Are recycling and reclamation of waste materials significant ways of dealing with the problem of waste disposal? This review of the subject puts this important issue in perspective and suggests a national approach as well as some reasons why it is not used.

Recycling and Reclamation

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Plastics, rubber & leather 3.0
Textiles 2.7
Wood 2.5
Rock, dirt, ash, etc. 3.7

It would appear logical that major efforts should be devoted to: 1) to reduce the rapid rate of obsolescence of our commodities, 2) to reduce the excessive amounts of waste produced, 3) to divert these materials from the municipal waste stream, and 4) to remove and reuse the most abundant items in these wastes.

Secondary Materials Industry

As far as I know, nothing has been done to reduce the rate of obsolescence of our commodities (our cars, refrigerators, washing machines, toasters); the problems are getting worse. Efforts are just beginning to reduce the excess wastes, e.g., cutting down on packaging, taxing non-returnable bottles, etc. However, the secondary materials industry, with more or less success, has been addressing itself for generations to the interception and reuse of industrial and commercial wastes. This industry generally operates by private collection of waste materials and sale of the materials, after necessary treatment, to manufacturers and processors. During World War II, the secondary materials industry was at its peak, but even last year the salvage of industrial wastes amounted to between $5 and $7 billion, greater in value than all municipal wastes operations. Major secondary materials include the following:

**Paper**—In the United States, 20% of 11 million tons of the total raw material requirements are recovered from waste paper, equivalent to 200 million trees, or a forest area of 14 million acres, the area of New Hampshire and Vermont combined.

**Iron and Steel**—More than 36 million tons of ferrous metals were reused by steel manufacturers in 1969; this represented 55% of the amount of raw steel produced. However, the new steel furnaces are designed to use less scrap and more pig iron and pelletized iron ore.

**Nonferrous Metals**—More than three million tons of nonferrous metals are recycled annually in the U.S. Over 50% (1 million tons) of our copper production comes from secondary or reprocessed copper; these wastes are, in many instances, richer than the ores. Recovered lead (one-half million tons) is twice the amount mined domestically, and is obtained from shop scrap and dead storage batteries. The one-quarter million tons of recovered aluminum constitutes 25% of the nation's annual requirement. There are some metals, such as nickel, that the U.S. lacks which can be
recovered from scrap. Most of the scrap supply now comes from industrial plants that produce metallic products.

Glass—The price for waste glass (cullet) has not kept pace with labor costs and by 1970 there were few cullet dealers operating in large cities, and cullet now constitutes only 5% of the raw materials used in glass manufacture. Waste glass requires considerable grading and must be sorted by color. Attempts are being made to obtain optical separation of waste glass and techniques are being developed to magnetically separate the glass and metal fractions of incinerator residue.

Textiles—30% of the 1.2 million tons of textiles wasted annually are sorted each year and used mostly as wiping rags for industry.

For these materials the secondary materials industries divert a very significant portion of the wastes from the main stream. However, much more can and should be done.

Some brief comment should be made regarding other wastes.

Swine Feeding—The feed value of commercial garbage is enough to induce continuance of a surprisingly substantial amount of swine feeding, despite the requirement that the garbage be disinfected. There are about 850,000 hogs each fed an estimated 25 pounds per day of cooked garbage—a total of more than 3 1/2 million tons each year. Most of this garbage is collected by private contractors and comes from restaurants, institutions, markets and to some extent from residences.

Plastics and Rubber—There has been less success with waste plastics and rubber. While the plastics manufacturing plants recycle their internal wastes, when plastic items are mixed with other solid wastes the cost of separation, sorting, cleaning and processing is tremendous compared to their salvage value.

Most waste rubber comes from scrap tires and about one million tons of tires are scrapped annually, visible on scrap piles all around the country. Reclaimed rubber could be employed for tires but the costs are prohibitive so that a constantly declining portion is retreaded or reclaimed. Distillate (pyrolysis) of scrap tires has been studied and found technically feasible on a large scale, however, there is some question whether even this method can be made economically attractive.

Recycling of Municipal Wastes

Many younger environmentalists are impatient with public works administrators who resist incorporating recycling in their municipal operations. It must be understood that the primary objectives for a municipality are regular, efficient, nuisance-free and hazard-free collection and disposal systems; salvage and reclamation programs cannot be allowed to subvert these objectives.

Markets for salvage have fluctuated and sometimes disappeared, and the prices for salvage have not kept pace with the labor costs involved. Municipal public works officials have been steadfast in their concern for proper waste disposal, not in making a nebulous profit from uncertain salvage operations. This is not to say that these operations have not been attempted in the past.

