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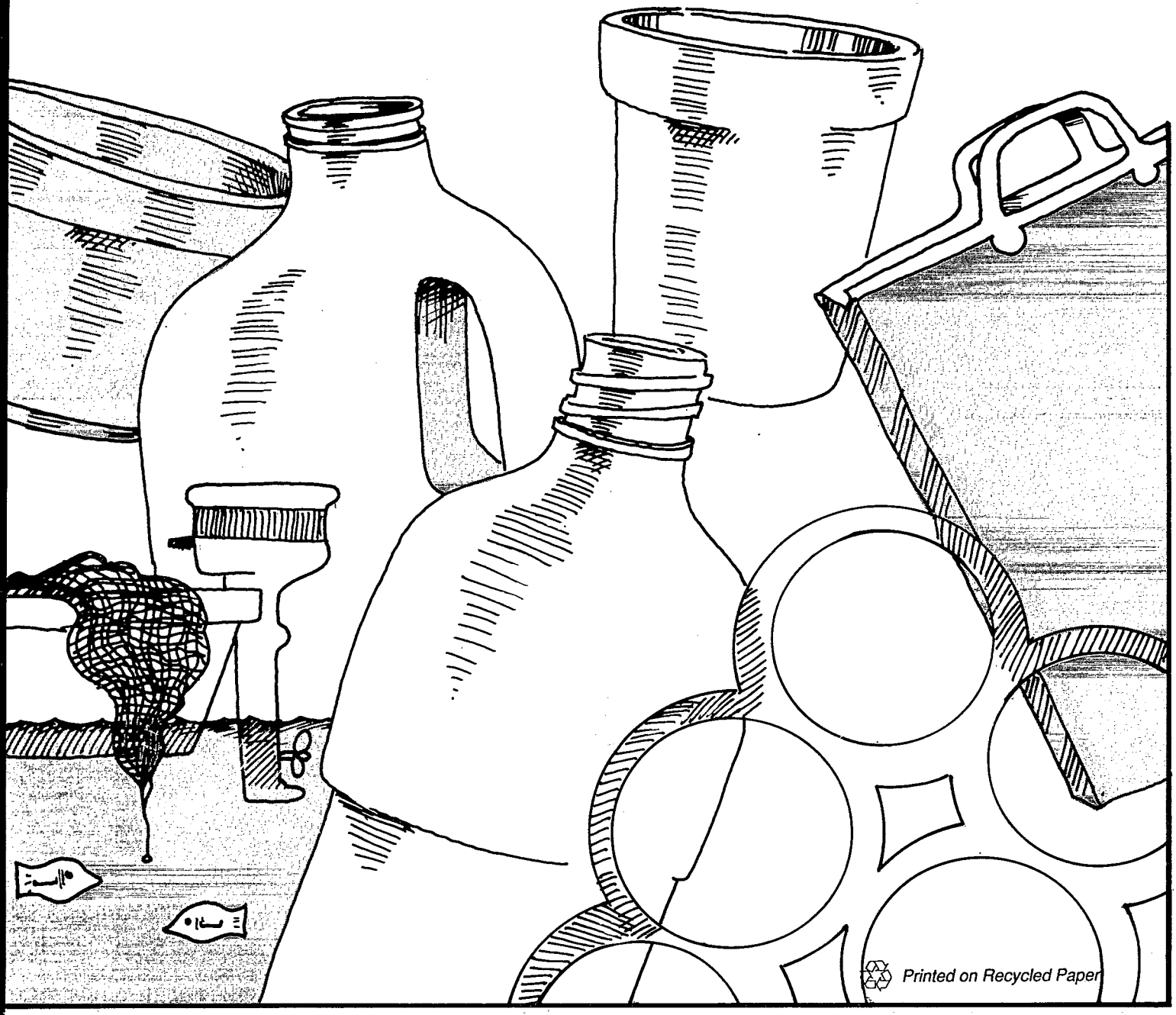
Office of Solid Waste / Office of Marine & Estuarine Protection

EPA

Methods to Manage and Control Plastic Wastes

Report to Congress
Executive Summary



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REPORT TO CONGRESS

Methods to Manage and Control Plastic Wastes

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United States Environmental Protection Agency
Office of Solid Waste
Office of Water

SUMMARY OF FINDINGS AND CONCLUSIONS

This report was developed in response to Section 2202 of the 1987 Plastic Pollution Research and Control Act, which directs EPA to develop a report to Congress on various issues concerning plastic waste in the environment. Specifically, EPA is required to:

- Identify plastic articles of concern in the marine environment,
- Describe impacts of plastic waste on solid waste management, and
- Evaluate methods for reducing impacts of plastic wastes, including recycling, substitution away from plastics, and the use of degradable plastics.

