COLLECTION OF YARD MATERIAL AND SPECIAL WASTES

This article is the fifth in a 10-part series being provided by the University of Wisconsin-Madison and *Waste Age* intended to provide haulers and municipalities with tools to improve the design and operation of their collection systems.

Two goals communities increasingly seek to achieve are the reduction of waste quantities being sent to disposal facilities and reduction of the toxicity of those wastes. Since yard wastes present a prime opportunity for reducing landfill needs, this lesson presents and evaluates different approaches for collecting these materials. The lesson then examines a few collection elements that can reduce the toxicity of the wastestream, including the separate collection of appliances and household hazardous wastes.

Why divert yard materials?

Separate collection and management of yard wastes offers one of the greatest opportunities to reduce the amount of materials being sent to landfills or other disposal facilities. Yard wastes are surpassed only by paper and paperboard in the U.S. municipal waste stream. These yard wastes are traditionally bagged, bundled, or otherwise gathered outdoors, separate from other household wastes. Segregation of yard wastes is therefore relatively easy to accomplish since the source separation required for such recyclables as newspapers and bottles is not necessary. The quantity of yard wastes in the waste stream and the relative ease of keeping them separate from other wastes means yard waste diversion offers the biggest "bang for the buck" in reducing the quantities of wastes sent to disposal facilities. Yard waste diversion programs commonly reduce waste disposal requirements by 15% or more; this typically

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exceeds the amount of waste reduction achieved by curbside recycling programs in the same communities.

Yard wastes also offer excellent opportunities for source reduction of wastes. For example, by encouraging and helping residents to mulch or compost grass clippings, the amount of collected materials, the costs of collection, and disposal tipping fees, can be substantially reduced.

The seasonal nature of yard waste generation leads to another, often overlooked, advantage of eliminating yard materials from general waste collection. Except in communities with significant seasonal swings in population (such as tourist and college towns), at least 80% of the seasonal variations in waste generation can be attributed to yard waste fluctuations. Staff and equipment requirements for refuse collection to meet periods of peak yard waste generation often result in under-utilized staff and trucks during other periods. Therefore, by eliminating yard wastes from the general waste stream through a combination of source reduction and separate collection, refuse collection workloads can be leveled, and the corresponding assignments of staff and equipment be better matched for increased efficiency. This benefit is even more pronounced in communities that offer twice-per-week refuse collection. Under such systems, the great majority of yard waste is set out for the first collection. Accordingly, diversion of yard wastes from general refuse collection in such collection systems will reduce the wide variations haulers otherwise experience between workloads for weekly first collections in spring and second collections in winter.

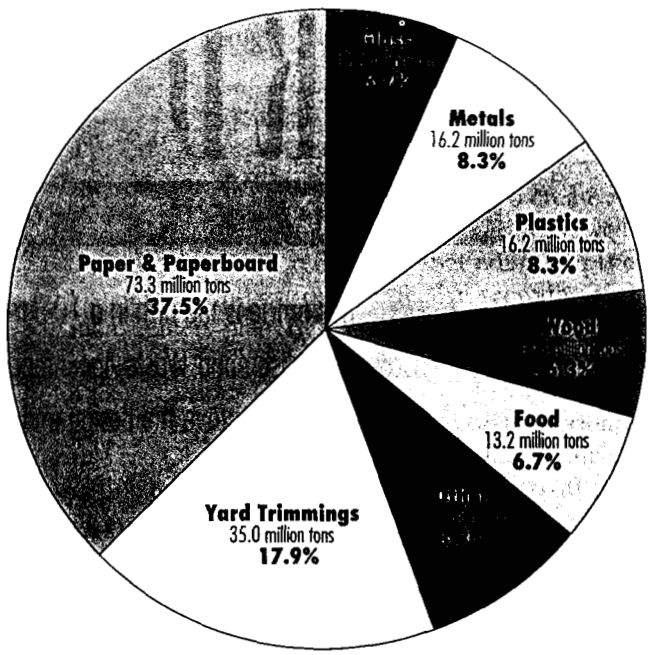
Yard wastes diverted from the waste stream can be composted or used as a mulch at home, or sent to a central location to develop a high-quality compost. Large brush can be chipped and used as to create various qualities of landscaping or gardening mulches. It is also useful as a bulking agent to compost grass or even wastewater sludge. The end results of effective yard waste diversion programs are substantial reductions in disposal requirements, more efficient collection of remaining refuse, and reuse of wood chips and composted grass and leaves.

