Recycling Steel Automatically–Through Resource Recovery

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ABSTRACT

Last year, more than 55 percent of all steel cans were recycled. But no matter how effective the local recycling programs may be, some steel cans and other steel products are overlooked and appear in MSW. This missed steel fraction is automatically recycled by resource recovery facilities through magnetic separation.

More than three-fourths of the operating resource recovery plants magnetically separate steel cans and other discarded steel items either pre- or post-combustion. Recovering ferrous scrap clearly reduces the post-combustion material that is landfilled and heightens the facilities' environmental performance.

Both the resource recovery and steel industries must heighten public awareness of the benefits of automatic steel recycling. Magnetic separation at resource recovery facilities is a simple method of diverting what would otherwise be relegated as solid waste to the landfill. It should be recognized as an increasingly important and valued part of the resource recovery and steel industries' overall recycling efforts.

This paper will discuss the status of steel can recycling in the United States, describe how recovered ferrous is beneficiated before recycling by the steel industry, and make recommendations for heightening awareness of the steel recycling contribution made by resource recovery facilities.

INTRODUCTION

Communities, businesses and institutions collect steel cans for recycling through curbside and dockside programs throughout the country. Last year, about 55.9 percent of all steel cans were recycled. Ferrous scrap dealers, the "original recyclers," collect and process enormous tonnages of scrap iron and steel for recycling. But no matter how effective local recycling efforts may be, some steel cans slip through recycling's nets and appear in the municipal solid waste stream. And the many other smaller iron and steel scrap items that do not routinely go to the scrap yard are also discarded. In areas served by resource recovery, however, this missed steel fraction is automatically recycled through magnetic separation.

More than three-fourths of the operating resource recovery plants magnetically separate steel cans and other discarded steel items either pre- or post-combustion. Automatic recycling of steel clearly reduces the post-combustion material that is landfilled and heightens the facilities' environmental performance through tangible recycling achievement. 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 recognized as an increasingly important and valued part of the resource recovery and steel industries' overall recycling efforts.

SOURCES OF STEEL SCRAP

It's important to understand how all forms of steel recycling take place and how it relates to resource recovery. The steel industry has a healthy appetite for steel scrap. The two types of steelmaking furnaces in use today, the basic oxygen furnace and the electric arc furnace, were designed to make fullest use of scrap resources. In fact, 70 million tons of steel scrap were recycled in 1995 alone.

This scrap is obtained from three sources: mill scrap generated during the steelmaking process itself; industrial scrap generated from the manufacturing process; and post-consumer scrap, or old steel products. Mill and industrial scrap resources never enter the municipal solid waste stream. They are routinely collected and shipped to ferrous scrap processors which prepare them for recycling.

However, more than half of the steel industry's supply of steel scrap comes from post-consumer scrap resources, some of which is derived from or never enter the municipal solid waste stream. These include the millions of tons of steel cans, cars, appliances and construction and demolition materials

recycled each year. For the most part, each of these commodities have a collection system that captures a large portion of them for recycling. There are some instances, though, where they will show up at a waste-to-energy plant.

Automobile recycling is a success story of huge proportions–with a virtual 100 percent recycling rate. Cars are not buried but are stripped, flattened and shredded, enroute to steel mill consumption. Various automobile parts, however, including oil filters and body components, incidentally enter the municipal solid waste stream and can be captured through resource recovery.

Appliance recycling is now also growing through communities across America. The recycling rate for appliances in 1995 was 74.8 percent. Appliances should be collected, processed and recycled routinely without ever entering the waste stream. Various components, such as replaced parts, and small appliances like toasters and fans show up in the municipal solid waste stream and are gathered by resource recovery.

Construction and demolition projects affect resource recovery by adding ferrous tonnage to the scrap iron and steel automatically recycled through magnetic separation. New construction or demolition on smaller jobs generate incidental iron and steel scrap that go to the municipal solid waste stream and can only be efficiently recovered through resource recovery. Larger jobs create significant quantities of scrap, however, that goes directly to a scrap dealer for mill preparation.

Therefore, through magnetic separation, waste-to-energy plants play an important role in capturing for recycling those ferrous components of the municipal solid waste stream that evade traditional recycling programs. Clearly, automatic recycling by magnetic separation at resource recovery facilities is a simple and desirable method of diverting what might otherwise be relegated as solid waste to the landfill. It is an increasingly important part of the resource recovery and steel industries' overall recycling efforts.

