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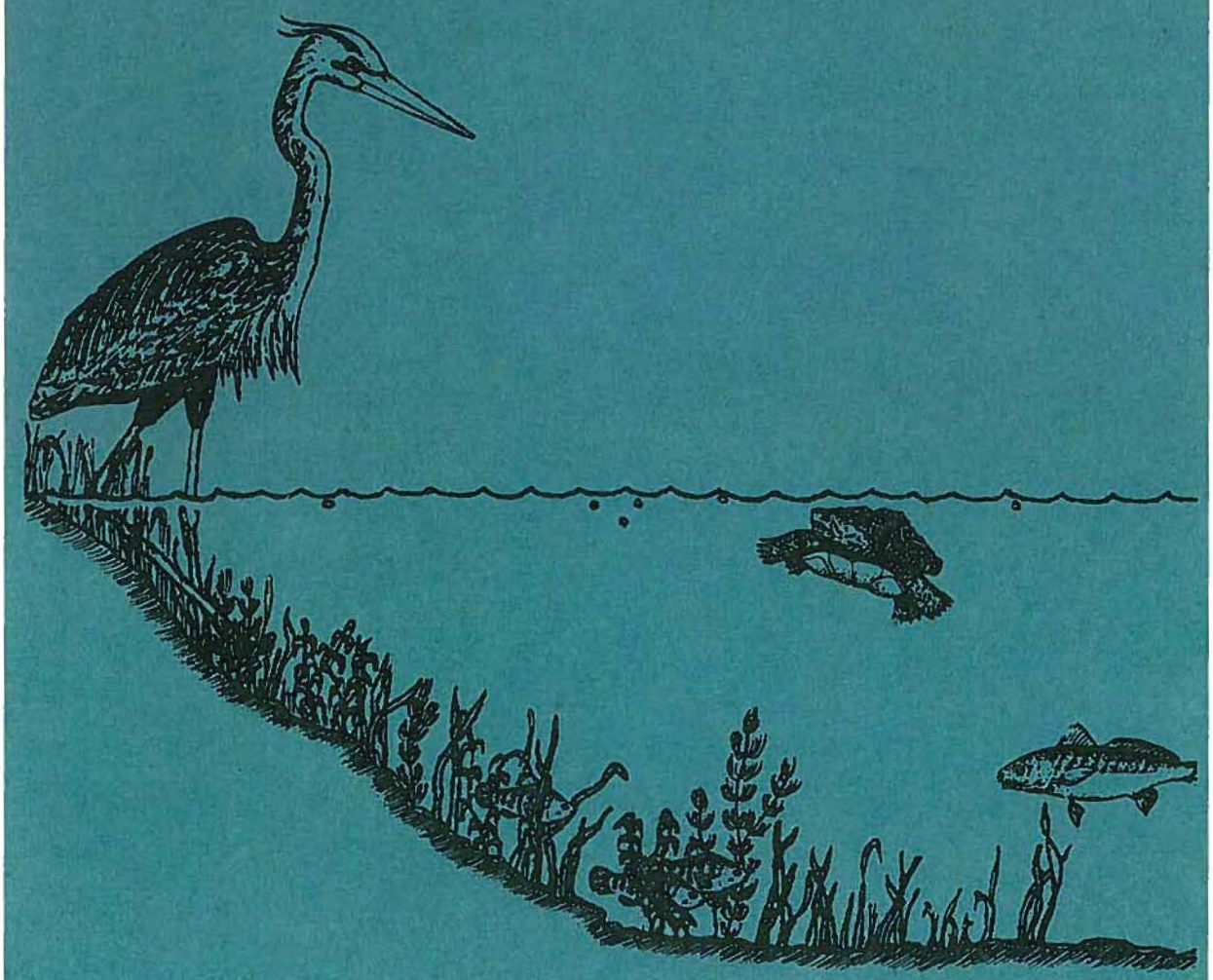
EPA

Plastic Pellets In The Aquatic Environment Sources And Recommendations

A Summary



INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is concerned about the amounts and types of debris in our oceans and on our beaches. This debris can have economic, aesthetic, and ecological impacts and can come from both land- and sea-based sources. One type of debris that has become of particular concern to EPA is the plastic pellet.

