent reduction in volume without glass container breakage. A field test is being conducted in Highland Park, New Jersey. If successful, it means the same packer trucks could be used for both garbage and recycling collection.

Sacramento goes the separation way

Last June a major debate in the city of Sacramento, California ended with the city council overriding a staff recommendation for an automated commingled approach to curbside recycling collection. Instead the city council moved in the same direction as Sacramento county by choosing a three-bin system that requires more sorting by the residents.

These decisions were impressive, according to Dan Regan, recycling coordinator for Sacramento County, because Sacramento is the only county in California to do its own garbage collection, and it happens to be the largest automated collection system in the state. An analysis by R.W. Beck and Associates for the county indicated the three-bin system
would cost $1.19 per account per month, while the commingled approach would require $2.17 per account per month. These calculations included collection and processing costs as well material revenues. Beck’s report further stated, "... commingled collection might in theory encourage greater participation due to the ease to the resident of recycling commingled materials, and might enable a much broader variety and volume of materials to be collected if sorting facilities are available, but evidence to date is not available to support this conclusion."
The position in the city council chambers for more separation was led by environmental groups and private waste paper dealers, among others. Their argument was that the three-bin system would "instill a greater recycling ethic and lead to greater participation" by the public.
Harry Miller with Smurfit Recycling in Sacramento feels that "commingled recycling collection and contamination are synonymous," especially with glass in paper. Miller contends that if there were an engineering solution that made a full commingled curbside collection work, the largest waste haulers in the country would already be using it.
Miller describes how glass particles brought into a paper null by waste paper can clog screens, leading to a pressure build-up and a water leak in a 200-gallon-per-minute system. "If the glass particles make it to the paper machine, they can cut the synthetic felt on which the pulp rides while the sheet starts to form. The glass cuts the plastic fibers, reducing the life of a $30,000 felt," says Miller.
Although Sacramento city staff researched the different approaches extensively and came to a different conclusion than R.W. Beck’s analysis, it appeared that concern for the marketability of glass containers and ONP, as well as the arguments of environmentalists and the public, were persuasive in the council’s decision for a three-bin separation.

San Diego Recycling uses truckside sorting approach
Although most of the research and development has been done for commingled collection and processing systems, San Diego Recycling's commitment to keeping materials separate has led to an innovative design for its processing center.
San Diego Recycling in Lemon Grove is owned by EDCO Disposal Company and provides curbside recycling collection and processing to a number of communities in San Diego County, such as Santee, Coronado and La Mesa. Because the company wanted to begin collection before its processing facility was available, it chose to have its drivers do some sorting on-route so the materials were ready to market.
It was felt that participation would be maximized if residents had to bag only their ONP and mixed paper separately, and could commingle glass bottles, metal cans and plastic bottles in a provided curbside storage container. The driver then sorted the glass bottles into clear and colored fractions, and separated the cans and plastics into separate bins. The ONP and the mixed paper were loaded into their own compartments to complete the six-material sort.
With a 52 percent weekly set-out rate in La Mesa, a driver makes 450 to 500 pickups during a long work day involving at least 9 hours of collection time. The 31 -cubic yard truck has flexible compartments adjustable for each specific town. When full, a typical truck would average 5.75 tons, with paper and plastics compartments filling up first (see Table 2).
To speed up route times after its proc-
essing facility comes on-line this year, Lynn France, San Diego Recycling’s operations manager, wants to investigate reducing material sorting by its drivers for one or two items. However, Coy Smith, president of San Diego Recycling, feels it is always better “to add a truck than to lose a market.” In particular glass bottles need to be kept separate from other materials. Smith believes the day will come when collectors will have to put on their waste paper shipping invoice “commingled or separated collection” to provide an indication of material quality. Separated material could bring a premium, he predicts.

One innovation at San Diego Recycling’s processing facility will help facilitate efficient unloading of the many materials. A truck scale combined with an unloading pit has been designed and engineered by Enterprise Baler Co. in consultation with San Diego Recycling. The scale is mounted over five bunkers. A side-dumping truck can empty in either direction and an end-dump can tip though an automatic door that opens in the scale platform. The material falls three to four feet into a bunker. A conveyor pulls material out for further processing. Weights are recorded after each material dump.

By way of contrast, in September the City of San Diego’s two-year old curbside recycling collection switched from a three-bin collection for ONP, glass containers and cans, to three-bin collection of ONP, mixed waste paper and commingled cans, glass bottles, PET and HDPE containers. The city’s processor, CR & R in Los Angeles, has assured the city that no materials will be landfilled, including any broken glass containers.

What about the future?

While it is difficult to state unequivocally that commingled collection or complete separation provides the better approach, there certainly is enough evidence to challenge the myth that commingled brings in more materials at a lower cost than a complete separation approach. Indeed the opposite may be true. Until the issue of glass container breakage and market capacity is solved, separate, color-sorted collection of glass containers seems more attractive.

However, what is true today may change tomorrow with the technology evolving for collection and processing, as well as recycling markets developing. RR

### Table 2 — San Diego Recycling curbside truck material profile

<table>
<thead>
<tr>
<th>Material</th>
<th>Volume (cubic yards)</th>
<th>Percentage filled capacity (1)</th>
<th>Weight (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONP (2)</td>
<td>9.0</td>
<td>100</td>
<td>2.75</td>
</tr>
<tr>
<td>Mixed paper</td>
<td>6.0</td>
<td>100</td>
<td>1.50</td>
</tr>
<tr>
<td>Aluminum and tin cans</td>
<td>3.5</td>
<td>90</td>
<td>0.25</td>
</tr>
<tr>
<td>HDPE and PET containers (3)</td>
<td>5.5</td>
<td>95-110</td>
<td>0.25</td>
</tr>
<tr>
<td>Green/amber glass</td>
<td>3.5</td>
<td>35</td>
<td>1.00</td>
</tr>
<tr>
<td>Flint glass</td>
<td>3.5</td>
<td>35</td>
<td>(4)</td>
</tr>
</tbody>
</table>

(1) Percentage of a particular compartment that is full when the truck is ready to unload.
(2) ONP = old newspapers
(3) HDPE = high density polyethylene, PET = polyethylene terephthalate
(4) The amount of recovered flint glass is included in the total of green and amber glass listed.