THE STEEL INDUSTRY: RECYCLING STARTED HERE

Most resource recovery facilities, recognizing the inherent recyclability of steel, magnetically separate scrap iron and steel rather than landfill it. When properly prepared, this recovered ferrous scrap is readily marketed. In addition to melting steel cans and other ferrous derived through resource recovery, the steel industry is also a major consumer of source separated steel cans, appliances, automobiles and steel construction and demolition materials. Iron and steel foundries also consume source separated steel cans in significant quantities, therefore providing additional incentive for steel cans to be included in curbside and drop-off programs. We need to look at why steel cans as well as other municipal solid waste derived ferrous are desirable when this has not always been the case.

Steel Mills and Foundries Recycle Steel Cans and Other Ferrous Scrap

Recycling 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 the art of steelmaking, the two types of furnaces used in today's steel mills require steel scrap to make new steel. The first, the basic oxygen furnace, combines molten iron with approximately 28 percent steel scrap. The other, the electric arc furnace, melts virtually 100 percent steel scrap.

Through advances in technology and increases in efficiency in the steelmaking and manufacturing processes, less mill and industrial scrap is being generated. This has created a demand for post-consumer scrap.

Increasingly since 1988, steel food, beverage, paint and aerosol cans, which are recyclable as scrap themselves for new steel production, have been filling this shortfall. Manufactured from the highest grade of steel, they are recognized as an excellent source of steel scrap and have gained great acceptance as a desired commodity. One of the reasons why is that steel cans no longer have the restrictive amounts of tin that melters once feared. They can now be directly charged into a steel mill furnace rather than be routed to a detinning facility first. As a result, the steel industry is prepared to consume all steel cans collected, recycling them into new steel.

In addition to new steel, steel cans are also being recycled into iron products. A study performed by the University of Wisconsin-Madison first confirmed how steel cans could serve as a scrap resource for foundries across the United States. Taking part in the study, Waupaca Foundry in Wisconsin recycled more than 15,000 tons of steel cans into iron products. Since then, several other foundries are recycling steel cans and are using or considering using municipal solid waste derived ferrous from resource

recovery. There are more than 1,500 iron and steel foundries, which will potentially provide end markets for many communities across the United States.

METHODS OF COLLECTION FOR RECYCLING

In the last seven years, old steel products have become a more desirable scrap resource. Automobile and construction and demolition material collections have long supplied steel mills and foundries with enormous quantities of steel scrap, while steel can and appliance collection programs have more recently taken root and now share a greater portion of the steel industry's overall recycling efforts. Magnetic separation at resource recovery facilities supplement these collection programs and, often in the case of steel cans, may even serve as the only steel recycling program in the community.

Source Separation Recycling Programs

Most residents are serviced by curbside recycling, or a combination of curbside and drop-off programs, that accept steel cans. In a curbside program, residents are responsible for commingling recyclables together into a storage bin and placing the bin at the curbside for collection. Recyclables are collected by truck and delivered to a secondary processor for 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 operate somewhat similarly. In the United States, there are now more than 16,000 curbside, drop-off and buy back collection programs that accept steel cans for recycling.

Steel cans and other recyclables generated by schools, businesses, hotels, restaurants and other commercial/institutional establishments are collected through their own dockside recycling programs. Employees separate empty steel cans and store them in a large container or roll-off for recycling. Haulers collect and deliver recyclables to secondary processors for handling and shipment to end market.

Many communities have established temporary or permanent collection programs to ensure that appliances do not enter the municipal solid waste stream. By weight, the typical appliance consists of about 75 percent steel, which is largely why 1,600 ferrous scrap processors across the country process ship them to steel mills for recycling. Since 1990, the national recycling rate for major home appliances has risen from 32 percent to 74.8 percent due in part to increased private and public sector awareness and the continuing development of a strong infrastructure for recovery of ferrous scrap from appliances.

Despite their complex construction, automobiles are one of today's most recycled commodities. Whole automobiles are simply not landfilled. The reason why is that the steel and iron components, which make up about 70 percent of the weight of the average vehicle, are too valuable. Instead, automobiles are shredded at ferrous scrap processing yards. In 1995, approximately 13 million tons of steel from shredded automobiles was shipped to steel mills for recycling.

The sheer size and number of construction and demolition projects in the United States produce a considerable amount of steel scrap. Each year, the steel industry recycles approximately 30 million tons of steel recovered from construction and demolition projects.

