DEALING WITH GARBAGE UNDER MARPOL ANNEX V:

Examples of Compliance Approaches Used by the Shipping Industry

Prepared for:

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Marine Entanglement Research Program
Northwest and Alaska Fisheries Center
Seattle, WA

Kearney/Centaur Division
A.T. Kearney, Inc.
Alexandria, VA

November 1989

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Contract No. 52ABNF800132

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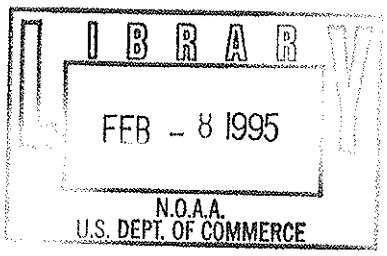

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Preface

This document was prepared by the Kearney/Centaur Division of A.T. Kearney, Inc. for the National Oceanic and Atmospheric Administration's Marine Entanglement Research Program under Contract Number 52ABNF800132. The document describes the compliance approach to MARPOL Annex V by six companies with oceangoing commercial vessels, two cruise lines companies, seven ports, one barge company, and the U.S. Navy. Results of a survey of vessel operators during routine boardings by the U.S. Coast Guard Marine Safety Office in Honolulu, Hawaii on their knowledge of MARPOL Annex V and their present method of compliance are also included. This document was prepared as part of a marine debris education program for the shipping industry.

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Alexandria, VA

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INTRODUCTION

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Background

Annex V of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73/78) entered into force on December 31, 1988. With the implementation of MARPOL Annex V, the way the shipping industry handles garbage changed. Over the side is no longer the unquestioned practice for garbage disposal. MARPOL Annex V prohibits disposal of plastics in the ocean and specifies the distance from shore that all other garbage may be dumped at sea.

The Marine Plastic Pollution Research and Control Act of 1987 (P.L. 100-220) amends the Act to Prevent Pollution from Ships and implements MARPOL Annex V in the United States. Neither MARPOL Annex V nor the Act to Prevent Pollution from Ships specifies how compliance is to be achieved. The approach and techniques used to comply with the at sea garbage disposal limitations are left to vessel owners and operators and the ports and terminals required to have facilities to receive ship-generated garbage.

To identify the range of approaches and techniques used by the commercial shipping and cruise industries using U.S. waters and at U.S. ports to comply with MARPOL Annex V, telephone interviews with shipping company and port operations personnel were conducted. The interviews were conducted between May and November 1989. The purpose of the interviews was to find out how a cross section of companies with different types of vessels were complying with MARPOL Annex V. The results of the interviews are, therefore, not a comprehensive survey of the shipping industry's response to MARPOL Annex V. The approach to MARPOL Annex V compliance used by the companies and at the ports was not known before the telephone contact was made.

This report summarizes the interviews conducted. It describes the approach and techniques used to comply with MARPOL Annex V by six companies with ocean going commercial vessels, two cruise lines operating out of U.S. ports, seven ports, and one barge company operating on the inland waterways. In addition, activities by the U.S. Navy to manage plastic and other solid waste are summarized. Military vessels are not included in MARPOL Annex V, but under U.S. law, military and other public vessels have until December 31, 1993 to comply with the new at sea garbage disposal limitations. The results of a survey of vessel operators on their knowledge of MARPOL Annex V and their method of compliance by the U.S. Coast Guard in Honolulu, Hawaii are also presented. The report is organized around four headings: ocean going commercial vessels, cruise lines, ports, and other. This report was prepared as part of a shipping industry marine debris education program sponsored by the National Oceanic and Atmospheric Administration's (NOAA) Marine Entanglement Research Program.

Comparable information on MARPOL Annex V compliance techniques is presented to the extent that the companies interviewed were willing or able to provide the information. The descriptions which follow are based on what information was provided by the companies. The type of waste regulated by MARPOL Annex V is referred to differently by some of the companies interviewed for this report. In the descriptions of MARPOL Annex V compliance techniques, this waste is generally referred to as garbage or plastic to be consistent with the terms used in Annex V of MARPOL (Regulations for the Preventive of Pollution by Garbage from Ships). Keystone Co. specifically asked that the term "trash" be used in the description of their activities. Lykes Bros. Steamship, Co., Inc. uses a four category classification system for separating solid waste. Their classification system is used in the description of their activities.

Examples of Approaches Used to Comply with MARPOL Annex V

The approaches and techniques used by commercial shipping and cruise line companies described in the remainder of this report include the following:

- Garbage separation, with storage of plastic waste on board and final disposal of plastic waste on shore;
- Garbage separation, with compaction and storage of plastic waste on board and final disposal of plastic waste on shore;
- Garbage incineration; and
- Product substitution.

Three of the six companies with ocean going commercial vessels interviewed have more stringent at sea disposal limitations than MARPOL Annex V. For two of the companies, these restrictions apply only to the Gulf of Mexico. For the third company, the policy applies worldwide.

At the ports included in this report, reception facilities for ship-generated garbage are generally provided through private contractors. Two of the seven ports included in the report have their own reception facilities for garbage regulated by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). APHIS requires food waste or garbage contaminated by food waste brought to U.S. ports from foreign waters to be incinerated or sterilized. APHIS regulations do no apply to vessels that operate only between the continental United States and Canadian ports.

Summary of Problems Encountered by Shipping Companies in Complying with MARPOL Annex V

Problems for the Company to Resolve

Several of problems identified by the shipping companies about MARPOL Annex V compliance can only be resolved by the companies themselves. These include such things as which budget will absorb the garbage disposal fees which are part of MARPOL Annex V compliance for some companies. It also includes logistic and scheduling problems for installing purchased garbage handling equipment such as trash compactors and incinerators. Crew turnover means the need for education, instruction, and supervision on company waste management and handling procedures.

Problems with Product Substitution

One of the suggested techniques for MARPOL Annex V compliance is to reduce the amount of plastics taken on board. That may be easier said than done. The U.S. Navy has had some success in reducing the amount of plastics on ships by changing its supply practices and requiring non-plastic products for certain items. Individual shipping companies do not buy the same quantities of supplies as the Navy. The shipping companies included in this report that have tried product substitution have done so with limited success. The description of the Keystone Shipping Co. MARPOL Annex V compliance activities includes a four page presentation made by the company's Director of Purchasing to the International Ship Suppliers Association on MARPOL Annex V and the need to minimize the use of disposable plastic products on vessels.

Problems Related to APHIS Regulated Garbage

APHIS regulations on garbage coming from foreign waters were in place before MARPOL Annex V entered into force. MARPOL Annex V did not affect APHIS regulations. However, plastic garbage on some vessels is primarily galley waste and when these vessels come to U.S. ports from foreign waters, this garbage is subject to APHIS garbage disposal requirements as well as those for MARPOL Annex V. Three types of problems related to APHIS garbage were cited by companies interviewed for this report. These were: 1) the need for crews to learn two sets of regulations on garbage at the same time, 2) the lack of APHIS approved reception facilities at some ports, and 3) the inability to offload APHIS regulated garbage on the weekends at some ports because no APHIS inspectors were available. The comments on the lack of APHIS approved receptions facilities were made before the August 28, 1989 deadline established by the U.S. Coast Guard regulations on MARPOL Annex V that ports and terminals be capable of receiving APHIS regulated garbage on a 24 hour notice.

