RESOURCE RECOVERY: AUTOMATIC RECYCLING OF STEEL CANS AND OTHER FERROUS

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Studies have shown that the amount of ferrous in the municipal waste stream is between four and seven percent (by weight). The inescapable conclusion is that annually in the United States, seven to twelve million tons of ferrous is therefore available for recovery from the municipal solid waste stream (MSW). While curbside and drop-off recycling programs divert and capture much of the steel can portion of the ferrous material, we observe that magnetic separation at resource recovery facilities is proving to be a significant means of collecting virtually all steel cans and steel products from the solid waste stream.

In 1993, 142 operating resource recovery facilities combusted about 18 percent of the municipal solid waste generated in the United States. About 75 percent of these facilities magnetically separated steel cans and other discarded steel items either pre- or post-combustion. The recovery of ferrous scrap reduces the amount of post-combustion residue material that must be landfilled. It also heightens the facility's environmental performance through recycling achievement.

Indeed, magnetic separation of steel cans at resource recovery facilities contributes significantly to overall recycling accomplishment. In February 1993, the Florida Department of Environmental Regulation (DER) and the Steel Recycling Institute (SRI), with the cooperation of Resource Recycling, Inc., determined what portion of the steel scrap in MSW is comprised of steel cans. A total of nine 55-gallon samples of steel scrap recovered from Resource Recycling, Inc.'s Pinellas County, South Broward and McKay Bay facilities were studied. Through this testing, it was verified that steel cans recovered at the resource recovery facilities contributed significantly to the overall recycling rate of steel cans in Florida.

The fact is that one out of every six steel cans made and used in this country is recovered automatically through resource recovery. Very few residents are aware of the fact that their resource recovery plant is ensuring that virtually all food, beverage and general purpose cans, including paint and aerosol, are being recycled. Even haulers who use these facilities may not be aware of this fact. Both the resource recovery and steel industries would do well to promote the benefits of this automatic recycling of steel cans and other ferrous. Clearly, magnetic separation at resource recovery facilities is a simple and desirable method of diverting what would otherwise be relegated as solid waste to the landfill. It should be routinely recognized as an increasingly important part of the resource recovery and steel industries' overall recycling efforts. (See Table 1.)

THE STEEL INDUSTRY: THE ORIGINAL RECYCLER

In 1991, the steel industry consumed 38.5 million tons of post-consumer steel. Approximately 970,000 tons of steel cans were recycled, with about 67 percent collected from curbside, drop-off, buyback and commercial/institutional recycling programs. The other 33 percent, approximately 340,000 tons, was derived from resource recovery facilities. Along with the steel cans, resource recovery facilities supplied the steel industry with another 300,000 tons of steel from household discards, including water heaters, bikes and lawn mowers. Had these non-container steel items not been collected from resource recovery facilities, they most likely would not have been recycled, since they are not normally collected in residential recycling programs or taken to scrap dealers.

More than 70 end markets, including steel mills and foundries, purchase steel scrap for recycling. A network

TABLE 1 KEY FACTS PERTAINING TO OPERATING MUNICIPAL WASTE COMBUSTION FACILITIES

	Mass Burn/RDF
Population Served (in millions)	~30
Communities Served	909
Number of States with Plants	33
Ferrous Metals Recovered* (in thousands of tons)	~562
Average Community Recycling Rate	23%
Number of Homes Supplied with Electricity (in millions)	1.3

*Based on response of representatives from 65 WTE projects.

SOURCE: Integrated Waste Services Association, 1993

of 1,500 ferrous scrap dealers across the country collect and process the steel scrap, then ship it to end markets. Selected scrap broker/processors that traditionally collected and processed cars, white goods or other ferrous scrap have expanded their processing capability to include steel cans and ferrous derived through magnetic separation at resource recovery facilities.