The Oceans and Coastal Protection Division (OCPD) of EPA's Office of Wetlands, Oceans and Watersheds (OWOW) recently conducted a comprehensive assessment of the sources, fate, and effects of pellets in the aquatic environment to determine what can be done to control and prevent their release to the environment. The goals of the study were to:

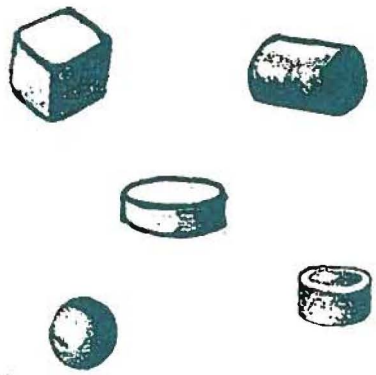
- Summarize what is known about the presence and impacts of pellets in the aquatic environment,
- Identify and evaluate how pellets escape into the environment, and
- Recommend ways to control or prevent future pellet releases.

The study promotes EPA's national policy on pollution prevention, which is based on the Pollution Prevention Act of 1990. EPA's policy is to (1) reduce or prevent pollution at the source whenever possible and (2) assist state and local governments and the private sector in achieving source reduction. The study results, therefore, will help to implement EPA's policy by assisting the plastics industry in implementing voluntary pellet-control programs to reduce the release of pellets into the aquatic environment. This brochure highlights EPA's report,

"One type of debris that has become of particular concern to EPA is the plastic pellet."

Plastic Pellets in the Aquatic Environment: Sources and Recommendations, which represents the first comprehensive assembly of information regarding the presence and ecological effects of pellets in the aquatic environment and is expected to become a basic reference for EPA and industry.

What Is a Plastic Pellet?



Plastic (resin) pellets are the raw materials that are melted and molded to create plastic products. Plastic may be formed into pellets of various shapes (e.g., spherical, ovoid, cylindrical), sizes (ranging from 1- to 5-mm diameter), and colors (most commonly clear, white, or off-white). The wide variety of plastic products produced internationally has created a demand for many different polymers, or resins. An estimated 60 billion pounds of resin, most of which is formed into pellets, is manufactured annually in the United States. The most commonly produced resins include polyethylene, polypropylene, and polystyrene.

After being formed, the pellets are packaged and transported to processors for molding into plastic products. At many points in their creation, transport, and use, pellets may be spilled and carried by rainwater and drainage systems into the aquatic environment. Once in the environment, the pellets will either float or sink: pellets that are heavier than water will sink to the bottom, and pellets that are lighter than water will either float at the surface or become suspended in the water column somewhere between the surface and the bottom. The EPA study focuses primarily on pellets that float.

The Environmental Problem: Sources, Fate, and Effects

Historically, several sources of pellets in the aquatic environment have been suggested, including direct discharges and improper wastewater disposal by the plastics industry; spillage from trucks, railcars, and ships; improper use of pellets; and waste disposal and sewer discharges by cities. The findings of the EPA Harbor Studies Program and Combined Sewer Overflow (CSO) Studies Program concluded that significant land-based pellet sources exist and the plastics industry is a likely source of the releases.

Pellets released by the plastics industry flow into the aquatic environment by two routes.

- ***CSO and stormwater discharges*** —
  Spilled pellets may be carried by rainwater into stormwater drains, which in turn transport the water into municipal wastewater systems. The pellets may then be discharged into the aquatic environment through stormwater discharges or, where the sewage and storm sewers are combined, through CSO discharges.