Marine Debris Education Materials

The approaches and techniques used by the shipping and cruise line companies interviewed for this report varied. Some simply sent written directives to the vessels. Others supplemented their written directives with marine debris education materials such as posters and videos. The following is a brief description of the posters and videos mentioned in the descriptions of MARPOL Annex V compliance activities.[1]

- Stow It, Don't Throw It, It's the Law. An 18 by 28 inch multi-color poster.
- Don't Teach Your Trash to Swim. An 11 by 17 inch blue and white poster. The full caption reads: Don't Teach Your Trash to Swim, Packaging, Line, Nets, Thrown Overboard Hurt You and Other Marine Life. Please Keep Refuse On Board Until You Land.
- Popeye. A 14 by 24 inch four color poster with Popeye the Sailor, Olive Oly, Brutus, and Wimpy explaining problems of marine debris.
- Trashing the Ocean. A 7 minute video in English on the consequences of marine debris and entanglement. The video was produced by NOAA, National Marine Fisheries Service.
- Marine Refuse Disposal Project. A 9 minutes video on the pilot project at the Port of Newport, Oregon on port reception facilities for garbage, primarily from commercial fishing vessels. The video was produced by NOAA, National Marine Fisheries Service. It is on the same tape as "Trashing the Ocean."

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[1] These materials are available from:

NOAA's Marine Debris Information Office
% Center for Marine Conservation
1725 DeSales Street, N.W.
Washington, DC 20036
(202) 429-5609

[blank]

OCEAN GOING COMMERCIAL VESSELS

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CHEVRON SHIPPING COMPANY

Overview

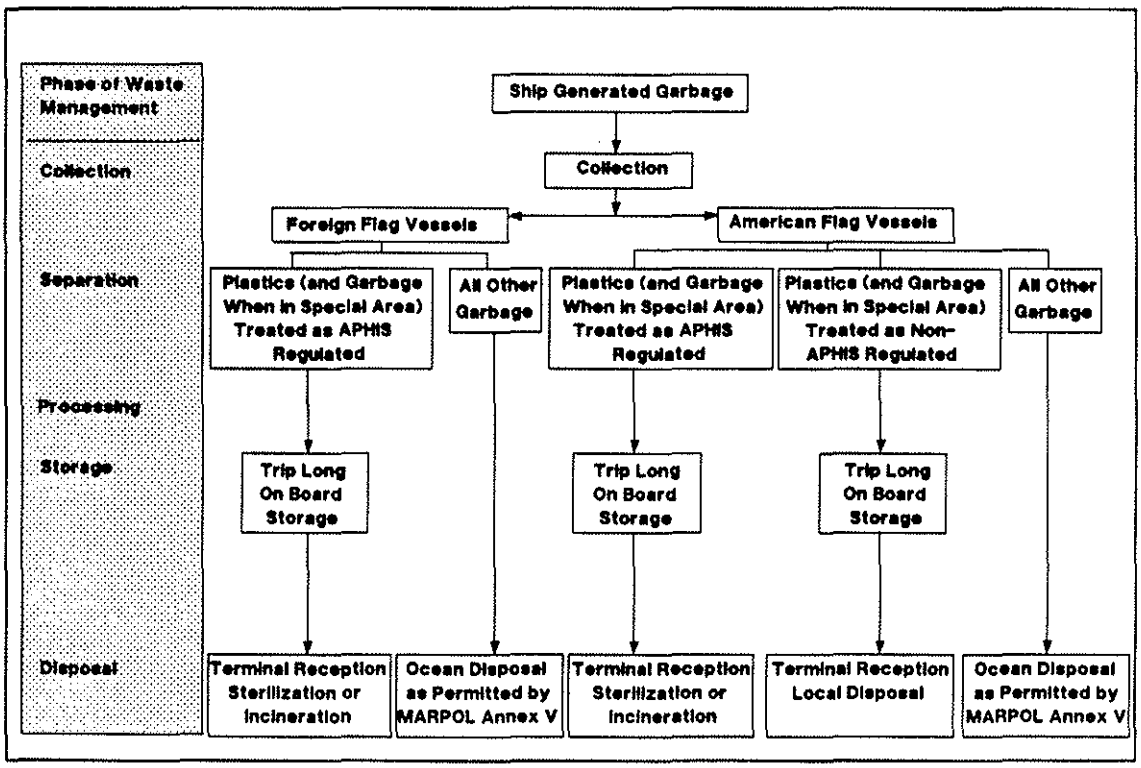
Chevron Shipping Company (Chevron) operates an owned/controlled fleet of 41 tankers and 4 tug boats. The fleet includes American and foreign flag vessels. Although most of the foreign flag vessels are registered in Liberia, which is not signatory to MARPOL Annex V, all Chevron vessels are required to be in full compliance with MARPOL Annex V. APHIS regulated garbage is generated by the tanker fleet.

Characteristics of Chevron's approach to MARPOL Annex V compliance include:

- On board separation of plastics from other garbage, on board storage, and shoreside disposal.
- Use of contractors at Chevron terminals which are required to handle disposal of APHIS regulated garbage.
- Required compliance with MARPOL Annex V by all Chevron tankers anywhere in the world.
- Designation of the Gulf of Mexico as a Special Area for all Chevron vessels.

Garbage Handling and Disposal Under MARPOL Annex V

Garbage handling and disposal procedures for the Chevron fleet are:



- Plastics are: 1) separated from all other garbage by vessel personnel, 2) stored on board, and 3) disposed of through terminal garbage reception facilities.

- Separate trash receptacles are provided at terminals for APHIS regulated and non-APHIS regulated garbage. American flag vessels separate garbage accordingly.

- Garbage from foreign flag vessels is treated as APHIS regulated garbage.

Three Chevron vessels were outfitted with different compactors for evaluation purposes. These vessels tested whether compactors are worthwhile, and if so, which model of compactor would best fit the fleet's needs. After evaluation, completed at the end of June 1989, the company decided not to outfit the remainder of the fleet with compactors.

Incinerators are not now being used on the Chevron tankers. The decision not to buy and install incinerators at this time was based on the following: 1) cost; 2) lack of guidelines from the Coast Guard; and 3) uncertainty of air quality standards which will be required of incinerators in the future.

Chevron is relying on its terminals for disposal of garbage and arrangements have been made for contractors at each of its terminals. Chevron worked with the U.S. Department of Agriculture and the California Department of Agriculture before contracting for garbage disposal services at its terminals.

Chevron has two policies related to MARPOL Annex V compliance which go beyond the requirements of the regulations. All Chevron tankers, whether registered in a signatory or non-signatory nation to MARPOL Annex V, must comply with MARPOL Annex V at all times. Under the provisions of MARPOL Annex V, ships with registry in countries which are not signatory to MARPOL Annex V are not required to comply with its at sea garbage disposal limitations when outside the waters of signatory nations. In addition, Chevron has designated the Gulf of Mexico as a Special Area for its vessels. Garbage disposal limitations are more restricted in Special Areas under MARPOL Annex V.