Steel scrap has been traditionally obtained from three sources: "home" scrap, derived from the production of steel; "prompt" scrap, derived from the manufacture of steel products; and "obsolete" scrap, steel products that have come to the end of their useful lives. The reuse of steel scrap has always been an integral part of the steelmaking process. In fact, for the past 50 years, more than 50 percent of the steel produced in the United States has been recycled into a multitude of new steel products. These new steel products will eventually be remelted again by mills to make new steel. Due to technological advances in steelmaking, the two types of furnaces used in today's steel mills require more steel scrap than ever. The basic oxygen furnace (BOF) blends molten iron with approximately 25 percent steel scrap. The electric arc furnace (EAF) uses virtually 100 percent steel scrap. With new efficiencies in steelmaking and all phases of manufacturing, less traditional scrap is being generated, thus creating a need for more externally sourced scrap. Through these sources, including export consumption, 66 percent of the domestic steel produced in recent years has been recycled.

Steel food, beverage, paint and aerosol cans contain at least 25 percent recycled steel and are recyclable as scrap themselves for new steel production. Manufactured from the highest grade of steel, they are now recognized as an excellent source of steel scrap and have gained great acceptance as a desired commodity. Steel cans no longer have the restrictive amounts of tin that melters once feared. Thus, the steel industry is fully prepared to consume the majority of steel cans collected, remelting them to produce new steel.

Source-separated steel cans are also being recycled into ductile and gray iron products. A study performed by the University of Wisconsin-Madison confirmed that steel cans are a valuable new scrap resource for foundries. Taking part in the study for the past two years, Waupaca Foundry in Wisconsin has recycled more than 15,000 tons of steel cans into ductile iron products. Several other foundries have also begun to recycle steel cans and are using or considering using municipal solid waste derived ferrous from resource recovery facilities. The more than 2,500 iron and steel foundries, serve as potential end markets that may locally serve many communities across the United States.

METHODS OF COLLECTION FOR RECYCLING

In the last four years, steel cans have advanced in their availability from collection programs and desirability for end markets to the point that competition now exists between local "traditional" recycling programs and the automatic recycling provided by the servicing resource recovery plants. Is it better to capture steel cans through source-separated curbside or drop-off recycling and then allow automatic recycling with resource recovery to catch the "strays?" Or, is it better to exclude steel cans from the curbside and drop-off altogether in favor of resource recovery? There is no single, best answer, as reflected by the different approaches seen across the nation.

At least 75 percent of all resource recovery facilities (both existing and planned) are located in areas serviced by curbside recycling programs, according to surveys conducted by Governmental Advisory Associates, Inc. (Table 2). Of these facilities, the material most often recovered both pre- and post-combustion was ferrous.

Residents in both urban and suburban areas are increasingly serviced by curbside recycling, or a combination of curbside and drop-off recycling. In a curbside program, residents are responsible for placing recyclables into a storage bin or bag and placing it at the curbside for collection. Recyclables are collected by truck and delivered to a secondary processor for magnetic separation and other sorting, preparation and shipment to end markets. Drop-off programs may operate as the sole recycling program in rural areas where curbside recycling is not feasible. To participate in this recycling program, residents bring their steel cans and other recyclable materials to a drop-off site. These sites may also supplement curbside collection, giving residents additional opportunities to recycle steel cans. Multi-commodity buyback centers provide additional local recycling options to the public. Steel cans and other recyclables generated by schools, businesses, hotels, restaurants and other commercial/institutional establishments are collected through their own internal re-

TABLE 2 RECYCLING PROGRAMS IN AREAS TO BE SERVICED BY RESOURCE RECOVERY PLANTS: PLANNED AND EXISTING FACILITIES*

Type of Recycling Program	Planned		Existing	
	Yes	No	Yes	No
Curbside	92.0%	8.0%	71.3%	28.7%
Commercial	84.0	16.0	70.6	29.4
Drop-off	56.0	44.0	66.4	33.6
Buyback	28.0	72.0	32.9	67.1
Materials Recycled				
METALS				
Aluminum	95.8%	4.2%	94.6%	5.4%
Bimetal cans	91.7	8.3	73.1	26.9
Steel cans	91.7	8.3	77.7	22.3
Other ferrous scrap	54.2	45.8	66.9	33.1
PAPER				
Corrugated cardboard	95.8%	4.2%	83.1%	16.9%
Newsprint	95.8	4.2	89.2	10.8
Office/computer paper	95.8	4.2	74.6	25.4
Magazines	25.0	75.0	19.2	80.8
Mixed paper	20.8	79.2	26.2	73.8
PLASTICS				
HDPE plastic	91.7%	8.3%	76.2%	23.8%
PET plastic	91.7	8.3	76.9	23.1
Other plastic	33.3	66.7	19.2	80.8
GLASS	100.0%	0.0%	91.5%	8.5%
OTHER MATERIALS	54.2%	45.8%	50.8%	49.2%

*A total of 168 resource recovery facilities responded to inquiries covering types of recycling programs, and 154 provided data about specific materials recovered in the source-separated recycling programs.