Alternative methods

When selecting collection methods for yard wastes, it is important to remember that the various vegetative materials that comprise this type of waste may be best handled by different collection methods. Specific categories of materials that should be considered in the evaluation of collection methods include: grass clippings, leaves, small brush (typically defined as 4 inches or less in diameter), and large brush (large trunks, branches and roots). The proportion of each in yard waste is highly community-specific, and changes by season.

Figure 1

Materials generated in municipal solid waste by weight, 1990 (total weight = 195.7 million tons)



Source: U.S. EPA/Franklin Associates, 1992.

Loose Collection. In loose collection systems, yard wastes are not placed in a bag or other container prior to pickup. Grass or leaves are raked into a pile at or near the curb. Brush or wood wastes are bundled or stacked at the curb. Loose materials can be scooped up mechanically or sucked through a vacuum tube into a truck. Mechanical collection, which can be used for any of the materials, typically uses either a bucket on the front of a loader to scoop materials into a dump truck, or a loader- or truck-mounted pincers to grab and lift materials into a truck. Vacuum collection can be accomplished using either a special truck that has the vacuum unit and storage compartment integrated in the same vehicle, or an open truck with a vacuum attachment. A third collection method, usually limited to leaf collection, uses a truck to pull a leaf- sweeping trailer with a horizontal spinning brush to sweep the leaves through a loading chute and into a truck.

Loose collection is rarely used for grass clippings because: unbagged grass is not easily handled by buckets and grapples; grass carried away by rainwater can easily clog catch basin grates or outlets; and piles of mown grass can quickly become unsightly and smelly. On the other hand, loose collection is the most popular method for collecting brush and stumps, because the equipment easily handles large, irregular shapes. The intermediate size of leaves allows them to be fairly easily handled by either loose or containerized collection. However, vacuum trucks should usually not be used to collect frozen or snow covered leaves to avoid problems with equipment operation and load freeze-up.

Benefits of loose collection are that residents save the cost and time of bagging materials, and materials do not need to be debagged at a yard waste composting or land application site. Also, loose collection can often be accomplished with existing equipment such as front-loaders and dump trucks. There are several disadvantages to this approach, however. Dirt, glass, and other street debris are typically collected with the yard wastes, and unless screened from finished compost, will decrease its value. Materials can wash into and block storm sewer grates and piles of materials can both obstruct parking and pose a parking safety hazard, as children might hide in the piles. Finally, this method does not lend itself to use of typical refuse collection trucks.

Bagged Collection. Bags used to collect yard wastes can be either paper or plastic. Benefits of bagged collection are practical and economic. Set-out is neater and there is less chance that stray material will be left behind. Sales of bags or bag stickers can be used to fund yard waste collection and composting. Bags make for efficient collection, because unlike rigid containers, there is no empty container to return to the curb, and a stop is not required if no bags are set out. Also, existing equipment, usually either packers or open bed trucks, can be used to collect bagged yard wastes.

The down side to bagged collection is that residents must do more work than for loose systems, sometimes a political problem if residents are used to simply raking materials to the curb. Also, after collection, the composting or landspreading operation must debag the materials. This issue is more problematic when plastic bags are used, since pieces of shredded plastic are objectionable to many markets for yard waste compost. Paper bags can be more readily composted with the yard wastes. When using a bag system, if specially marked bags or stickers are required, program logistics must address the purchase of bags/stickers, their distribution, and a pricing strategy.

Some communities have tried to avoid debagging at composting sites by having workers remove bags as yard wastes are collected. A study in Huntington Woods, Mich., found that debagging doubled the time required for yard waste collection. Removal of bags by collection crews exposes workers to hazards from knives or other tools used to slit bags. Also, debagging grass that has "cooked" outdoors for a week or more is a smelly, messy job that collection crews strongly dislike.