To increase awareness of MARPOL Annex V and the consequences of marine debris among its shipboard personnel, the NOAA videos "Trashing the Oceans" and "Marine Refuse Disposal Project, Port of Newport, Oregon" have been shown and a copy of each is retained on board each vessel. Placards are also used on board ships as reminders that overboard disposal of plastics is not permitted.

GULFCOAST TRANSIT COMPANY

Overview

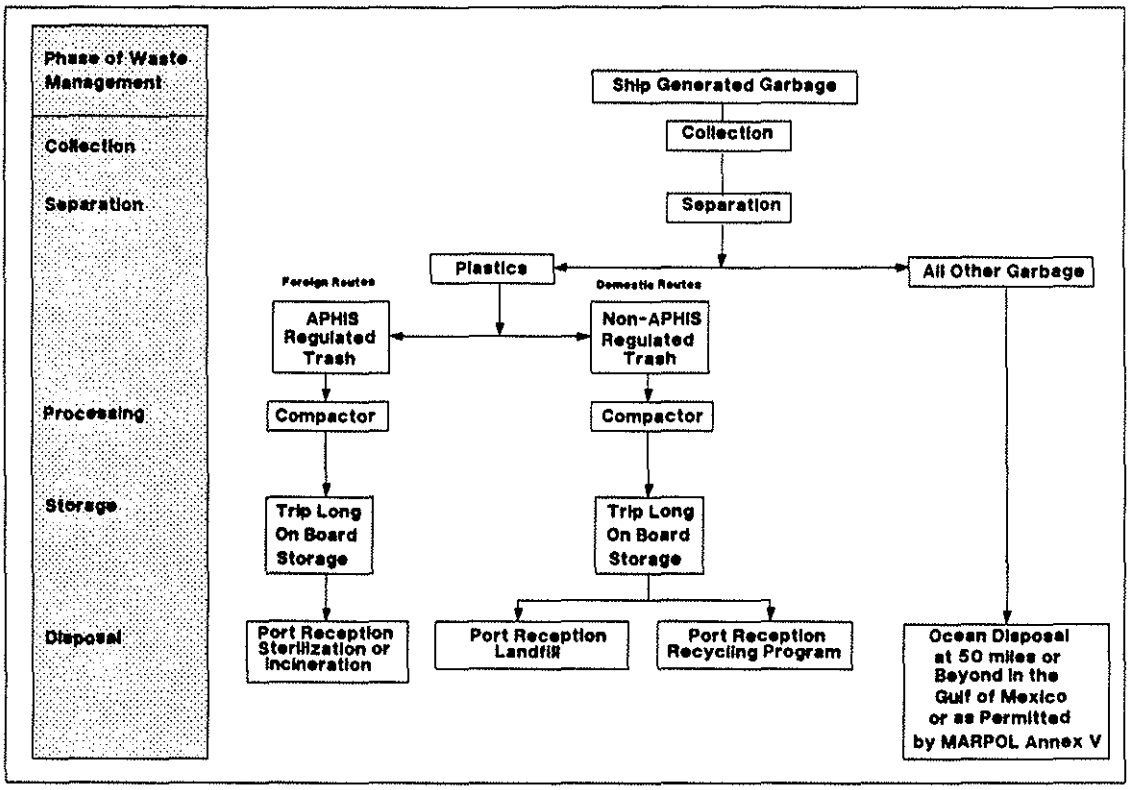
Gulfcoast Transit Company (Gulfcoast) operates 13 oceangoing tug/barges. These vessels have a crew of about 8 persons. The trading routes of these vessels are primarily in the Gulf of Mexico, although there are some routes to West Africa, South America, and the West Coast.

Characteristics of the Gulfcoast approach to MARPOL Annex V compliance include:

- On board separation of plastic from other garbage, on board storage of plastic garbage, and shoreside disposal.
- Use of trash compactors to reduce the volume of plastic garbage.
- Ocean disposal of non-plastic garbage in the Gulf of Mexico, if necessary, restricted by company policy to 50 miles or beyond.

Garbage Handling and Disposal Under MARPOL Annex V

Garbage handling and disposal procedures for the Gulfcoast fleet are as follows:



- Plastics are: 1) separated from all other garbage by vessel personnel at the source, 2) compacted in on board trash compactors, 3) stored on board in a storage locker, and 4) disposed of at port reception facilities.

- Other garbage is disposed of at sea. In the Gulf of Mexico, at sea disposal is restricted to 50 miles or beyond.

Each of the Gulfcoast vessels is outfitted with a trash compactor. The vessels are not large enough to be retrofitted with incinerators. The trash compactors are used for compacting plastic trash, and on some vessels to crush cans before they are disposed of at sea. Plastic garbage is placed in plastic garbage bags and stored in a mesh storage container above the main deck. The bags are offloaded in port to dumpsters. If it is foreign garbage (APHIS regulated garbage), it is tagged and disposed of through port or terminal contractors.

Gulfcoast tried to reduce the amount of plastic that is taken on board. It ordered and received biodegradable plastic trash bags. They then realized that biodegradable plastic bags could not be disposed of at sea. For awhile, they switched to milk in paper cartons. They then realized that the outside is coated with plastic. The company is now following its traditional supply practice.

Gulfcoast's policy on at sea disposal of non-plastics in the Gulf of Mexico is more restrictive than MARPOL Annex V. Many of Gulfcoast's trading routes are in the Gulf of Mexico. Non-plastic garbage, by company policy, can only be disposed of in the Gulf of Mexico at 50 miles or beyond, compared to 3, 12, or 25 miles depending on the situation under MARPOL Annex V.

Problems Encountered

- The amount of garbage that accumulates on long sea voyages, for example a 20 day journey from San Francisco to the Canal Zone.
- Lack of storage space topside.
- Training new personnel. Cooks and seamen, those who handle the garbage, are instructed in garbage handling procedures through individual on the job training by the vessel master or mate.
- Inability to offload APHIS regulated garbage on the weekend at some ports.

KEYSTONE SHIPPING CO.

Overview

Keystone Shipping Co. (Keystone) has a fleet of 16 vessels, 15 tankers and 1 bulk carrier. The fleet includes 16 American flag vessels. The same approach to MARPOL Annex V compliance is used on all vessels. APHIS regulated trash is generated on the fleet's trading routes. The crew size for each vessel is in the range of 25 to 30 persons.

Characteristics of the Keystone approach to MARPOL Annex V compliance include:

- Product substitution for plastic.
- Use of specially made trash receptacles marked "Plastics Only" in each room, the passageways, and in the trash collection areas.
- Use of specially made placards on MARPOL Annex V regulations.
- On board separation of plastic from other trash, retention of plastic trash on board, and shoreside disposal.

Preparations for MARPOL Annex V Implementation

During the summer of 1988, Keystone used two ships (one trading on the west coast and one trading on the east coast) to determine the amount and type of plastic trash generated. Plastics were separated from other trash and inventoried. Based on these test ships, the company decided that purchasing compactors and/or incinerators was not necessary.

