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MAGNETIC SEPARATION OF STEEL CANS: A KEY TO SOLID WASTE MANAGEMENT[1]

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Abstract

A growing number of communities are finding that municipal magnetic separation of steel cans is an ecological, economic, and technological solution to part of their solid waste problem. Steel's unique magnetic property permits the large-scale efficient reclamation of steel cans from collected municipal garbage.

Magnetic separation enables municipalities to extend the life of scarce landfill sites, produces revenues from the sale of scrap cans, lowers the cost of waste disposal, and helps conserve a valuable resource through recycling. It also leads to salvaging vastly greater numbers of used cans than do the volunteer collection programs.

Successful recycling programs require that economically viable markets be maintained for reclaimed materials. America's steel industry is actively developing uses for reclaimed steel cans. Steel producers have agreed to accept all reclaimed steel cans for remelting into new steel products. Also, the copper mining industry uses salvaged cans to produce copper from low grade ore. Detinners and ferroalloy plants offer additional markets for salvaged steel cans.

Recycling Seen as Solution to Solid Waste Disposal

In recent years the American public has been made acutely aware of the "third pollution"–solid waste. Two salient facts underscore the gravity of the situation. Ten pounds of household and industrial waste per capita are generated in this country every day, a figure that is expected to double by the year 2000. This trend becomes alarming when coupled with the fact that many areas are running out of suitable landfills to get rid of their trash.

Although many agencies and industries are working on the problem, the final solution lies in the future. Most authorities are agreed that one of the best answers is to reclaim valuable materials from household refuse, then recycle or otherwise reuse them. Ironically, we are spending an estimated $4.5 billion a year to collect and discard garbage that contains $5 billion worth of reusable metals of all kinds. Some progress already has been made in developing systems for separating refuse into its reusable components.

This report covers the advances that have been made in recovering steel, or "tin," cans. It describes how some cities are successfuly recovering steel cans by magnetic separation at the rate of almost 2.5 billion a year. It also describes how these cans are remelted or reused for a variety of purposes. Hopefully, this "state of the art" report will help other communities to take this important first step in the proper disposal of solid waste.

Municipalities, Regions "Mine" Scrap Steel Cans Magnetically

Concerned citizens in some 350 cities throughout the country are separating cans from their household garbage and carrying them to collection centers established by can manufacturers and the aluminum and steel industries. They recovered an estimated 800 million cans in 1971. In addition to conserving resources, their commendable efforts dramatized the need for recycling.

But solid waste experts consider citizen collection centers a stopgap effort at best. When measured by the 70 billion cans that were used in 1971, citizen collection campaigns produced comparatively insignificant results.

There is a better way. It is magnetic extraction of steel cans as a component of municipal and regional trash collection systems. It is working *now* in localities throughout the U. S. *(a)* In Chicago, the city sanitation department is retrieving more than 700 million steel cans annually and realizing revenues in excess of $100,000. *(b)* Atlanta, which has been employing magnetic separation for more than 35 years, salvages 100 million cans a year. *(c)* Three cities in California–Oakland, Sacramento, and Martinez in Contra Costa County–are "mining" 335 million steel cans annually. *(d)* The small town of Franklin, Ohio (pop: 15,000–site of a demonstration recovery system for steel, paper, glass, and cellulose fibers–is reclaiming 10 million steel cans a year. Although the cans constitute less than 4% of the trash processed, about 10% of the plant's revenue comes from the sale of can scrap to a nearby steel producer. *(e)* By the end of 1972, San Francisco expects to be recovering cans at a rate of 275 million a year. They will be salvaged at a transfer station where garbage from collection trucks is compacted and transferred to larger trucks for hauling to a sanitary landfill site 32 miles away. *(f)* Smaller cities employing magnetic

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TABLE 1. CITIES OPERATING STEEL CAN RECOVERY SYSTEMS (AS OF JULY, 1972)