Plastic bags for yard waste collection programs can either be standard film (typically low-density polyethy-

Table 1

Characteristics of Yard Waste Collection Methods

	Mechanical Claw-Truck[1]	*Vacuum Leaf Collector-Truck*[1]	*Packer Truck*[2]	*Dump Truck*[2]	*Front-end Loader Dump Truck*
Convenience to Residential Generator	Excellent	Excellent	Very Good	Very Good	Very Good
Ease of Implementation[3]	Easy	Easy	Easy	Easy	Easy
Effectiveness	Moderately Efficient[4]	Very Efficient[5]	Very Efficient[5]	Very Efficient[5]	Moderately Efficient[4]
Capital Cost[6]	High	High	Moderate	Low	High
O&M Cost[7]	Moderate	High	Low	Low	Moderate
Operational Problems	Low	High	Moderate	Low	Low
Labor	Low – Moderate	Low – Moderate	Low	Low	Low – Moderate
Noise	Moderate	Potentially High	Moderate	Low	Moderate

[1] *Usually used for seasonal collection.* [2] Used for weekly collection. [3] Includes a public education program. [4] Capture rate is approximately 90%. [5] Capture rate is approximately 100%. [6] Assumes new equipment is purchased; although use of existing equipment is very likely. [7] Cost comparison made per collection activity. Refer to *footnotes* 1 and 2.

Source: *BioCycle*, June 1989.

lene), or they can be special biodegradable or photodegradable plastics. Biodegradable and photodegradable bags were developed to help eliminate the need to debag yard materials prior to composting. Biodegradable plastic bags typically use a vegetable starch as a binder, which will eventually cause the bag to biologically degrade into small pieces of plastic. Photochemically degradable bags are designed to become brittle and disintegrate in the presence of ultraviolet sunlight. The primary advantage that plastic bags have over paper bags is that they typically cost substantially less than wet strength kraft bags. However, most programs that have tried the degradable plastic bags have found that the plastics do not break down sufficiently in the conditions and timeframe typical of most composting operations, and remaining plastic in finished compost reduces the value and available markets for this material. Whereas kraft paper bags cost more than plastic bags, they more readily degrade and are less detrimental to the marketability of the compost.

If plastic bags are used they should be transparent or translucent rather than opaque, so that unacceptable contaminants can be detected and removed at time of collection. Paper bags are commonly made of brown kraft paper, and marked with a program logo to designate that they meet program requirements. Although it is often suspected that paper bags will easily tear or break, especially if subjected to rain, most communities have found wet strength kraft bags to perform well, and less susceptible to tearing during filling than most plastic bags. Paper bags for yard waste typically open flat on the bottom and are left open on the top. Although these paper bags are reasonably stable, if they are knocked over, yard wastes will be spilled, a less likely occurrence if sealed plastic bags are used.

Most haulers that collect bagged yard wastes for composting or landspreading use the same trucks that they do for refuse collection, but they collect the materials on different runs. The exception is on low-density routes, where it sometimes costs less to separate the bags than to make an additional collection.

Rigid Containers. Another option for collecting yard wastes is to use large plastic bins, which are typically designed for dumping by automatic or semi-automatic lifting arms on collection trucks. Rigid containers used for yard waste collection are large, usually at least 60 gallons. However, a few communities have tried using smaller containers to enable manual collection. Large rigid containers are usually considered for yard waste collection only in locations where the same automatic or semi-automatic trucks are used to collect other wastes.

Advantages of rigid containers are neat set-out and collection, with minimal spillage; bags do not need to be purchased and then added to the wastestream; injuries to collection workers are minimized; and the system is very convenient to residents, since wheeled containers move easily for loading and set-out. Also, if they are large enough, rigid container systems can be used to collect other compostables, such as food scraps, with yard wastes. Disadvantages are: containers and the specialized collection equipment are relatively expensive; and the container restricts the volume available for yard waste set-out. Also, if yard waste containers are kept at the set-out point, as in alley pickup systems, collection crews will be slowed down to check all containers, empty or not. To address the volume limitation issue, most programs using rigid containers provide for or allow use of bags for overflow materials, especially for fall leaves and large brush. Large stumps and branches may need to be picked up by other equipment.