In this report, EPA has examined two other methods for reducing impacts associated with plastic wastes in addition to those specified in the statute. These are: (1) source reduction of plastic waste (this is broader than substitution away from plastics) and (2) methods for controlling the sources of plastic marine debris.

SCOPE OF THE REPORT

The report focuses primarily on plastic waste in the municipal solid waste (MSW) stream, that is, post-consumer plastic waste. The only exception to this focus is the consideration of plastic pellets, which are the raw materials used in the processing and manufacture of plastic products. Pellets are included in the report because they have been found in high concentrations in the marine environment and they pose ingestion risks to some forms of marine life.

SUMMARY OF MAJOR FINDINGS AND ACTION ITEMS

PRODUCTION AND USE OF PLASTICS

Plastics are resins, or polymers, that have been synthesized from petroleum or natural gas derivatives. The term "plastics" encompasses a wide variety of resins each offering unique properties and functions. In addition, the properties of each resin can be modified by additives. Different combinations of resins and additives have allowed the creation of a wide array of products meeting a wide variety of specifications.

U.S. production of plastics has grown significantly in the last 30 years, averaging an annual growth rate of 10%. Continued growth is expected. The largest single market sector is plastics packaging, capturing one-third of all U.S. plastics sales. Building and construction (25% of U.S. sales) and consumer products (11%) follow.

Plastics production and use has grown because of the many advantages plastics offer over other more traditional materials. A few of the desirable intrinsic properties of plastics include: (1) design flexibility -- plastics can be modified for a wide variety of end uses, (2) high resistance to corrosion, (3) low weight, and (4) shatter resistance. Table ES-1 provides information on some of the major classes of plastic resins, their characteristics, and examples of product applications.

PLASTICS IN THE MARINE ENVIRONMENT

EPA has identified several articles of concern in the marine environment due to the risks they pose to marine life or human health or to the aesthetic (and related economic) damage they cause. These articles of concern are: plastic pellets, polystyrene spheres, syringes, beverage ring carrier devices, uncut plastic strapping, plastic bags and sheeting, plastic tampon applicators, condoms, fishing nets and traps, and monofilament lines and rope.

Many other items of marine debris (made from plastic as well as other materials) have been identified during the development of this report. Taken as a whole, all components of marine debris are unsightly and offensive to many people.

Specific sources for each debris item are not well known; however, the major land-based sources appear to be:

- Combined sewer overflows (CSOs) and sewage treatment plants
- Stormwater runoff and other non-specific sources
- Plastic manufacturing and fabrication and related transportation activities (for pellets)

The major marine-based sources appear to be:

- Commercial fishing vessels
- Offshore oil and gas platforms

Recreational littering (on land and from vessels) also contributes to marine debris.

The following are EPA's **major action items** for reducing and controlling the sources of marine debris:

COMBINED SEWER OVERFLOWS --

- EPA will ensure that all permits for CSO discharges include technology-based limitations for the control of floatable discharges.

Table ES-1
PLASTIC RESIN CHARACTERISTICS, MARKETS, AND PRODUCTS

Resin Name	Characteristics	Primary Product Markets	Product Examples
Low-Density Polyethylene (LDPE)	Moisture-proof; inert	Packaging	Garbage bags; coated papers
Polyvinyl Chloride (PVC)	Clear; brittle unless modified with plasticizers	Building and construction; packaging	Construction pipe; meat wrap; cooking oil bottles
High-Density Polyethylene (HDPE)	Flexible; translucent	Packaging	Milk and detergent bottles; boil-in-bag pouches
Polypropylene (PP)	Stiff; heat- and chemical-resistant	Furniture; packaging	Syrup bottles; yogurt tubs; office furniture
Polystyrene (PS)	Brittle; clear; good thermal properties	Packaging; consumer products	Disposable foam dishes and cups; cassette tape cases
Polyethylene Terephthalate (PET)	Tough; shatterproof	Packaging; consumer products	Soft drink bottles; food and medicine containers

- EPA is developing guidance for States and local communities on effective operation and control of a combined sewer system. Information on low-cost control mechanisms, which may be helpful in reducing releases of floatable debris, will be included.