Reduction Plants—In New York City, at the turn of the century, several large-scale salvage operations were carried on. Reduction plants processed food wastes, dead animals, and fish for the production of glycerine, oils, fertilizers and animal hides. Although each of the plants was successful initially, by 1915 all had been abandoned, not for economic reasons but also because of the unsanitary nuisances (rats, flies, odors) they created. Similar experiences were encountered in other cities. Although municipalities have abandoned this process, large packing houses operate rendering plants and manufacture substantial quantities of fertilizers, glues, glycerine, soaps and dyes from selected commercial wastes.

Paper and Metals Salvage—In the 1930s, New York City awarded contracts to private bidders for salvage and reclamation privileges at some 20 landfill sites, incinerator plants and marine transfer stations. Salvage became less attractive over the years, and interference with normal disposal operations, the nuisances created and the declining salvage market caused their discontinuance. Other cities, such as Washington, D.C., and Detroit, have also tried and failed. Although paper is the largest proportion of salvageable material in municipal refuse, municipalities utilizing expensive separate collections have been faced with the problem of disposing of baled mixed paper prices that can not even pay the freight charges to the paper mills.

Composting—About 20 compost plants have been tried and failed in the U.S. Composting is the biochemical degradation of organic materials to a humus-like material which can be used as a soil conditioner. The major advantage of the process appears to be that it produces a potentially marketable and useful product from solid waste. However, unless some beneficial use is actually made of the end product, composting is of no value as a means of municipal refuse disposal.

In 1965, I made a survey of more than 20 composting plants in Europe and Israel and concluded that the income from salvage at these plants averaged 16¢ per ton and the income from the sale of compost averaged $2.15 per ton of compost (or $1 per ton of raw refuse processed). On the other hand, the average cost of producing one ton of compost was $4.55. The weight of compost produced was only 46% of the raw refuse processed; the remainder constituted the rejects which had to be disposed of by burning or burning.

At Edinburgh and other cities, what began as a profitable business gradually deteriorated, with a lack of demand for the product at any price; unwanted piles of compost and scrap metals were commonplace. Obviously the market for compost is very much smaller than the amount of refuse available, and it is most important that a determination be made that a continuing market exists before a plant is planned or constructed.

All in all, these efforts at recycling municipal wastes have not been very fruitful. More success has been had with incinerators and landfills, but there is surprisingly little enthusiasm for these processes.

Waste Heat Recovery—Waste heat from some incinerators can produce steam which can be sold at a price equivalent to $3 or $4 per ton of refuse. Today, there are successful steam generating plants in Atlanta and Miami, a brand-new plant in Montreal, and one recently began operations in Chicago. The newly designed water-wall incinerator furnaces are also able to produce electric power with emissions controlled to meet any air quality standards, but the
are extremely expensive and require highly skilled personnel. Power plants in the United States have resisted using refuse for power production despite good experience in Paris, Amsterdam and Munich.

Landfills—Landfills are reclamation projects, since the refuse is used to fill pits, quarries, marshes and other land that is unusable unless filled. Landfills date back to Colonial days and it is estimated that 146 sites totaling more than 7,000 acres have been filled in New York City alone; about 4% of the total land area has thus been created from submarginal lands. However, there is mounting opposition from conservationists to even the most effectively controlled sanitary landfills.

Restraints

Is there any acceptable way that we can reduce the amounts of solid wastes that require disposal? Many advocate slowing the economic growth rate of the United States. While this obviously would serve to reduce solid wastes, it would ill-serve the 26 million persons classified in the poverty level who still aspire to obtain a fair share of America’s wealth and commodities. In any case, no such trend is evident, nor likely, and the forecast is for a 4½ to 5% growth per annum in the 70’s.

However, recycling, as a large scale operation, could serve as a valuable anti-inflationary force by reducing a portion of the needless waste. But even the most optimistic estimates indicate that at least 50% of municipal wastes are non-salvageable. Indeed, a study made by the Los Angeles Bureau of Sanitation showed that if all recyclable materials collected by the city were removed and reclaimed it would only account for 8% of the total amount of wastes now being deposited in landfills.

The study concludes that recycling would consume two times as much labor, equipment and fuel as present collection methods, and worse, there would be no market for these materials. A report by the Midwest Research Institute supports the conclusion that there is a lack of demand from industry for increased amounts of secondary materials.