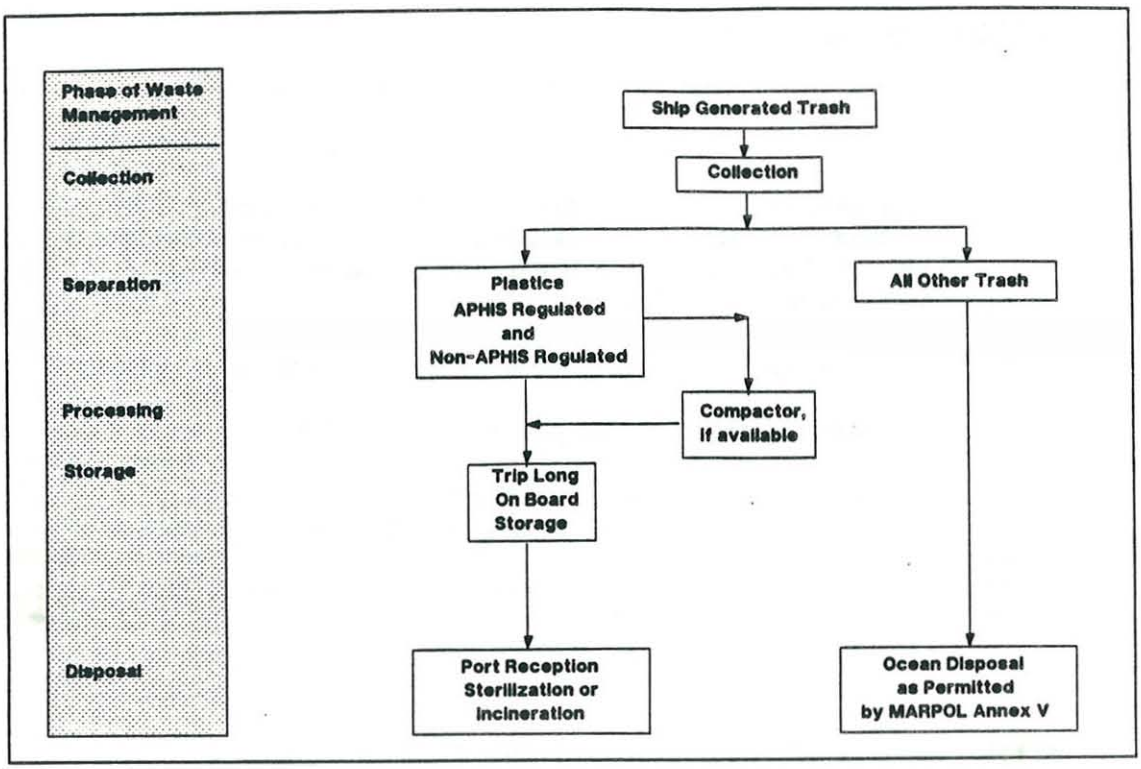
Keystone started using paper bags and paper hot drink cups on its ships in late 1988. This was done as a means of instructing the crew that disposal of plastic trash was about to change. Paper bags and cups were chosen because their substitution for plastic trash bags and foam cups could be easily done. Further, they were products that the crew would notice as being different and would asked about the change. Trash handling practices according to MARPOL Annex V began on Keystone ships in November/December 1988, just prior to the required compliance date. Before then, trash from Keystone vessels was disposed of at sea.

Trash Handling and Disposal Under MARPOL Annex V

Overall Approach

Trash handling and disposal procedures for the Keystone fleet are as follows:

- Plastics are: 1) separated from all other trash by vessel personnel and 2) stored for shoreside disposal into port trash reception facilities. Vessels with compactors compact the plastic trash before storing it.
- All other trash is disposed of according to MARPOL Annex V at sea disposal limitations.



The Keystone approach to MARPOL Annex V compliance emphasizes reduction of plastics on board ships and separation of plastics from other trash. Highlighted below are some of the major points of their approach to compliance.

Changes in Supply Practices

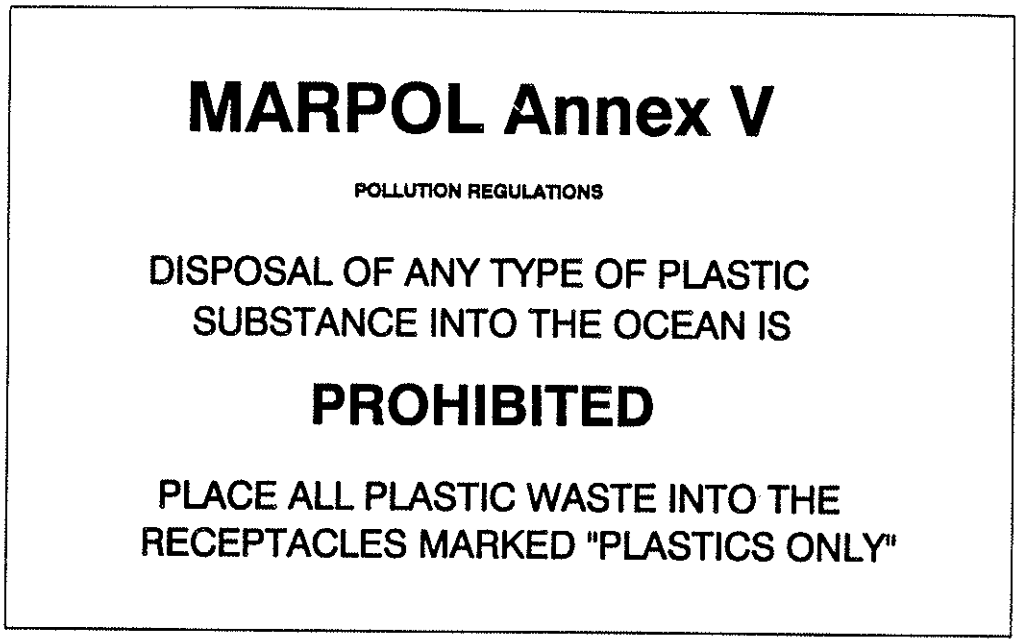
Keystone has attempted to reduce the amount of plastics used on its ships. However, they have been frustrated in their attempts to reduce the amount of plastics on board by the inability of their suppliers and the unwillingness of some key manufacturers to provide products without using plastic. They have asked their suppliers to substitute non-plastic for plastic items. The amount of plastic on board their ships has been reduced to the extent that their suppliers have been able or willing to accommodate their request. All shipments packed and repacked by Keystone personnel are prepared using non-plastic packaging material.

Recognizing the importance of the suppliers' role in reducing plastics on ships, Keystone's Director of Purchasing presented a paper called "Trash Management at Sea" at a 1988 conference of the International Ship Suppliers Association. The paper discusses the problems of plastics in the ocean, provides an overview of MARPOL and MARPOL Annex V, and discusses the effects of MARPOL Annex V implementation. The paper urges the co-operation of suppliers in Keystone's efforts "to minimize the use of disposable plastic products on ocean-going vessels." A copy of this paper is included at the end of this discussion.