- EPA will sample a limited number of CSO discharges to pinpoint which articles are frequently released from CSOs.

STORMWATER DISCHARGES --

- EPA is developing a Report to Congress on stormwater discharges. Floatable discharges will be considered in this report. The report is expected to be completed by mid-1990.

- A subsequent report will be prepared on control mechanisms necessary to mitigate the water quality impacts of discharges examined in the initial Report to Congress. A final report is targeted for the end of 1991.

- EPA will sample and study a limited number of stormwater discharges to better pinpoint which articles are released from these sources.

VESSELS --

- EPA recommends that Federal and State agencies should enter into agreements with the U.S. Coast Guard to enforce Annex V of MARPOL, which prohibits the discharge of plastic waste at sea.

- EPA recommends that port facilities, local communities, industry, and interested Federal agencies should coordinate efforts to develop recycling programs for plastic waste that is brought to shore in compliance with Annex V of MARPOL.

- EPA will support the National Oceanic and Atmospheric Administration's (NOAA) investigation of methods to reduce the loss and impacts of fishing nets and gear by providing related information, such as information on degradable plastics.

LITTER PREVENTION AND RETRIEVAL --

- EPA will continue to support and conduct a limited number of harbor and beach surveys and cleanup operations.

- EPA will continue to work with NOAA and other Federal Agencies to distribute educational materials to consumers on marine debris.

- EPA is developing an educational program for consumers that describes the proper method for disposing of household medical waste.

MANAGEMENT OF PLASTIC WASTES

Most post-consumer plastic waste is landfilled along with municipal solid waste. A small percentage (approximately 10%) of municipal solid waste is incinerated, and 10% is recycled. Only 1% of post-consumer plastic waste is recycled.

Plastic waste accounts for a large and growing portion of the municipal solid waste stream. Plastics are about 7% (by weight) of municipal solid waste and a larger percentage by volume. Current waste volume estimates range from 14 to 21 percent of the waste stream. The amount of plastic waste is predicted to increase by 50% (by weight) by the year 2000.

Half of the plastic waste stream is packaging waste. The rest of the plastic waste stream includes non-durable consumer goods such as pens and disposable razors and durable goods such as furniture and appliance casings.

Management of plastics in a landfill

Plastic wastes have not been shown to create difficulties for landfill operations. The structural integrity of a landfill is not affected by plastic wastes.

Plastics wastes affect landfill capacity because of the large and growing amount of plastic waste produced, <u>not</u> because the wastes are not degradable. Some have claimed that plastic waste affect landfill capacity even more than other larger volume wastes (e.g., paper) because plastics do not degrade in a landfill. While it is true that plastic wastes are very slow to degrade in landfills, recent data indicate that other wastes, such as paper and food waste, are also slow to degrade. Degradation of waste, therefore, has little effect on landfill capacity.

Data are too limited to determine whether plastic additives contribute significantly to leachate produced in municipal solid waste landfills. Only certain additives have the potential for causing a problem; however, their contribution to leachate volume or toxicity is unknown.

Management of plastics in an incinerator

Plastics contribute significantly to the heating value of municipal solid waste, with a heating value of three times that of typical municipal waste.

Controversy exists regarding whether halogenated plastics (e.g., polyvinyl chloride) contribute to emissions from municipal waste incinerators. Emissions of particular concern are acid gas emissions and dioxin/furan emissions. EPA and the Food and Drug Administration are

Technologies exist for recycling either single homogeneous resins or a mixture of plastic resins:

- Recycling of relatively homogeneous resins (e.g., PET from soft drink bottles) may yield products that compete with virgin resins. Such recycling offers the greatest potential to reduce long-term requirements for plastics disposal. However, a system to capture and recycle the products of such recycling must be established.

- Recycling of a mixture of plastic resins often yields products that compete with low-cost commodities such as wood or concrete. This approach may capture a large percentage of the plastic waste stream because separation of resins is not a barrier to this approach. However, because the products of this type of recycling may eventually require disposal, mixed plastics recycling may delay, but may not ultimately reduce, the long-term requirements for plastic waste disposal.