For recycling to be meaningful, we will require new technology, new systems for collection, new marketing programs for new products, greater market acceptance of present products and the solution of economic, engineering and environmental problems. We will need to provide tax incentives (capital gains and rapid depreciation, investment credits), depletion allowances, freight rate equalization, elimination of purchasing prejudices and perhaps federal legislation to prohibit the use of hazardous or scarce products which can not be effectively recycled.

Health Considerations in Recycling

Prompt and regular garbage collection, processing and disposal are matters of public health, not simply material handling. Solid wastes bear a definite etiologic relationship to disease, and where these wastes are not disposed in a sanitary manner, the morbidity and mortality rates in fecal-borne disease in the population are high. Transmission, whether by direct contact, vector transfer or indirect contact, is due to environmental contamination by these wastes.

Flies are carriers of many disease agents, particularly dysentery, and they proliferate enormously in organic wastes. Roaches are commonly spread through improper sanitation and poor waste handling. Both flies and roaches are implicated in the spread of food-borne infections, which total at least 10 million cases annually in the United States. Breeding places provided by solid wastes can, under certain circumstances, contribute to dissemination of mosquito-borne disease agents, resulting in malaria, yellow fever, dengue and encephalitis in the human population.

Although few human cases of rodent-borne disease are being reported today, and human plague experienced in recent years in this country seems to be of sylvatic origin, a serious potential epidemic hazard exists whenever solid wastes are handled in a manner to encourage the breeding of rodents. Significant numbers of cases of rat-bites and rat-bite fever are being reported today, particularly in ghetto areas. Mice infest improperly stored wastes; they have been incriminated in food poisonings and their mites are responsible for outbreaks of Rickettsia pneumonia in urban areas.

Solid wastes handling is one of our most hazardous occupations, with an injury and illness rate nine times that of all other U.S. jobs. Skin rashes and irritations have been traced to the soiled clothing of refuse collectors. Dust, contamination and mechanical hazards are potential sources of risk. Refuse collection has numerous perils and dangers for workmen who are not alert or well-trained, including cuts and abrasions. Yet with all the talk of solid waste recycling, ostensibly to reduce its long-term environmental hazard, there is practically no concern expressed about its immediate health hazard.

I was shocked to see a film on NBC-TV entitled “Earth Year I” which was described as an “ecology special which demonstrates what the individual can do to help solve pollution problems.” Well-intentioned but undoubtedly misguided youngsters and matrons were shown scrounging through garbage, collecting cans, bottles and newspapers. The hazards of cuts and injuries from sharp metal cans and glass, exploding aerosol cans, punctures from discarded hypodermic needles, and the potential for contamination with infected fecal and respiratory wastes are obvious. Would anyone think of rummaging in a bin containing hospital wastes? Yet as physicians know, there are more sick people at home on any day than there are in all the hospitals and their wastes are put out for collection with the others. And wastes from doctors’ offices are not collected separately either. Scavenging from waste receptacles is condemned, quite properly, in every civilized country.

To get back to the TV film, the materials that were collected by these volunteers were then brought to collection centers where they were sorted and crushed as required. The operations were conducted in cellars and stores under questionable sanitary conditions, with dust and noise and excellent opportunities for injuries and rodent and insect infestation.

Are we abating or creating environmental hazards? Are the parents, schools and public health authorities parties to these ventures? Or have they completely abdicated their responsibilities?
Today and Tomorrow

All solid waste projects must be planned in a comprehensive manner after adequate study. The Resource Recovery Act of 1970 provides for:

A study of incentives, subsidies, depletion allowances, capital gains treatment, etc., for secondary resource industries, paralleling those given to primary industries.

A study analyzing market demand and the impact of recovered resources.

An investigation of the use of federal procurement to broaden the market for recycled materials.

Development of a national materials policy, relating to both primary and secondary resources.

Continuation of research efforts, and

Grants to establish manpower training in resource recovery.

These objectives, which were incorporated in the $150 million resource recovery program passed by Congress, are sound and should be pursued without delay.

On the other hand, the Mayor's Council on the Environment put out a 24-page supplement in a Sunday edition of the New York Times. The supplement carried the picture of a dead bird on the cover with the caption "Birds today, People tomorrow? What you can do to end New York's Environmental Crisis."

In a section entitled "Solid Waste and Recycling" it noted:

Garbage threatens to bury us. It is responsible for filling in acres of natural wetlands, polluting our harbors and waterways, and despoiling our land with sanitary landfills and litter. Burning garbage contributes significantly to New York's air pollution.