SOURCE: 1993-94 Resource Recovery Yearbook Directory and Guide.

cycling programs. Employees separate, rinse and flatten empty steel cans and store them with glass, plastic and aluminum in a large container or roll-off for recycling. Haulers collect and deliver these recyclables to secondary processors for sorting preparation and shipment to end market, often being mixed with residential collection.

Whether source-separation recycling is available or not, resource recovery facilities offer unique advantages. Ferrous scrap, including steel cans, cannot be combusted or melted at the facility — it would take the steel mill temperatures in excess of 3000 degrees Fahrenheit to do that. But, by magnetically separating steel scrap before or after combustion of the organic MSW, resource recovery facilities avoid landfilling this recyclable material. The incremental costs of the beneficiation and processing of this unique grade of steel scrap for reuse by steel mills, foundries and other end markets is offset by the incremental revenue and cost avoidance. ASTM E702-85, "Standard Specification for Municipal Ferrous Scrap," originally published in 1979, governs the chemical and physical requirements of the various end markets.

When seeking to maximize the diversion of recyclable material from the solid waste stream, curbside and drop-off collectors and processors are largely dependent upon the steady, willing participation of residents in a traditional source-separation recycling program. However, magnetic separation of steel cans at resource recovery facilities automatically recovers more than 90 percent of the steel can scrap generated from a community. Residents fully and completely participate in recycling steel cans just by disposing of them normally. For instance, in 1992, it was determined in Florida that steel cans are being recycled at a rate exceeding 50 percent. This higher than national average recycling rate for steel cans is rightfully credited to magnetic separation by resource recovery facilities, plus curbside-derived tonnages from those areas not served by resource recovery.

Just as importantly, steel cans are automatically recycled from the entire community. This means that in addition to all households being covered, area businesses, schools, and other commercial/institutional establishments automatically recycle their used steel cans. Therefore, magnetic separation of steel cans at resource recovery facilities achieves tremendous economies of scale by fulfilling the functions of both residential and commercial/institutional recycling programs. Finally, resource recovery facilities magnetically separate all types of steel cans, large and small, including steel food, beverage, paint and aerosol containers, from a community's solid waste stream.

PROCESSORS OF STEEL CANS AND MUNICIPAL SOLID WASTE-DERIVED FERROUS SCRAP

All steel cans, whether collected from communities through source-separation recycling programs or through magnetic separation with other ferrous scrap at resource recovery facilities, require processing before shipment to the steel industry end markets. When collected through community recycling programs, steel food and beverage cans should be rinsed clean. Steel aerosol cans must be empty of their contents, and steel paint cans should only have a thin skin of dry paint left on the inside of the can. All steel cans are collected, magnetically separated and baled together, regardless of type. Ferrous scrap dealers have long supplied the steel industry with scrap prepared to specification; they are highly effective processors of source-separated steel can scrap because the necessary equipment to process steel cans is already in place, and the links to end markets for steel cans are well developed. Material recovery facilities also serve to prepare steel cans collected through community recycling programs. These facilities magnetically sort steel cans from commingled recyclables for baling and shipment to end market. In some case, they ship the bales to a scrap dealer for greater densification.

In contrast, steel cans and other ferrous scrap generated from resource recovery facilities must first be upgraded through additional processing. This beneficiation is necessary because ferrous recovered before combustion

has residue from solid waste, while ferrous recovered after combustion is coated with ash. Selected scrap dealers have become specialty vendors for performing this needed beneficiation. Methods, which vary from one to another, include shredding, air classification, screening, trommeling and additional magnetic separation. Beneficiation produces ferrous scrap that is an attractive, marketable material with predictable chemical characteristics, as noted in ASTM E702-85, described previously.