Source Reduction Programs. Most communities starting yard waste collection programs realize quickly that although separate collection will divert large quantities of material from the landfill, similar effects can be achieved far less expensively by not collecting the material in the first place. Encouraging residents to leave clippings on the grass or to compost grass and leaves at home can greatly reduce waste collection costs. Some communities have encouraged this behavioral shift by requiring use of special bags priced to recover a significant part of program costs.

Other communities have eliminated the pickup of grass clippings altogether. For example, the city of Madison, Wis., in 1989 announced it would no longer provide pickup of grass clippings, since yard wastes were no longer being accepted at the county's landfill. Residents were encouraged to leave clippings on the lawn or compost them at home. Free drop-off sites were made available to those residents who insisted on bagging clippings. Also, collection was still available for brush and leaves. Although many Madison residents were initially upset that a traditional service was being revoked, the large majority of residents now compost or leave clippings on the lawn.

Many other communities in Wisconsin and nearby states are implementing similar source reduction approaches. Certainly, climatic, demographic, and political differences may limit the direct applicability of a no-collection approach. However, the experience of Madison and many other cities demonstrates that source

reduction approaches are more achievable than initially believed. An option that offers major landfill diversion possibilities while also reducing both collection costs and tipping fees deserves serious consideration. The bottom-line message is to seriously and creatively seek source reduction opportunities that make sense for your customers and community.

Staffing and scheduling

Staffing and equipment requirements for yard waste collection vary by season. Staffing adjustment is often best accomplished using temporary labor and permanent workers who can be reassigned to other functions during low-growth seasons. When estimating seasonal workload requirements, consider consulting with municipal foresters, who track plant growth and can be helpful in forecasting variations in yard waste generation from expected norms.

Although it is best to schedule yard waste collection on the same day as refuse collection it may not be possible if the same trucks must be used for both collections. Fortunately, yard waste collection programs usually do not suffer significant participation losses if pickup is scheduled on a different day, unlike curbside recycling programs, for which same-day collection is more critical to achieving high participation. It is also preferable to schedule yard waste collection early in the week, since lawn mowing, weeding, and pruning are most frequently done on weekends.

The frequency of yard waste collection should be selected to match local generation patterns. Most grass collection programs collect weekly during the growing season. Brush collection schedules typically vary from weekly to monthly. Leaf collection is typically offered on a few occasions in the fall and perhaps once in the spring.

Participation rates for weekly yard waste collection programs are typically 85-95%. Weekly set-out rates commonly average 70-85%.

Comparing the costs

Reliable, comparable data that allow cost comparisons of alternative collection methods for yard wastes are difficult to find. Usually the composition and quantities of materials collected, as well as cost accounting methods used, vary so greatly that comparative evaluations of different programs are extremely difficult.

One of the best published studies was performed in 1988 by the city of Bristol, Conn. Bristol compared the costs of collecting leaves only, using: 1) a vacuum collection truck with a driver and two rakers; 2) bag collection, using mostly two-person and some three-person crews, and biodegradable plastic bags; and 3) loose collection using front-end loaders and dump trucks, using one operator, three truck drivers, and two rakers. The vacuum collection crew collected an average of four tons of leaves per 10-hour day, resulting in operating costs of $106 per ton. The bag collection crew, using a 25-cubic-yard rear packer routinely collected at least 20 tons per 10-hour day, resulting in operating costs of $55 per ton of leaves. The loader-and truck crew averaged approximately 15 tons per 10-hour day, and experienced operating costs of $496 per ton. Bagged collection with use of existing compactor trucks produced the lowest costs in Bristol, due largely to the high productivity that crews can achieve with this approach.