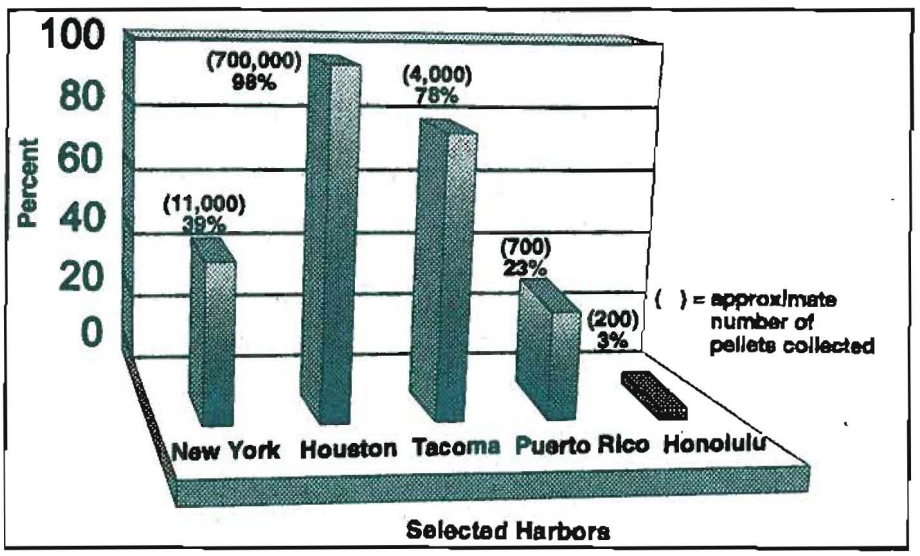
- ***Direct spills into the aquatic environment*** —
  Pellets may be spilled directly into waterways, such as during cargo handling operations at ports or during cargo transport at sea.

The presence of pellets in U.S. coastal waters was first reported in the early 1970s, and pellets have since been reported in most of the world's oceans. More recently, EPA studies of aquatic debris (EPA Harbor Studies Program) revealed widespread distribution of plastic pellets in U.S. harbors located on the Atlantic, Pacific, and Gulf coasts, and pellets were among the most commonly found items in most of the harbors. Pellets were found in 13 out of 14 harbors sampled. The greatest number of pellets was found in the Houston Ship Channel at Houston, Texas, where more than

250,000 pellets were collected in one sample alone. Notably, Houston has one of the greatest concentrations of plastics industry facilities in the United States.

During its CSO Studies Program, EPA also found pellets in the municipal wastewater systems of Philadelphia and Boston. For example, pellets accounted for over one-half of the man-made debris collected at one Philadelphia stormwater discharge. Pellets were also found in samples collected from four sewage treatment plants; based on the study findings, EPA has estimated that more than 20,000 pellets per day may be present in the sewage treated by one Philadelphia plant. The pellets are removed from the sewage during sewage treatment. The presence of pellets in the plant shows that the pellets are released from land-based sources and could be released to the aquatic environment during treatment plant shutdowns or through CSOs and stormwater discharges during rainy periods.

The persistence of a pellet in the aquatic environment may be measured in years, depending on the resin type, the types and amounts of additives, and the reactions of the resins and additives to environmental processes (e.g., weathering, sunlight, wave



Percent of pellets found in the total number of debris items collected in selected samples from the Harbor Studies Program.

action). Once in the environment, pellets may be transported by stormwater runoff, rivers, and water currents to areas far away from the source.

There are several documented accounts describing the ingestion of pellets and other plastics by wildlife, most notably seabirds and sea turtles; however, impacts or biological effects of the pellets have not been clearly defined or demonstrated conclusively in most wildlife. Seabirds ingest pellets more frequently than any other animal, and approximately one-quarter of all seabird species are known to ingest pellets. Pellets ingested by seabirds are suspected to cause false feelings of satiation (i.e., the birds feel as if they have eaten) and reduce the feelings of hunger. Ultimately, this may result in a decrease in energy reserves and the ability to survive adverse environmental conditions. Suspected impacts on sea turtles, fish, and other aquatic life have been less frequently reported and studied.