No one arrangement is necessarily better than another, and variations in the process itself may depend on the quantities and demographics of the municipal solid waste processed, consideration of pre-burn or post-burn separation characteristics, whether the beneficiation is done at the plant or off-site, and what the end markets are seeking in terms of their own specifications. Most operators would agree that beneficiation should be performed on the site of the resource recovery facility. When performed on-site, no additional arrangements or negotiations need to be made regarding leftover residue. Solid waste residue can go back into the resource recovery plant, while the ash can be appropriately managed. Facilities that beneficiate the MSW ferrous fraction in their own plant may either set up their own system or work in partnership with a ferrous broker/processor who specializes in such beneficiation and marketing. Off-site beneficiation does occur, however, when there is limited space at the site of the facility, or when equipment for beneficiation already exists off-site. The disposition of off-site residue is, as noted, a matter that must be coordinated to the satisfaction of all parties.

Each steel company and foundry has its own specifications for acceptable tin coated and tin free steel can scrap. The following are general specifications for the forms normally purchased. In each category, the steel can scrap may include aluminum lids, but generally excludes nonmetallics or nonferrous metals, except those used in can construction.

CONCLUSION

Although the automatic recycling of steel is being performed by many resource recovery facilities, the public serviced by these facilities is largely unaware of this fact. It would be ironic if these same citizens selectively avoided the purchase of products contained in steel cans, thinking them to be unrecyclable, when the diametric opposite is true. Such action over time would displace steel cans with other containers that lack the automatic recycling advantage. To determine the extent of the public's awareness and perceptions of steel recycling in resource recovery plants, the SRI is sharing information with the Integrated Waste Services Association (IWSA) on public attitudes and opinions. This will benefit both organizations since the information will be used to develop specific advertising messages and communications tools. These messages will be incorporated into the SRI's ongoing public awareness and education campaigns where resource recovery facilities and automatic recycling are in place. The automatic recycling of steel, in addition to volume reduction and energy recovery, is an additional environmental benefit offered by resource recovery facilities and will bring added recognition among public and key constituents.

TABLE 3 SUMMARY OF FERROUS MATERIAL RECOVERY AT SELECTED RESOURCE RECOVERY FACILITIES

Plant Location (Operator)	*Technology*	*Processing Capacity (Tons/Day)*	*Ferrous Recovery (Tons/Month)*	*Ferrous Recovered As Percent of Total Waste Processed*
Detroit, MI (ABB)	RDF	4,000	3,200	5.0-5.5%
Dade County, FL (Montenay)	RDF	3,000	2,570	3.8-4.0%
Eden Prairie, MN* (EPR, Inc.)	RDF Processing	470	200	2.5%
Pinellas County, FL (Wheelabrator)	Mass Burn	3,000	1,450	1.9%
Baltimore, MD (Wheelabrator)	Mass Burn	2,250	1,200	2.0%
Hillsborough County, FL (Ogden Martin)	Mass Burn	1,200	650	2.1%
Camden, NJ (Foster Wheeler)	Mass Burn	1,050	570	2.1%
Tulsa, OK (Ogden Martin)	Mass Burn	1,125	470	1.7%

**Fuel preparation only at this site*

SOURCE: Solid Waste & Power

Steel cans and other ferrous scrap are easily recovered for automatic recycling through magnetic separation at resource recovery facilities. (See Table 3 for specific examples.) Performing magnetic separation decreases resource recovery facility costs for disposal of post-combustion material and generates incremental scrap revenue. Whether recovered before or after combustion, properly beneficiated municipal solid waste-derived ferrous is a readily marketable material. Through the benefit of automatic recycling, these facilities recover virtually all steel cans from the community, as well as other discarded iron and steel items, independent of active participation by residents. This method of diversion of steel cans from the solid waste stream accordingly provides a solid base for the measured statistical rate of steel can recycling.

Resource recovery facilities should heighten public awareness of automatic steel can recycling. The overall environmental image of these facilities should be bolstered as the public realizes that approximately one out of every six steel cans recycled in the United States is recovered through magnetic separation at resource recovery facili-

ties. By mutually working towards increased public awareness of automatic recycling of steel cans and other ferrous at resource recovery facilities, both the resource recovery and steel industries can accomplish their respective goals. The SRI is prepared to heighten accomplishment and awareness by working with the IWSA and its member companies as well as the haulers who deliver municipal solid waste to these facilities for energy recovery and recycling nationwide.

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