The cost of loose collection was considerably higher than the other methods, primarily because it is labor-intensive. Despite its relatively high cost, loose collection is still often the best approach for collecting brush and wood wastes not easily bagged and manually loaded. Also, note that the costs cited in the Bristol study did not include equipment costs, since virtually all of the equipment was already owned by the city. However, the relative costs of these collection methods for other communities could differ substantially if the availability of existing equipment to assist in any of the three collection methods caused significant differences in the capital costs attributable to each of the alternative methods.

Collecting "special" wastes

In addition to providing for the collection of recyclables, yard wastes, and refuse, a growing list of other "special" wastes needs to be addressed when meeting the overall waste collection needs of a community. Some materials, such as furniture, might warrant separate collection because of size considerations. Others, such as tires and auto batteries, might not be accepted at landfills, and therefore may need a special collection network to collect and deliver these wastes to appropriate processors. Still other materials, such as household hazardous wastes, can, if separately collected and managed, reduce environmental liabilities at disposal facilities used for municipal solid wastes.

Haulers and local governments need to consider all of these special collection requirements to meet the collection needs of a service area. The quality and cost of overall service will be improved when integration of special services is well planned. Issues include how the material is collected, who performs the service, what

equipment is used, and how it is paid for. The list of materials requiring special collection is certain to change as environmental understanding grows, waste disposal regulations change, and the nature of the waste stream changes. Several current examples of special waste collections are discussed here to illustrate the collection issues these wastes present, and the opportunities that exist for coordinating these special collection services with the rest of the waste collection system.

Collecting appliances

Large consumer appliances–referred to as "white goods"–are often collected separately from other residential wastes. In earlier years, separate handling was necessary because truck sizes and compactor strength could not readily accommodate these bulky items. Although many of today's larger, high-compaction trucks can physically accept and crush household appliances, environmental regulations and concerns lead many haulers to segregate large appliances for separate pickup.

Principal concerns about appliance disposal center around the presence of polychlorinated biphenyls (PCBs) and chlorofluorocarbons (CFCs) in discarded appliances. PCBs can be found in such appliance sources as the capacitors in old refrigerators, freezers, air conditioners, dehumidifiers, microwave ovens, and mercury vapor lamps, and in the electrical ballasts of fluorescent light fixtures. PCBs can cause highly persistent and toxic contamination of soil, surface water, and groundwater. CFCs are contained as refrigerants and in insulating foam in many of the same appliances. Handling or disassembly may cause CFCs to be released. Upon release, CFCs migrate to the upper atmosphere, where they attack the earth's ozone layer, which provides protection to earth from the sun's ultraviolet rays.

Although some haulers have responded to these new regulations by no longer accepting appliances, others have responded with new services that help communities meet the new requirements. Many haulers and recyclers now charge a fee for pickup and processing of appliances. As part of their services, they remove PCB-containing capacitors and ballasts from the appliances, recover CFCs from refrigerant and insulation, and then sell scrap metal to recycling markets. A fuller discussion of the new business opportunities created by federal CFC recovery requirements is presented in the February 1993 *Waste Age*. In addition to responding to these processing needs, haulers also must review collection methods for appliances to assure that they do not cause the rupture of cooling coils and the subsequent release of refrigerant. Generally this means gentler handling during loading, transportation, and unloading, including less use of grapples, clamshells, and similar grasping and handling devices.

These changes in the requirements for collecting and processing appliances illustrate the need for collection systems to be ready to adapt to changes in waste regulations and policy. As noted at the beginning of this article, when the "job" changes, the collection system needs to adjust to meet the modified job description. Haulers and community leaders should anticipate regulatory changes, identify likely impacts on existing collection methods, and work cooperatively to develop creative, responsive solutions that create minimum disruption to services and fairly accomplish any necessary adjustments to existing contracts for services.