Location	Separation system	Estimated daily tons of garbage	Estimated daily tons of cans collected[1]	Estimated annual can recovery[1]	Markets
Amarillo, Texas	After incineration	200	12	50 million	Copper mines
Atlanta, Georgia	After incineration	700	16	100 million	Ferroalloys
Chicago, Illinois	After incineration	4,000	100	730 million	Copper mines
Franklin, Ohio	Slurry system	60	5	30 million	Steel making
Houston, Texas	Dry separation at a transfer station	450	20-25	104-130 million	Copper mines
Los Gatos, Cal.	After shredding, before incineration	300	20	120 million	Copper mines
Madison, Wisc.	After shredding	250	7-8	38-41 million	Steel making/ copper mines
Martinez (Contra Costa County), Cal.	Portable separator at landfill	500	20	80 million	Copper mines
Melrose Pk., Ill.	After incineration	400	16	83 million	Copper mines
New Castle County, Delaware	After shredding	1,200	60-96	312-500 million	Detinners/ steel making
Oakland, Cal.	Portable separator at landfill	600	40	182 million	Copper mines
Pompano Beach, Fla.	After shredding	200	7	35 million	to be established
Sacramento, Cal.	Portable separator at landfill	250	12	74 million	Copper mines
St. Louis, Mo.	After shredding, before incineration	1,000	50	260 million	Pilot operations
St. Petersburg, Fla.	Segregated by householders before magnetic separation	N.A.	N.A.	3 million	Detinners
Stickney, Ill.	After incineration	250	10	84 million	Steel making
Tampa, Fla.	After incineration	750	20	104 million	Steel making/ copper mines

[1]Data supplied by municipalities or estimates based on 4% of total garbage less 20% for incinerator loss. Source: Survey by American Iron and Steel Institute.

TABLE 2. CITIES PLANNING STEEL CAN RECOVERY SYSTEMS 1972-73 (AS OF JULY, 1972)

Location	Separation system	Estimated daily tons of garbage	Estimated daily tons of cans collected[1]	Estimated annual can recovery[1]	Scheduled opening
Brevard County, Fla.	After shredding	655-900	26-36	108 million	Fall 1973
Ft. Lauderdale, Fla.	After shredding	600	24	124 million	Spring 1973
Framingham, Mass.	After incineration	250	10	42 million	Mid-1973
Harrisburg, Pa.	After incineration	400-500	16-20	66 million	Mid-1972
Hempstead, N. Y.	Slurry system	1,700-2,000	119-140	618-728 million	Late 1973
Milford, Conn.	After shredding	150-200	6-8	41 million	Fall 1972
Newington, Conn.	After shredding	450	18	83 million	Mid-1973
San Diego, Cal.	After shredding	250	10	52 million	Late 1973
San Francisco, Cal.	After shredding at transfer station	1,500	60	275 million	Late 1972
Scottsdale, Ariz.	After shredding	250	10	52 million	Spring 1973
Vancouver, Wash.	After shredding	200-300	8-12	41 million	Fall 1972

[1]Data supplied by municipalities or estimates based on 4% of total garbage less 20% for incinerator loss. Source: Survey by American Iron and Steel Institute.

separation are Milford, Conn. (pop: 50,000); Pompano Beach, Fla. (38,000); Vancouver, Wash. (40,000); Harrisburg, Pa. (85,000); Madison, Wisc. (172,000). Please refer to Tables 1 and 2 for a list of cities as of mid-1972 which are either using magnetic separation or planning to install it.

Magnetic separation adaptable to all systems

Several different systems are employed to produce reusable ferrous materials. Oakland extracts cans from household refuse at the landfill site. St. Louis and Los Gatos, Calif., remove the cans before the remainder of the garbage is incinerated. Amarillo, Louisville, Chicago, Atlanta, and Stickney, Ill., take the cans out after incineration. In Franklin, Ohio, cans are removed from a slurry that is formed by pulverizing the garbage and mixing it with water.

In some systems, the entire mass of refuse is shredded initially. This homogenizes the garbage and eliminates the need for a dirt cover every day in a sanitary landfill. It also expedites can recovery and helps remove some of the residual organic materials. In other systems, the scrap is shredded after the cans are recovered.

Shredding is an important step in the recycling process. It helps produce a "clean" scrap product when the cans have not been incinerated. Further, it provides the density necessary for economical shipping.

Landfill life extended

Regardless of the system used, extracting steel cans has the important benefit of reducing the cost of transporting refuse to landfill sites, as well as prolonging use of the sites. In San Francisco, engineers claim magnetic separation will extend the life of a landfill by 25%.

Governmental agencies, private companies, and organizations are developing systems to reclaim all reusable materials. The National Center for Resource Recovery—which is funded by materials suppliers, labor organizations, food and beverage producers, container manufacturers, and similar groups—is planning demonstrations of recovery systems in 12 cities throughout the U. S. Others are developing sorting techniques which use slurries, air classifiers, and mechanical separators. Some systems call for burning refuse and converting the energy into steam or electricity. Another approach converts garbage into compost.

Virtually all these systems use, or are adaptable to, magnetic separation of steel cans. When processed properly, the steel can scrap can be sold for remelting of other reuse.