"Pellets were found in 13 out of 14 harbors sampled."

Although pellets may not be as aesthetically displeasing as other items of debris, such as sewage and medical debris, the quantities present and the pellets' persistence in the environment are cause for notice. One overseas investigator went so far as to suggest that if high numbers of pellets continue to be deposited on certain New Zealand beaches, someday people in that area may be sunbathing on plastic-sand beaches instead of natural-sand beaches.

The Plastics Industry

The Society of the Plastics Industries, Inc. (SPI) has worked with EPA to develop an understanding of operations within the plastics industry and identify potential sources of pellet losses to the environment. SPI is the major national trade association

of the plastics industry. Its membership consists of more than 2,000 companies that are responsible for approximately 75 percent of the $100 billion total sales of plastics and plastic products in the United States. These companies supply raw materials (e.g., pellets) and manufacture plastics and plastic products for the plastics industry. In addition, SPI members design, construct, and manufacture equipment and machinery used by the plastics industry. EPA's recent study of plastic pellets was completed with the voluntary cooperation and assistance of SPI and seven companies in the plastics industry.

For the purposes of the study, the plastics industry was divided into three major sectors.

- ***Pellet producers***, which create the polymers, form the pellets, and ship the pellets to contract packagers or processors.
- ***Pellet transporters/contract packagers***, which are intermediate pellet handlers. Transporters carry bulk shipments between the industry sectors via railcars, bulk trucks, and freight trucks. Contract packagers repackage bulk shipments into smaller containers (e.g., bags and cardboard boxes), which are shipped to processors.
- ***Pellet processors***, which mold the pellets into user products.

To determine how pellets are released to the environment from each of these three sectors, SPI arranged for each industry sector to be visited by the study team. Seven companies (two producers, two transporters/contract packagers, and three processors) were visited during the study.

Study Findings

Several pellet release pathways were identified for each of the three industry sectors described above. Most of the release pathways were common to all three sectors, with only a few being

unique to one or two sectors. The pathways may be categorized into eight general areas where pellet releases are a problem.

1. ***Poor communication between industry management, company management, and management of related industries (e.g., shipping industry).*** Not all company managers have recognized the pellet problem and the need to control pellet releases. Pellet spillage information, such as the condition of packages and the receipt of unsealed rail hopper cars, is shared between companies only occasionally.

2. ***Lack of employee awareness and inadequate training.*** Employees are generally unaware of the environmental effects of pellets and their own responsibility for controlling pellet releases to the environment. For example, one major release pathway is through package damage caused by improper operation of forklifts while moving pallets. Cargo handlers may allow pellets to escape into the environment because they are unaware of the hazards of pellets.

3. ***Inadequate containment facilities and apparatuses.*** Most companies have few or no cooling-, waste-, or storm-water containment systems, including portable screens, in place for controlling pellet releases to the environment. Pellets that are present in these waters may be discharged into municipal storm and sanitary sewers or into natural drainage systems.

4. ***Careless routine operations.*** Whenever pellets are handled, there is the potential for pellet spillage. Manual pellet handling is more likely to result in spills than handling by mechanical conveying systems (i.e., pneumatic systems that move pellets by using air flowing through sealed pipes). However, if pneumatic systems are not properly maintained

and closed, pellets may leak through openings in the system. Pellets may also be released during the transfer of damaged, unrepaired packaging.

5. ***Inadequate housekeeping practices.*** If pellets are not quickly picked up after they are spilled, they may be scattered and eventually released into the environment. Pellets may be transported throughout interior and exterior areas of a facility via shoes and clothing, vehicle tires, wind, and stormwater runoff.

6. ***Easily damaged or leaky packaging.*** Paper and cardboard packaging is easily damaged during transport and handling and, in fact, may be designed to be easily broken when loading molding machines. Damaged or leaky packaging is a major source of pellet loss to the environment; valved, self-sealing bags may not completely close, thereby allowing pellets to leak from the opening.