Changes in Ship Board Trash Handling

Keystone has sent instructions to each ship that plastic trash is to be separated from other trash, stored on board, and disposed of on shore. The definition of plastics in MARPOL Annex V has also be sent to each ship. Those ships already outfitted with compactors now use them to compact plastics before on board storage. These compactors had previously been used for general trash.

Keystone had placards and trash receptacles with the words "Plastics Only" burned in white onto the outside specially made. These are used on each vessel. The placard measures 5 inches by 8 inches and uses white lettering on a red background. The text of the placard is as follows:



There are 35 of these placards on each ship; one in each room, and one in the common areas.

A series of different sized trash receptacles is used to collect plastic trash. Each room has a 7 gallon trash can labelled "Plastics Only." These trash cans are emptied into 32 gallon trash cans also labelled "Plastics Only." There are four 32 gallon "Plastics Only" trash cans on each ship. These are located in passageways. The contents of the 32 gallon trash cans are emptied into 55 gallon trash cans labelled "Plastics Only" in the trash collecting area of the ship.

Problems Encountered

- Inability of suppliers and unwillingness of manufacturers to reduce the amount of plastic in products and packaging used on ships.
- Lack of trash reception facilities at some ports.
- Inability of the Department of Agriculture to respond to the need for handling APHIS regulated trash on the weekends.

Trash management at sea

by Louis A. Cavaliere, Keystone Shipping

Louis A. Cavaliere.

THE accumulation of trash and refuse in the oceans of the world has become a well-publicised issue. For years, the oceans, because of their vastness, have been treated as a dumping ground for the world's trash and all types of waste. There comes a point of saturation, however, and many believe that we have reached, and have already exceeded the point at which trash in the oceans becomes excessive. A visit to any coastal shore will bear this out. Trash has accumulated on our shores to the point where it has become an aesthetic eyesore, a nuisance to bathers, a bane to fishermen, and a danger to marine wildlife. There are three reasons why trash has become so noticeable in our oceans. One is that more trash is being generated today than at any other point in history. As more trash is generated on land, a percentage of that trash will find its way into the oceans. A second reason is that a greater percentage of what is being disposed of today as trash is non-biogradable plastics. A third reason is the density of population at the shore line.

Plastics is a wonder of modern technology that has become so popular in industrial, commercial, and residential use because of its light weight, durability, and strength. Ironically, these characteristics are exactly what leads to the problem of plastics being disposed of at sea. Where most trash substances such as paper, wood, foodstuffs, etc. degrade and break down in relatively short periods of time, subsequently finding their way into the ecosystem of the marine environment, plastics behave differently. Plastics take several hundred years to break down biologically. Instead of blending into the marine ecosystem, plastics resist absorption thereby causing disastrous effects on the environment. Plastic ingestion and plastic entanglement have killed thousands of sea birds, sea mammals, and fish. "To date, approximately 15 per cent of the world's 280 species of sea birds are known to have ingested plastics".[1]

Trash reaches the ocean from land and from seaborne vehicles such as ships, barges and offshore platforms. Although outright ocean dumping of trash by countries, states, and municipalities is prohibited, the dumping of trash into the ocean from ships and platforms has always been a normal and legally accepted practice. Merchant vessels and warships alike accumulate their trash on the fantail (stern) of the ship and then dump it when out at sea. For U.S. vessels, the Refuse Act of 1899 (33 USC 403) authorized the dumping of trash at sea beyond the three mile limit of the shoreline. Amazing as that seems, this includes all types of solid refuse, sewage and trash, including plastics. Table A depicts amounts of trash that have been generated in the United States from 1960 to 1984.[2]

Note that as the total amount of gross waste generated increased almost twofold from 1960 to 1984, the same time period saw an increase in plastics as a percentage of waste discarded from 0.5% to 7.2%, or a fourteenfold increase! In a 1975 study, the National Research Council of the National Academy of Sciences estimated that approximately 6.4 million metric tons of the above total net waste was discharged into the oceans. Of that, approximately 7% or 45,000 tons consisted of plastic garbage.

Those of us who have been to sea are familiar with trash disposal procedures and how seemingly endless the ocean appears as a receptacle for absorbing our wastes. The trash dumped at sea is usually disposed of in plastic garbage bags. Ships being a microcosm of society, generate the same types of trash that households, factories, and municipalities do. It is revealing to note how prevalent plastics have become as an item of consumption in our throw-away society. Plastics are found in bags, styrofoam (popcorn) packing material, six-pack holders, bottles, caps, lids, styrofoam cups and utensils, strapping bands, sheeting, fishing nets, buckets, hard hats, vegetable sacks, milk jugs, egg cartons, gloves, rope, shoes, flashlights, straws, stirrers, syringes, lighters, and the ubiquitous shrink-wrap. The use of plastics is so widespread, it would almost be impossible to prevent their ingress on board a ship. If ships were restricted from using plastic utensils, tools, etc., the plastic would still show up in the form of packing material and shrink-wrap for spare parts and food provisions. Indeed, more and more plastics are being used in ship's construction.

We are dealing here with two recognized problems, that of trash pollution of the ocean in general, and that of plastics pollution, and the associated problems of that pollutant in particular. The problem is global. Vessels of all nations pollute the ocean freely and legally as long as it is done outside of the legal territorial limit. It is long overdue, however, to restrict and control the disposal of trash and garbage into the oceans. The harm that is being done to the marine environment must be minimized, if not eliminated in some way. Annex V represents the first effort on an international basis to clean up our oceans.

Annex V – a summary

The pollution of the ocean environment by the maritime industry has been a focus of concern since the early seventies when the International Maritime Organization adopted the International Convention for the Prevention of Pollution by Ships in 1973, and then modified by protocol in 1978. The Convention is known as MARPOL, and it consists of five annexes, each one of which is designed to combat a particular type of pollution. The five annexes are listed as follows:

I Regulations for the Prevention of Pollution by Oil.
II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.
III Regulations for the Prevention of Pollution by Harmful Substances in Packaged Form.
IV Regulations for the Prevention of Pollution by Sewage from Ships.
V Regulations for the Prevention of Pollution by Garbage from Ships.

Annexes I (Oil) and II (Chemicals) are known as the mandatory annexes and are already in force internationally. Annexes III, IV, and V are the optional annexes which require individual ratification by nations signatory to MARPOL. Each

1. D.H.S. WEHLE and F.C. COLEMAN, "Plastics at Sea" *Natural History*, Vol. 92, No. 2, February, 1983, p.20.

2. U.S. Department of Commerce, *Statistical Abstract of the United States, 1987*, p.191.

Article provided courtesy of the author.

TABLE A

SOLID WASTE – HAZARDOUS WASTE SITES

No. 335. Municipal Solid Waste Generation, Recovery and Disposal: 1960 to 1984

[In millions of tons, except as indicated. Covers post-consumer residential and commercial solid wastes which comprise the major portion of typical municipal collections. Excludes mining, agricultural and industrial processing, demolition and construction wastes, sewage sludge, and junked autos and obsolete equipment wastes. Based on material-flows estimating procedure and wet weight as generated.]