The ultimate solution to our solid waste problem is not incineration or dumping. We must implement a two-pronged program: (first) to generate less waste and re-use what we can; (second) the second part of the program, recycling, holds the greatest promise. What New Yorkers toss out in their garbage everyday is potentially a valuable source of raw material that can be reclaimed through recycling. . . .

Recycling will create hundreds of thousands of new jobs in a new multi-billion dollar industry.

The ad repeatedly advised the citizens to save newspapers for collections, to take non-returnable bottles and cans to recycling and reclamation centers and to set up such centers in community projects. Obviously, the studies, analyses and research recommended by the Resource Recovery Act are regarded as superfluous.

New York is not alone in this flurry of recycling activity. The Aluminum Association now has can reclamation centers operating in several major cities and more will be added.

Adolph Coors Co., a brewery in Colorado, is paying 10c per pound for return of its cans.

The Glass Container Manufacturers Association instituted bottle redemption drives at 90 glass container manufacturing plants in 25 states.

Safeway stores and Concern, Inc., the Washington Ecology Center, opened a recycling center for glass containers, aluminum, and newspapers in the Washington area. Material will be transported to Baltimore for reuse.

Canada Dry Corp. announced an action program Operation Ecology, which includes the establishment of recovery centers at company plants for collection of glass and metal containers.

Coca-Cola Bottling Co. of New York opened collection points for glass bottles and aluminum cans.

Why this concentration of activity on cans and bottles? Surely silica and aluminum are among our abundant natural resources. If the aim is to reduce the litter problem, why remove these items from stored garbage?

Has everyone jumped on the solid wastes recovery bandwagon?

I certainly hope that all these companies utilizing this free labor can find something of value in these wars other than good public relations.

The National Association of Secondary Materials Industries has cautioned that there is a need to develop markets for goods made from recycled materials before collection drives are launched. And the U. S. Environmental Protection Agency asked for a study of the impact of beverage containers upon society and solid waste management in order to develop a policy on disposable containers.

Richard Vaughan, Commissioner of the Solid Waste Management Office, EPA, stated, "The principle of recycling and reuse of waste materials, systematically developed and applied, is of extreme importance, but realistically the technology and the economic forces governing do not presently admit recycling as an immediate and total answer to a community's solid waste problem. Even when salvaging and reuse becomes an integral part of every solid waste system, a residual fraction cannot be reclaimed and must be disposed."

William Ruckelshaus, EPA administrator, summed up the situation when he stated that recycling will not provide a substantial solution to the trash problem for the next 10 or 15 years. However, he predicted, at that time most major metropolitan areas will have it in some form, either as recycling or the production of energy.

If recycling will not provide a substantial solution for the next 10 or 15 years, what are we to do now? There are several attractive methods on the horizon, such as high temperature incineration and pyrolysis, but they are not yet ready for general municipal installation. Despite statements which assert that "sanitary landfills are despoiling our land" and that "incineration is environmentally degrading," these are two proven, effective, reliable methods for processing and disposing of solid wastes and can be operated in a manner to meet all acceptable standards for environmental quality, provided that adequate and skilled personnel are utilized, not political ward heelers. Landfills can serve to reclaim submarginal land. The newer water-wall incinerators with air pollution control devices can not only reduce our wastes, but can generate steam or electric power from these wastes, and the collected residue and fly ash can be used for productive purposes.

Then why are questionable recycling centers being advocated by the politicians rather than these proven methods? I can give you my opinion. Almost everyone is in favor of recycling: it has its built-in constituency. The capt
The cost of the newer incinerators is very high and contractors distrust their air pollution controls. And the politicians who determine the priorities for expenditures of city funds postpone, vitiate, and outrightly reject projects that may be unpopular with any sizable segment of the voting population or expensive to budget. In New York City, for example, operations at four municipal incinerators have been discontinued within the past two years but no new incinerator has been built since 1962 and no sanitary landfill site has been established since 1955 despite the fact that there are potential sites and new incinerators have been designed. These are the real reasons why "our garbage threatens to bury us!"

Referring again to Dr. Kilvington, in his presentation in 1887, he said: "In the majority of our cities the great problem of the disposal of waste matter is still practically unsolved, and that it is so is due, not to the absence of methods, not to the paucity of inventive skill, nor to the lack of ingenuity in devising means to this desirable end, but in very large measure, to official indifference and popular ignorance of sanitary essentials." Good doctor. Amen!

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