7. ***Improper shipping practices.*** Improperly sealed rail hopper car valves, poorly maintained transporting vessels, and inappropriate cargo-handling practices may release large numbers of pellets to the environment.

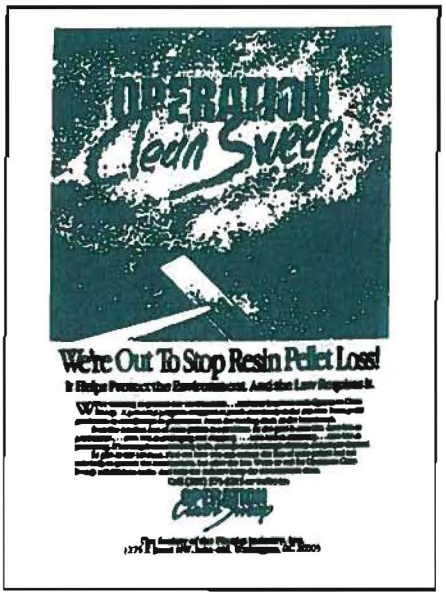
8. ***Lack of recycling.*** Some companies do not attempt to recycle spilled pellets and, instead, dispose of the pellets with other facility trash.

RECOMMENDATIONS

Existing Federal regulations provide a basis for controlling the release of plastic materials, including plastic pellets, into the aquatic environment. The recently revised National Pollutant Discharge Elimination System permit program guidelines [40 CFR122.26(b)(12)] enable regulators and municipalities to impose significant penalties on a company or sewage treatment plant operator if pellets are present in its stormwater discharge in

violation of its permit. Although penalties alone will not completely control the release of pellets, they can encourage companies to implement control measures. Ultimately, controlling releases of plastic pellets into the aquatic environment is the responsibility of the plastics industry.

In response to the early findings of the pellet study and other EPA studies conducted since 1988, SPI founded a Resin Pellet Task Force to investigate the pellet problem. In July 1991, following the findings of the task force, SPI initiated Operation Clean Sweep, an industry-wide education campaign aimed at committing the plastics industry to the total containment of pellets. It is anticipated that SPI and the industry will use EPA's comprehensive study along with campaign literature and information to control pellet releases from industry sources to the aquatic environment.



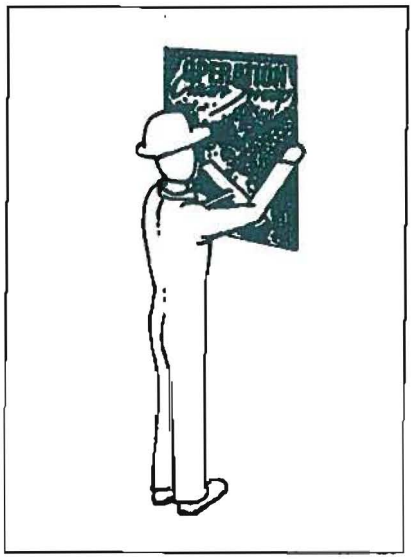
Advertisement for the 1991 SPI Operation Clean Sweep Campaign.

The release of pellets from pellet producers, transporters/contract packagers, and processors can be controlled through actions identified in the EPA study. Recommendations to the plastics industry are the following:

- ***Adopt the SPI 1991 Pellet Retention Environmental Code and the 1992 Processor's Pledge.*** The code is a commitment to total containment of plastic pellets and was developed by SPI's resin-producing members in response to the findings of EPA studies. This code encourages source reduction activities to prevent releases, and suggests ways to recapture spilled pellets.

- ***Educate employees and train them to minimize pellet spillage and loss.*** Employees must recognize their role in preventing releases.

- ***Install pellet containment systems or use portable containment apparatuses.*** The use of inexpensive portable screens or similar devices can effectively control pellets at the spill source.



Educate employees.

- ***Institute pellet containment activities during routine plant operations.*** For example, cleaning pneumatic lines into a portable screen before breaking connections will minimize pellet loss through spillage.