The major factors currently limiting plastics recycling are:

- *Collection and supply.* This appears to be the greatest limitation facing recycling of both single resins and a mixture of resins; however, the recycling of single resins is more severely limited by the lack of ability to separate a complex mixture of plastic wastes (such as would be collected through a curbside program). There are several methods of collection including curbside collection, drop-off centers, buy-back centers, and container deposit legislation (i.e., "bottle bills"). Curbside collection and bottle bills have received the most attention:

  -- Curbside collection of plastics (and other recyclables) can capture a great variety and amount of plastic waste. However, this strategy imposes relatively high costs for collection and is not universally applicable (e.g., not all areas offer curbside collection of municipal solid waste).

  -- Container deposit legislation, which was enacted primarily to control litter, not increase recycling, has proven effective at diverting plastic soft drink containers from disposal; however, soft drink bottles represent only a small percentage (approximately 3%) of plastic wastes. Thus, this method, as currently implemented, will not divert significant amounts of plastic wastes. In addition, recycling officials have raised concerns that container deposit systems remove the most valuable, revenue-generating material from the recycling stream. This may impair local efforts to recycle other materials (e.g., newspaper, cans, etc.) in curbside collection programs.

  These two collection strategies are interrelated. Waste management officials need to carefully weigh the costs and benefits related to each strategy (described in Section 5 of this report) and, very importantly, the relationship between the two choices before selecting a collection mechanism.

- *Markets.* The markets for the products of mixed plastics recycling still face serious questions, particularly regarding cost-competitiveness. Markets for the products of single resins such as PET and HDPE appear to be large. Recycling of other single resins (e.g., PS) is only just beginning; therefore, market evaluations are difficult to make.

The following are EPA's **major action items** regarding plastics recycling:

- EPA is providing technical assistance and general information to the public on plastics recycling through a municipal solid waste clearinghouse and a peer match program. Both of these efforts offer information and assistance on recycling of all municipal solid waste components, not just plastics.

- EPA is examining potential incentives and disincentives to recycling of municipal solid waste components.

- EPA calls on the plastics industry to continue to research and provide technical and financial assistance to communities on plastics collection, separation, processing, and marketing.

Degradable Plastics

There are various mechanisms that are technically viable for enhancing the degradability of plastic. *Biodegradation and photodegradation are the principal mechanisms currently being explored and commercially developed.* The most common method for enhancing the biodegradability of plastics has involved the incorporation of starch additives. Production of photodegradable plastics involves the incorporation of photo-sensitive carbonyl groups or the addition of other photo-sensitive additives.

Before the application of these technologies can be promoted, the uncertainties surrounding degradable plastics must be addressed. First, the effect of different environmental settings on the performance (e.g., degradation rate) of degradables is not well understood. Second, the environmental products or residues of degrading plastics and the environmental impacts of those residues have not been fully identified or evaluated. Finally, the impact of degradables on plastic recycling is unclear.

EPA does not believe that degradable plastics will help solve the landfill capacity problems facing many communities in the U.S. However, there may be potentially useful applications of this technology, including agricultural mulch film, bags for holding materials destined for composting, and certain articles of concern in the marine environment (.e.g, beverage container rings).

The following are EPA's **major action items** regarding degradable plastics:

- EPA has initiated two major research efforts on degradable plastics. The first project will evaluate degradable plastics in different environmental settings and examine the byproducts of degradation. The second project will evaluate the effects of degradable plastics on post-consumer plastics recycling. Interim results are expected by mid-1990.

- EPA calls on the manufacturers of degradable plastics to generate and make available basic information on the performance and potential environmental impacts of their products in different environmental settings.

- Title I of the 1988 Plastic Pollution Control Act directs EPA to require that beverage container ring carrier devices be made of degradable material unless such production is not technically feasible or EPA determines that degradable rings are more harmful to marine life than non-degradable rings. The uncertainties regarding degradable plastics (discussed above) pose some difficulties for EPA's implementation of this Act; however, some specific information is known regarding ring carrier devices:

  -- EPA has not identified any plastic recycling programs that currently accept or are considering accepting ring carriers. Therefore, degradable rings should not impair recycling efforts.

  -- Ring carriers are usually not colored and therefore do not include metal-based pigments. Thus, concerns regarding leaching of pigments appear to be minimal for these devices.

  The research on degradable plastics (see above) now underway at EPA will help resolve remaining issues. EPA will initiate a rulemaking to implement the above legislation in 1990. A final rule is expected by late 1991.