RECLAIMED STEEL CANS HAVE VARIED END USES

The routes that reclaimed steel cans may take from collection to recycling or other reuse are well established. There are several viable markets. Among them are: *(a)* remelting in steel mills, *(b)* reuse in copper mining, *(c)* detinning, and *(d)* reuse in the production of ferroalloys.

Use of scrap is traditional in steelmaking. In the last 30 years, recycled scrap has accounted for more than 50% of the raw material used to make new steel. Almost one-half of this scrap is generated in the mills; the remainder—about 30 million tons a year—is post-consumer scrap purchased from outside sources.

Although steelmakers for many years occasionally put salvaged cans into furnaces, the practice did not present any serious technical problems because of the relatively small quantities involved. When the nationwide emphasis on improving the environment made more imperative the recycling of billions of used cans, controlled melting tests were begun in March, 1970. Two questions had to be resolved.

First, there was concern that non-ferrous contaminants in reclaimed cans might damage steelmaking furnaces. Second, it was essential to make certain that discarded cans—especially those that might have been combined with other metals, principally copper, in municipal incinerators—did not adversely affect the carefully monitored chemistry of molten steel.

Tests resolve technical questions

Answers to some of these technical questions were provided by early tests in basic oxygen furnaces, the principal method of making steel today. Aluminum and lead were oxidized and carried off in the slag or captured waste gases, respectively. Tin could be tolerated if it did not exceed product specifications. However, with respect to incinerated scrap, the presence of copper presents some problems which have not yet been fully resolved.

To avoid metallurgical complications, the studies recommended that tin cans be limited to 5% of the total scrap charge in BOFs. Similar limits were developed for open hearth and electric furnaces. The latter, in most instances able to process charges made up entirely of scrap, offer even better potential markets for can scrap.

Despite restrictions on melting practices, the vast quantities of steel containers can be remelted. For example, if the maximum weight of tin cans were added to the scrap charges of BOFs alone (which produce 65% of the nation's steel), an estimated 20 billion cans could be recycled annually. The increasing use of new tin-free steel beverage cans eventually may relax restrictions on scrap charges.

More recent tests have been made by the steel industry to determine the feasibility of using incinerated can scrap in blast furnaces, which reduce ore to pig iron as the first step in making steel. While there still are some questions—such as size, density, cleanliness, and certain contaminants—the blast furnace is considered another potential method for recycling discarded steel cans.

With these existing and potential remelting techniques available, the steel industry has guaranteed that all steel produced for canmaking contains a minimum of 25% of recycled scrap.

Scrap cans yield tin, help produce copper

Detinning is an industrial process for recovering tin from cans rejected in the manufacturing process, from municipal solid waste (when cans are separated before incineration) or from other sources.

Since the U. S. has no deposits of tin, all of the metal used for a wide variety of purposes must be imported. More than 50,000 tons are brought in from abroad each year. Although reclaiming tin is relatively simple, only 3,000 tons a year are being salvaged. There are about 7.5 lb. of tin in every ton of scrap cans and detinners, who claim that recovered tin is purer than the metal produced from ore, say they will buy all the clean, non-incinerated can scrap they can get.

Detinning plants, as of mid-1972, were located at Baltimore; East Chicago, Ind.; Elizabeth, N. J.; Gary, Ind.; Los Angeles; Milwaukee; Newark, N. J.; Pittsburgh; San Francisco; Seattle, and Tampa.

Another significant market for steel can scrap is the copper industry in the western states. Some 600,000 tons of shredded cans a year (detinned or incinerated) are used as "precipitation iron" to recover copper from low-grade ore. Nearly 15% of all U. S. copper is produced by this process. It is estimated that up to 900,000 tons of steel can scrap (about 18 billion cans) a year could be used for this purpose.

Still another market for steel can scrap is in the production of ferroalloys, where the iron is combined with carefully controlled amounts of elements such as silicon and manganese. The material is then used as part of the "melts" for alloy steel or castings in foundries.

CONSUMERS PREFER CONVENIENCE PACKAGES

Although non-returnable containers comprise only a small percentage of household trash, their high visibility in the form of litter makes them prime targets for restrictive legislation.

Marketing data clearly indicate American consumers prefer the convenience of one-way metal, glass, paper and plastic containers. Despite expressions of concern for the environment, sales figures show that most people continue to use disposable containers. Marketing experts believe that this preference will prevail even if deposits are imposed on convenience containers.

A survey by Opinion Research Corporation in January, 1972, revealed that only 8% of 1,525 people interviewed thought bans on one-way containers would reduce the problems of litter and solid waste—and 24% said recycling was a better solution.