Item and Material	1960	1965	1970	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Gross waste generated	82.30	96.30	118.30	122.70	130.40	133.30	138.00	140.70	139.10	140.90	137.80	144.10	148.10
Per person per day (lb)	2.50	2.77	3.18	3.11	3.28	3.32	3.40	3.43	3.35	3.36	3.25	3.37	3.43
Materials recovered	5.90	6.20	8.00	9.10	10.80	11.60	11.80	13.00	13.40	13.20	12.90	13.90	15.10
Per person per day (lb)	.18	.17	.21	.23	.27	.29	.29	.32	.32	.31	.30	.32	.35
Percent of gross discards recovered:													
Paper and paperboard	18.00	15.00	16.90	19.20	19.80	20.70	19.90	20.90	21.90	20.60	20.60	20.70	20.80
Glass	1.50	1.20	1.20	2.70	3.40	3.50	3.30	4.00	5.00	5.00	5.20	5.90	7.20
Ferrous metals	.50	1.00	1.20	1.90	2.10	2.40	2.70	3.10	3.20	3.10	2.80	2.70	2.80
Aluminium	NA	NA	1.60	12.40	11.80	13.10	13.70	13.00	19.60	28.40	30.90	29.30	29.40
Processed for energy recovery	NA	.20	.40	.70	.90	1.40	1.50	2.30	2.70	2.30	3.50	5.00	6.50
Per person per day (lb)	NA	.01	.01	.02	.02	.03	.04	.06	.06	.05	.06	.12	.15
Net waste disposed of	76.40	91.90	109.90	112.80	118.70	120.30	124.70	125.40	123.00	125.40	121.40	125.20	126.50
Per person per day (lb)	2.32	2.59	2.94	2.86	2.96	2.99	3.07	3.05	2.96	2.99	2.86	2.92	2.93
Percent distribution of net discards:[1]													
Paper and paperboard	32.10	35.00	33.10	30.40	32.90	33.10	33.90	34.40	33.60	34.50	33.20	35.30	37.10
Glass	8.40	9.20	11.30	11.60	11.30	11.40	11.60	11.30	11.30	11.30	11.00	10.40	9.70
Metals	13.70	11.60	12.20	11.80	11.10	10.90	10.50	10.60	10.30	10.00	10.10	9.90	9.60
Plastics	.50	1.50	2.70	3.90	4.70	5.30	5.80	6.40	6.00	6.10	6.70	7.00	7.20
Rubber and leather	2.20	2.40	2.70	3.30	3.10	2.80	2.80	3.30	3.30	3.20	3.00	2.60	2.50
Textiles	2.60	2.40	2.00	2.20	2.10	2.00	2.20	2.30	2.30	2.40	2.40	2.30	2.10
Wood	3.90	3.80	3.60	3.80	3.80	3.90	3.70	2.60	3.90	3.50	4.00	4.00	3.80
Food wastes	14.60	13.10	11.50	11.80	11.00	10.60	10.00	9.60	9.20	8.90	8.80	8.50	8.10
Yard wastes	20.30	19.20	19.00	19.50	18.30	18.20	17.70	17.70	18.20	18.20	18.70	18.10	17.90
Other wastes	1.70	1.70	1.70	1.90	1.80	1.80	1.80	1.80	1.90	1.90	2.00	1.90	1.90

NA – Not available. [1] Net discards after materials recovery and before energy recovery.

Source: Franklin Associates, Ltd., Prairie Village, KS, *Characterization of Municipal Solid Waste in the United States, 1960 to 2000*, 1966. Prepared for the U.S. Environmental Protection Agency.

optional annex enters into force separately, one year from the date on which at least fifteen nations, representing fifty per cent of the world shipping tonnage, have ratified them. Annexes III and IV have not yet met this requirement and are not yet scheduled to enter into force.

Annex V (Garbage) will enter into force on 31 December, 1988. The United States was the 29th country to ratify the Annex, and by its ratification, the United States Senate had the honour of bringing the total world tonnage over the 50 per cent mark, from 48 to 52 per cent. The status of all of the MARPOL Annexes are summarized in Table B.[3]

Simply stated, Annex V prohibits the disposal of any type of plastic substance into the ocean. Other types of garbage may be disposed of into the sea by ships with the following restrictions:

(1) Twenty-five nautical miles from land for dunnage, lining, and packing materials that will float.
(2) Twelve nautical miles from land for food wastes and all other types of garbage. Garbage is defined by the Annex as all kinds of victual, domestic, and operational waste generated during normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in one of the other Annexes.
(3) Three nautical miles from land if the garbage in (2) above has passed through a grinder.

However, disposal of garbage is further restricted for five "special areas" designated as the Mediterranean Sea, the Baltic Sea, the Black Sea, the Persian/Oman Gulf, and the Red Sea. The United States is attempting to have the Gulf of Mexico designated as a MARPOL "special area". Within the above "special areas", disposal of plastics is prohibited. In addition, all other garbage is prohibited except for food wastes which may be disposed of twelve nautical miles from land. The desire of the U.S. Congress to include the Gulf of Mexico as a "special area" is so strong that it was included as an amendment to the Senate's ratification of MARPOL Annex V. However, MARPOL cannot consider any amendments until the Annex goes into force in December, 1988.

The Annex further prohibits fixed and floating platforms from disposing any plastics or trash into the ocean. The only garbage disposal allowed from platforms is food waste, and then only if the food has been passed through a grinder, and only if the platform is twelve or more nautical miles from land.

The provisions of Annex V contain three exceptions. These are:

(1) disposal of garbage necessary for the safety of a ship;
(2) the escape of garbage resulting from damage to a ship;
(3) the accidental loss of synthetic fishing nets.

Table C[4] is a handy summary of garbage disposal restrictions.

Annex V, then, is a deliberate attempt to prohibit the disposal of plastics from ships at sea, and to limit the disposal of all other types of trash. These regulations call for unprecedented actions on the part of seafarers, ship operators, and shipowners to do their part in the clean-up of the ocean environment. Unprecedented co-operation is also necessary from those

3. U.S. Senate, 100th Congress. *MARPOL CONVENTION, ANNEX V.* Senate Executive Report 100-8, p.31.

4. International Maritime Organization. Marine Environment Protection Committee. *Draft Guidelines for the implementation of Annex V.* MEPC 25/WP 10, p.11.

Article provided courtesy of the author.

who support ocean-going vessels, such as Port Authorities, to provide reception facilities to receive trash, and for ship suppliers to offer as many products as possible that do not contain plastic substances or wrapping materials.

Effects of implementation

Enactment of Annex V regulations will have a direct effect on the methods in which trash is disposed of from every ship and floating craft in the world.

Seafarers today are conditioned by hundreds of years of total unconcern toward the effect that the disposal of trash has upon the ocean. A seaman gives no thought as to where ship-board trash will go – over the side. For as long as man has gone to sea in ships, this attitude has been accepted. The law will now require a seaman to think first before tossing. As with most other pollution and safety programmes, the burden for providing the education and monitoring of their crews will fall upon the shipowner.