Recycle pellets.

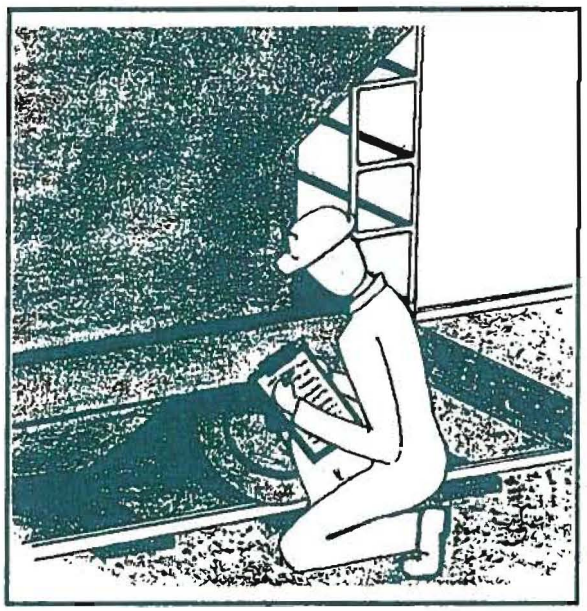
- ***Recycle spilled pellets.*** By recycling spilled pellets, the plastics industry can recover revenue that would have been lost by disposing of them and can minimize pellet releases to the environment during trash disposal.

- ***Improve the quality and frequency of pellet spill clean-up procedures.*** Frequent vacuuming and broomsweeping collect pellets before they escape into the environment.

- ***Use puncture-resistant packaging and minimize the use of valved bags.*** The use of reinforced valveless bags, such as polypropylene woven bags that are sewn shut, would minimize pellet loss due to damaged or incompletely sealed packaging.

- ***Inspect shipping vehicles (e.g., rail hopper cars, bulk trucks, freight trucks) before and after loading and offloading of pellets.*** This action will prevent spillage from leaking railcar and truck valves, and securing the valves with tamper-resistant cable will discourage pellet loss due to vandalism.

- ***Inspect shipping containers before loading and after offloading of pellets.*** Containers may be resealed or repaired before additional pellets are lost, and pellets may be recovered instead of being released into the environment.



Inspect shipping vehicles.

Many of the recommended control mechanisms are currently available and are being voluntarily implemented by some companies within the plastics industry. Most of the mechanisms, such as employee education, portable screens, and improved housekeeping, control pellet releases immediately at the source; these mechanisms can be easily and inexpensively implemented. Systems that direct spilled pellets into one containment area are effective but are more expensive to implement.

Environmental Inspection Checklist

Inspected by: _____
Date: _____
Time: _____

	Yes	No
(1) Are all catch trays properly placed under each shipping bay? If no: How many are improperly placed? _____ How many are missing? _____	☐	☐
(2) Are bins properly placed under hopper cars being unloaded? If no: How many are improperly placed? _____ How many are missing? _____	☐	☐
(3) Are the screens over the drains clear of excess debris, which could inhibit water flow?	☐	☐
(4) Is the roof clear of product? If no: Estimate amount of product on roof. _____ lb	☐	☐
(5) Are tracks free of pellets and/or powder? If no: Identify location of any problem(s).	☐	☐
(6) Are fences and drainage ditches free of plastic? If no: Identify location of any problem(s).	☐	☐
(7) Is there any evidence of plastic being dumped into trash compactors?	☐	☐
(8) Is all transfer equipment capable of keeping product from spilling/being released into the environment? If no: Identify equipment that requires attention.	☐	☐
(9) Are log books being maintained at each production line with information about spills, actions taken, recommendations, etc.?	☐	☐
(10) Were any other potential problem areas identified during the inspection? If yes: List specific problem areas.	☐	☐

Example of an Environmental Inspection Checklist developed to monitor the effectiveness of routine maintenance procedures.