Fortune magazine discussed at length impending legislation and packaging trends in the June, 1972, issue. The article concluded that "among experts who have studied the problems most intensively, there is growing doubt that such bans will do much good and strong suspicion that they might well make things worse."

A 220-page analysis of the beverage container issue recently was prepared for the EPA by the Research Triangle Institute. It dealt with one factor that often is ignored. The document declared:

"The consumer's right to demand, through the price mechanism, the type of product he desires is one of the important characteristics of the free enterprise system. To reduce his freedom to choose a type of packaging would reduce consumer welfare."

MAGNETIC SEPARATION CAN SPUR NATION'S RECYCLING PROGRAMS

The advantages of reclaiming steel cans by magnetic separation have been demonstrated in many cities, but there still are obstacles that must be overcome before the system can be utilized anywhere in the country.

There is, for example, the consideration of quality. Depending on the end use, salvaged cans must be processed according to the size, cleanliness, and density of the final scrap product. Removal of residual organic materials also is necessary when the cans have not been incinerated.

The major problem is, perhaps the economic factor. Despite ease of recovery and existing markets, steel scrap has a relatively low value compared to other materials. Another complication is the differential in freight rates. In most localities the cost of shipping all types of scrap is relatively high.

There are no easy answers to many questions raised by recycling, but one fact has been clearly established. Magnetic separation of steel cans is the most advanced form of reclamation available now. In 1971 the number of municipal and regional systems using it doubled over the previous year and the list is expected to increase steadily.

Magnetic separation can be the catalyst in convincing consumers, environmentalists, and legislators that recycling is the logical solution to the treatment of solid waste.

SOURCES OF INFORMATION ON RECYCLING

One of the best sources of more information about recycling is the National Center for Resource Recovery, Inc., the clearing house for data compiled about all types of refuse handling systems.

National Center for Resource Recovery, Inc.
1211 Connecticut Avenue, N.W.
Washington, D. C. 20036

To learn more about new ways to collect, handle, sort, and salvage household refuse, contact:

National Solid Waste Management Association
1145 19 Street, N.W.
Washington, D. C. 20036

American Public Works Association
1313 East 60 Street
Chicago, Ill. 60637

The Resource Recovery Act of 1970 is being administered by the U. S. Environmental Protection Agency. To qualify your city for Federal funds to build a recycling system, contact:

Solid Waste Management Office

Environmental Protection Agency
Rockville, Md. 20852

Further information about how the scrap processor fits into the recycling of cans is available from:

Institute of Scrap Iron and Steel
1729 H Street, N.W.
Washington, D.C. 20006

To learn more about what the manufacturers and major users of steel cans—brewers, soft drink producers, and food processors—are accomplishing, get in touch with:

The Can People
Suite 1200
110 E. 59 Street
New York, N. Y. 10022

U. S. Brewers Association, Inc.
1750 K Street, N. W.
Washington, D. C. 20006

National Soft Drinks Association
1101 16 Street, N.W.
Washington, D.C. 20036

National Canners Association
1133 20 Street, N.W.
Washington, D.C. 20036

To join the battle against litter consult:

Keep America Beautiful
99 Park Avenue
New York, N. Y. 10016

ANTIBIOTICS IN MILK COULD CAUSE FOOD POISONING PROBLEMS

Here's another reason to keep antibiotics out of milk. University of Wisconsin food scientists have found that antibiotics in milk could lead to the type of food poisoning caused by imported cheese in 1971.

The 1971 food poisoning outbreaks were traced to Camembert or Brie cheese imported from France. Tests showed that the cheese, as well as stool samples from ill patients who had eaten the cheese, yielded certain strains of bacteria called *Escherichia coli.*

It is not rare to find this organism in cheese, but it had never before been known to cause food poisoning in the U. S. This led food scientists H. S. Park, E. H. Marth, and N. F. Olson to study how the organism behaves in Camembert cheese.

To do this, they made Camembert, adding toxic strains of *E. coli* to the milk, along with the usual commercial starter culture of lactic acid bacteria.

They found that this toxic microbe—like most other bacteria—grew in the cheese making process. But it failed to survive in the cheese because of the acidic environment and other conditions produced by the starter bacteria.

However, the picture was different for a batch of cheese in which they used milk which had been contaminated with antibiotics. While the antibiotics inhibited growth of the starter bacteria, they didn't affect growth of *E. coli* and a high number of the toxic microbe remained in the cured cheese. In fact, the Camembert in this batch had eight times more *E. coli* than cheese made from antibiotic-free milk.

While there may be many reasons the French Camembert had enough *E. coli* to cause illness, the study suggests that one of these could be a drop in the amount of acid produced during the manufacturing process.