Concerning the matter of implementation on board ocean-going vessels, the guidelines refer to three specific requirements: The keeping of a garbage log in the form of a refuse record book; the posting of placards that outline the provision of Annex V; and, the development of a shipboard garbage management programme. These provisions will be required within one year after the entry into force on 31 December, 1989. The exact make-up of the refuse record books, the wording of the placards, the locations of where these placards are to be posted, and the composition of a shipboard management plan have not yet been determined.

TABLE B

STATUS OF MARPOL 73/78
(as at 4 August 1988)

State	Annexes I & II	Annex III	Annex V	Annex IV
Antigua and Barbuda	X	X	X	X
Australia	X			
Austria	X	X	X	X
Bahamas	X			
Belgium	X			
Brazil	X			
Brunei Darussalam	X			
Bulgaria	X			
Burma	X			
China	X			
Colombia	X	X	X	X
Cote d'Ivoire	X	X	X	X
Czechoslovakia	X	X	X	X
Democratic People's Republic of Korea	X	X	X	X
Denmark	X	X	X	X
Egypt	X	X	X	X
Finland	X	X	X	X
France	X	X	X	X
Gabon	X	X	X	X
German Democratic Republic	X	X	X	X
Germany, Federal Republic of	X	X	X	X
Greece	X	X	X	X
Hungary	X	X	X	X
Iceland	X			
India	X			
Indonesia	X			
Israel	X			
Italy	X	X	X	X
Japan	X	X	X	X
Lebanon	X	X	X	X
Liberia	X			
Marshall Islands	X	X	X	X
Netherlands	X	X	X	
Norway	X	X	X	
Oman	X	X	X	X
Panama	X	X	X	X
Peru	X	X	X	X
Poland	X	X	X	X
Portugal	X	X	X	X
Republic of Korea	X			
St. Vincent and Grenadines	X	X	X	X
South Africa	X			
Spain	X			
Sweden	X	X	X	X
Switzerland	X			
Tunisia	X	X	X	X
Tuvalu	X	X	X	X
USSR	X	X	X	X
United Kingdom	X	X	X	
United States	X		X	
Uruguay	X	X	X	X
Yugoslavia	X	X	X	X
Total Number	52	34	35	31
Percentage Tonnage*	80.81%	46.91%	51.91%	41.60%

*Source: Lloyd's Register of Shipping Statistical Tables, 1987.

TABLE C

MARPOL 73/78 Annex V – Summary of Garbage Disposal Restrictions

Garbage Type	All Vessels Except Offshore Platforms & Associated Vessels		‡ Offshore Platforms & Associated Vessels
	Outside special areas	† In special areas	
Plastics – includes synthetic ropes and fishing nets and plastic bags	Disposal prohibited	Disposal prohibited	Disposal prohibited
Floating dunnage, lining and packing materials	Disposal prohibited less than 25 miles from nearest land	Disposal prohibited	Disposal prohibited
Paper, rags, glass, metal, bottles, crockery and similar refuse	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited	Disposal prohibited
*Paper, rags, glass, etc. comminuted or ground	Disposal prohibited less than 3 miles from nearest land	Disposal prohibited	Disposal prohibited
Food waste not comminuted or ground	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited
*Food waste comminuted or ground	Disposal prohibited less than 3 miles from nearest land	Disposal prohibited less than 12 miles from nearest land	Disposal prohibited less than 12 miles from nearest land
Mixed refuse types	§	§	§

* Comminuted or ground garbage must be able to pass through a screen with a mesh size no larger than 25mm.

† Special areas are the Mediterranean, Baltic, Red and Black Seas, and Persian Gulf areas.

‡ Offshore platforms and associated vessels includes all fixed or floating platforms engaged in exploration or exploitation and associated offshore processing of seabed mineral resources, and all vessels alongside or within 500m or such platforms.

§ When garbage is mixed with other harmful substances having different disposal or discharge requirements the more stringent disposal requirements shall apply.

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However, these requirements are consistent with those of Annex I and Annex II of MARPOL which also require oil record books, placards and management programmes for controlling pollution by oil and chemicals. The implementation costs for these refuse record books, placards, and programmes will be the responsibility of the shipping company. Unlike Annex I and II, however, the provision sof Annex V must be familiar to all hands and to recreational craft as well, since each and every mariner is a potential disposer of plastic trash going over the side.

Concerning the matter of engineering, the marine industry must develop and improve technology for shipboard garbage compactors and incinerators, and other equipment that may be able to store or process trash onboard. The waste management industry must respond to the need for reception facilities in ports to accept and dispose of shipboard trash. The response of a shipping company to the matter of engineering and technology is optional. The addition of any equipment to handle trash is entirely optional, so long as the requirements of Annex V are met.

What then, can be done with the plastic trash that accumulates on board? It is impossible to prohibit plastic from coming aboard each ship. Spare parts and food provisions are packaged in plastic. Consumables, especially cleaning liquids, are stored in plastics. Hence, the plastic trash that will accumulate must be segregated and disposed of separately ashore, or onboard by burning in an incinerator. It may be as simple as hauling the plastic trash ashore to a dumpster every time a ship comes into port.

What then, can ship do with all of its trash whilst the vessel is in one of the special areas? If all trash disposal is prohibited except food trash, then we have a further accumulation of garbage that must be removed when a vessel enters port. The problem of trash accumulation is compounded for ships that trade within a special area. For these ships, a month's worth of trash may accumulate before being accepted in port. Onboard compactors or incinerators may be the answer for vessels in this situation.

Another problem exists for U.S. Flag ships that trade foreign and purchase food stores overseas. Trash generated from this source, including food wrappers and packaging materials, comes under the strict regulations of the Department of Agriculture (7 CFR 330.100). Although foreign source food trash may be disposed of at sea, what about the plastic wrapping and packaging materials? These items must be accumulated onboard and hauled off in port by a certified waste collection firm under the direction of the Animal and Plant Health Inspection Service of the Department of Agriculture.

Realizing that come 1989 it will be illegal for ships registered in signatory nations, and all other ships within the waters of those nations, to discard plastics into the ocean, responsible shipowners will implement a trash management programme for each of its vessels. The crucial question is what does a ship do with its plastic trash. The alternatives stated above include burning the plastics in an onboard incinerator, or accumulating the plastics, either loosely or via onboard mechanical compactors, for disposal ashore.

What are the risks involved for non-compliance of these regulations? It is the responsibility of each signatory nation to decide how it wishes to enforce Annex V, and what penalties will be imposed for violations. The implementing legislation (see reference three) in the United States mandates that Annex V will be enforced by the U.S. Coast Guard, and will apply to U.S. ships anywhere in the world, and to foreign flag shipping while operating in the navigable waters of the U.S. or within the 200 mile Exclusive Economic Zone (EEZ). The U.S. Coast Guard is authorized to inspect U.S. and foreign flag shipping, when operating as above, for compliance with Annex V. The U.S. Coast Guard is empowered to assess civil penalties of up to $25,000 for each violation, or for each day of a continuing violation. Wilful violators may be subject to a $50,000 criminal fine, and/or a term of imprisonment of up to five years.