Household hazardous wastes

Many of the same chemicals, solvents, acids, caustics, pesticides, and herbicides that must be shipped as hazardous wastes if discarded by a business, also show up in residential wastes. Because federal regulations exempt residential wastes from classification as hazardous wastes, these functionally hazardous constituents can be legally disposed of in non-hazardous landfills or incinerators if they are part of household wastes. It is commonly estimated that household hazardous wastes comprise approx-

Table 2

Household Hazardous Wastes Received at Hennepin County, Minn. Permanent Facility During 1991

Waste	Lab-Pack Volume	Actual Volume
Waste oil	—	11,000 gallons
Latex paint	—	19,500
Oil-base paint	—	19,600
Flammables	—	3,600
Aerosols	5,720 gallons	630
Acids	1,300	250
Bases	800	200
Chlorinated solvents	650	120
Pesticides/poisons	5,500	1,400
Flammable pesticides	1,800	500
Oxidizers	250	100

Source: *Household Hazardous Waste Management News*, February 1992.

imately 0.5-1.0% of the residential waste stream. Increasingly, communities are providing means for separate collection and management of household hazardous wastes. This is especially true when the same governmental entity or company responsible for refuse collection also owns the disposal facility, and therefore directly benefits in reduced liability.

Until recently, most household hazardous waste collection efforts employed one-day special events in which residents were asked to bring listed hazardous materials to an advertised drop-off location. Often these efforts did not include funding to enable follow-up periodic collection events. An argument against these one-day events is that pre-event publicity raises residents' awareness of household hazardous waste, then provides little opportunity for disposal. When residents are unable to drop off materials at the one-day event, they might be prone to toss those materials out with normal household trash in the days and weeks following the missed drop-off opportunity. Recognizing the need to provide a continuing viable disposal option for these materials, an increasing number of communities have begun to implement permanent collection programs for household hazardous wastes.

To date, very few communities have attempted curbside pickup of hazardous wastes because of hazards to workers, safety and liability concerns regarding materials set at the curb, and inadequacies of most existing collection equipment to safely transport many household hazardous waste items. Kent County, Del., and the city of Los Angeles ran pilot programs in which residents could call an advertised number to request door-to-door pickup of hazardous items, but both communities decided to drop the programs because of costs. Several other communities, including Minneapolis, Spokane, Wash., and Warren County, N.J., pick up household batteries, which residents place in sealable plastic bags, for collection with household recyclables.

Haulers or local governments that own or operate landfills, waste-to-energy facilities, or composting plants will appreciate the value of reducing waste stream toxicity through a household hazardous waste facility. However, municipalities and haulers that do not own disposal facilities might still lend their support to such programs for environmental or liability-reduction reasons. Wastewater treatment districts also benefit from these programs, and may be helpful allies in organizing and funding a program.

Funding, location, promotion, and operational responsibility of household hazardous waste programs should be coordinated with other elements of the waste collection system. Most successful programs are funded through a surcharge on tipping fees or a per-capita fee throughout the jurisdiction offered the service. Some programs also offer fee-based services to businesses that generate very small quantities of hazardous wastes, although state regulations differ considerably on whether this is allowed. Permanent collection facilities or one-day drop-off sites are often best located at existing disposal or transfer facilities. When located at the same site, efficiencies of staffing can be realized. Promotion of a household hazardous waste program should emphasize source reduction, and clearly explain the role of the program as one element of an overall coordinated waste management strategy for the community. ▮

HOMEWORK ASSIGNMENT

1. Obtain waste composition data for a nearby community. Estimate the percent of the residential wastestream that yard materials comprise on : (a) an annual basis; (b) during the peak month of waste generation; and (c) during the minimum month of waste generation.
2. List the relative advantages and disadvantages of alternative methods of collecting yard wastes. Which approach do you think is best suited to the community you live in; why?
3. Find out whether your state has rules regarding the disposal of residential appliances. Compare requirements, if any, regarding the recovery of ozone-depleting compounds with federal rules proposed as part of the Clean Air Act Amendments.

REFERENCE LIST

Aquino, John T., "Appliance Pick-Up and Disposal: New Rules, New Opportunities," *Waste Age*, February 1993.

Dean, Lillian and Mark Wollenweber, "Curbside Collection of Grass Clippings," *BioCycle*, January 1989.

Glenn, Jim, "Taking a Bite Out of Yard Waste," *BioCycle*, September 1989.

Selby, Mark ", Yard Waste Collection," *BioCycle*, June 1989.

Segall, Lori, and Ron Smith,"Raking vs. Bagging," *BioCycle*, September 1989.