Automatic Recycling of Steel Cans and other Ferrous from Resource Recovery Facilities

Whether source separation recycling is available or not, resource recovery facilities offer unique advantages. It takes steel mill temperatures in excess of 2800 degrees Fahrenheit to melt steel. The typical waste-to-energy facility's furnace temperature rises as high as 1800 degrees Fahrenheit, but far short of the temperature needed to melt steel. But, by magnetically separating steel scrap before or after combustion, resource recovery facilities avoid landfilling this recyclable steel scrap. The incremental costs of cleaning and processing of steel scrap for reuse by steel can end markets is largely offset by the incremental revenue and cost avoidance. The intangible value of recyclability itself is even higher and is suggested as a benefit for all concerned.

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 participation of area residents in a traditional 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 participate in recycling steel cans just by disposing of them normally. For instance, it was determined in Florida in 1994 that steel cans are being recycled at a rate exceeding 64.4 percent. This

higher than national average recycling rate for steel cans is rightfully credited to magnetic separation by resource recovery facilities across the state.

Just as importantly, steel cans and other ferrous scrap are automatically recycled from the entire community serviced by resource recovery. This means that in addition to all households being covered, area businesses, schools, and other commercial and institutional establishments automatically recycle their used steel cans, old bicycles, tools and other used items. Therefore, magnetic separation of steel at resource recovery facilities achieves tremendous economies of scale by fulfilling the functions of both residential and commercial/institutional recycling programs for steel items.

Finally, resource recovery facilities magnetically separate all types of steel products, including steel food, beverage, paint and aerosol containers, appliance and automobile components, and construction and demolition debris from a community's solid waste stream. Steel paint and aerosol cans, in addition to steel food and beverage cans, are part of the steel industry's overall recycling efforts--even though they may not be included in a community's source separated recycling program. Minor or even major product contamination of these containers is handled in a very forgiving nature by the combustion process. In addition, ferrous scrap not normally recoverable–such as steel box springs from a mattress–are recovered for recycling from the 80 percent of the facilities that separate steel post-combustion.

According to the Steel Recycling Institute's most recent statistics, 98 resource recovery facilities across the country separate steel cans and other ferrous for recycling, accounting for more than 40 million residents serviced. Of these, more than 18 million residents are serviced exclusively by resource recovery, meaning their steel cans and other post-consumer steel products would not be recycled if it were not for the presence of these facilities.

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

All steel products, whether collected from communities through source separation recycling programs or through magnetic separation with other ferrous scrap at resource recovery facilities, require processing for shipment to steel industry end markets.

Source Separation Recycling Programs

When collected through community recycling programs, steel food and beverage cans should initially 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 may be processed and baled together, regardless of type.

Ferrous scrap dealers have long supplied the steel industry with processed scrap. More recently, many of these businesses have added steel cans to their collections of appliances, automobiles and construction materials as the demand for steel cans has risen. Scrap processors are effective processors of source separated steel can scrap because much of 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 process steel cans recovered from communities through community recycling programs. These facilities magnetically sort steel cans from commingled recyclables for baling and shipment to end market.

Appliances, automobiles and construction and demolition material are processed at ferrous scrap yards for recycling. Automobiles and appliances are shredded and the steel is magnetically separated from the remaining material. Depending are their size, construction and demolition materials may be sheared, baled or shredded before shipment to end market.

Cleaning Steel Cans and Other Ferrous at Resource Recovery Facilities

Before they are recycled, steel cans and other ferrous scrap generated from resource recovery facilities must first be upgraded through additional processing. This is necessary because ferrous recovered from the estimated 20 percent of facilities that separate it before combustion has residue from solid waste, while ferrous recovered after combustion is coated with ash.

Specialty vendors typically perform the necessary steps. Methods vary from vendor to vendor, but ordinary proven mechanical processes are used, such as shredding, air blowers, screening, trommeling and additional magnetic separation. Cleaning the ferrous scrap produces a marketable material with predictable chemical characteristics.

Most operators would agree that this process 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. It can just go back into the resource recovery plant–or, if ash–be

appropriately managed. Off-site cleaning of the steel does occur, however, when there is limited space at the site of the facility, or when existing equipment for process already exists off-site. Residue is disposed of in accordance with local, state and federal laws.

CONCLUSION

Steel cans, automobiles, appliances and construction materials are already recycled in enormous quantity. Automatic steel recycling through resource recovery assists the steel industry in recovering the smaller ferrous components that would otherwise be landfilled. Performing magnetic separation decreases a resource recovery facility's costs associated with the disposal of post-combustion material and generates incremental scrap revenue. Whether recovered pre- or post-combustion, ferrous scrap is a marketable material. These facilities, through automatic recycling, recover virtually all steel cans from the community–independent of active participation by residents. The increased diversion of steel cans and other ferrous items from the solid waste stream accordingly improves the measured statistical rate of steel can recycling and provides a measurable recycling statistic for resource recovery.