It is obvious then, that the implementation of Annex V will have numerous consequences that go beyond the simple phrasing of the Annex itself.

The entire maritime industry must be made aware of these new regulations. This includes the source for the majority of the consumable plastics being placed onboard the ship, that is, the ship supplier. Can the ship supplier offer a full range of products that do not include plastics in any form? Can the ship supplier put pressure on their own suppliers to substitute for plastics? Can the ship supplier offer any alternatives to plastics such as biodegradable plastics, or returnables? What about recycling of glass, paper, and metal products? I doubt that many of the ship suppliers have an immediate solution to any of these questions or suggestions. As I challenge you, however, to pursue some of these ideas, the ship supplier is urged to be responsive to the increased demand that the ship-owner will place upon you for paper packaging, paper trash bags and disposable paper cups and dinnerware. Although these paper items will not completely eliminate the use of plastics onboard ships, they will at least decrease our dependency, while at the same time increase the mariners' awareness that plastics are not to be disposed of at sea.

Keystone Shipping Co. urges a joint effort on the part of shipowners, federal authorities, port authorities, ship suppliers, manufacturers, processors, and maritime organizations (such as ISSA) to deal with the immediate need of eliminating plastics disposal at sea. and we urge your co-operation as we attempt to minimize the use of disposable plastic products onboard ocean-going vessels.

We at Keystone have been working actively for many years with others in the international tanker community, generally known as TOVALOP, in successfully reaching satisfactory and practical solutions to the oil pollution problem. Now we are ready to join in a similar co-operative effort to achieve full compliance with Annex V. We hope that your organization will support us in this effort.

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LYKES BROS. STEAMSHIP CO., INC.

Overview

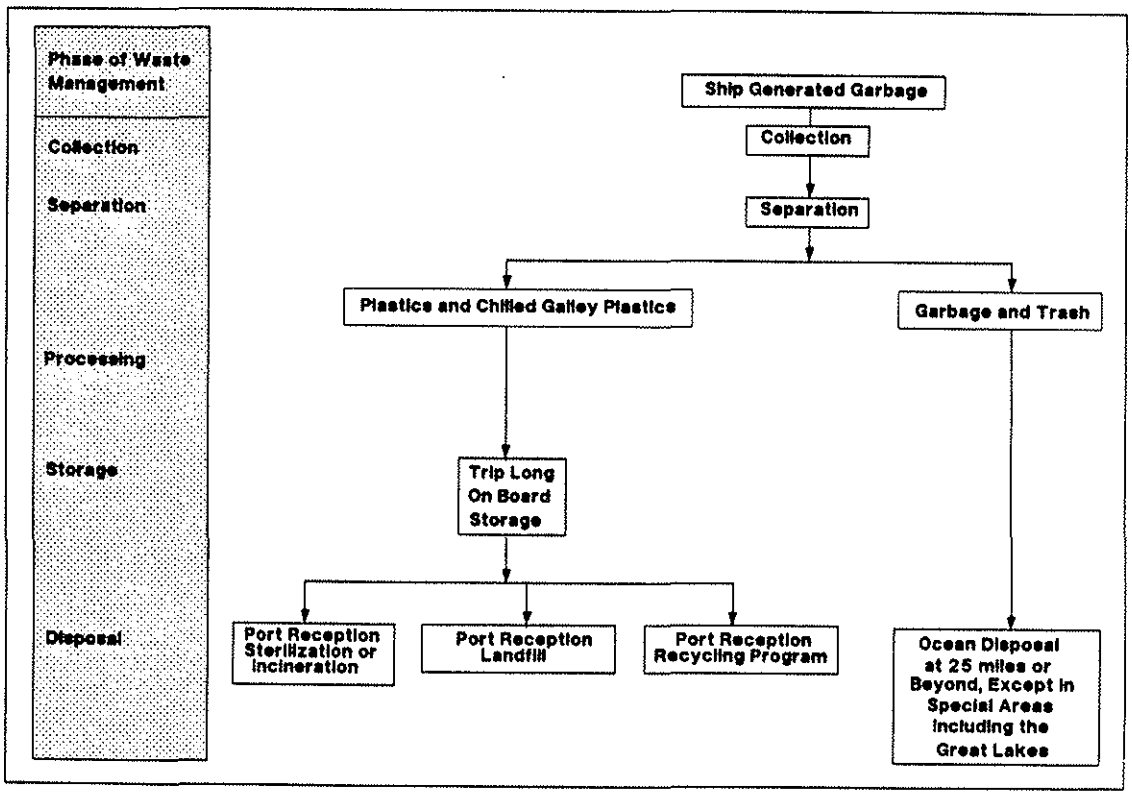
Lykes Bros. Steamship Co., Inc. (Lykes) operates a fleet of 30 U.S. flag dry bulk and container vessels. The fleet operates worldwide.

Characteristics of Lykes' approach to MARPOL Annex V compliance include:

- On board separation of four categories of waste: Plastics, Chilled Galley Plastic, Garbage, and Trash.
- On board storage of Plastics and Chilled Galley Plastic, and shoreside disposal.
- At sea disposal of food waste at least 25 miles offshore and at sea disposal of non-plastic waste and non-food waste, except in Special Areas, at least 25 miles offshore. Special Areas for the Lykes fleet are the Mediterranean, Great Lakes, Baltic, Red and Black Seas, and the Persian Gulf area.

Solid Waste Handling and Disposal Under MARPOL Annex V

Solid waste handling and disposal procedures for the Lykes fleet are as follows:



- Solid waste is separated at the source by vessel personnel and passengers into individual containers. Solid waste is separated into four categories: Plastics, Chilled Galley Plastic, Garbage, and Trash.

- Plastics and Chilled Galley Plastics are removed from vessels at each port where regulations permit such removal and the price is not prohibitive. In U.S. ports, Garbage, plastics which have been in contact with fish or animal food products, and Chilled Galley Plastics are disposed of through APHIS approved contractors.

- Food waste is disposed of at least 25 miles offshore. Non-plastic, non-food waste is dumped at least 25 miles offshore, except in Special Areas where at sea disposal is prohibited.

Waste separation on the Lykes fleet started in March 1987. The current procedures are set forth in a written directive on MARPOL Annex V regulations sent to all masters, chief engineers, chief mates, and chief stewards in December 1988. The Lykes directives are more stringent than the MARPOL Annex V requirements.

Solid waste on the Lykes fleet is divided into four general types: Plastics, Chilled Galley Plastics, Garbage, and Trash. The written directive on MARPOL Annex V regulations includes a technical definition of plastic and examples of plastic items. It directs personnel, for purposes of the MARPOL Annex V regulations, to consider an item to be made of plastic unless there is no question that the item is not made of plastic. The other categories of waste are defined as follows:

- Chilled Galley Plastics: Plastics which have been in contact with any fish or animal food product; meat, meat products, or poultry, after they have been washed and then properly placed in a container in one of the reefer boxes and chilled to below 40° F.

- Garbage: All waste material derived in whole or in part from fruits, vegetables, meats, fish, poultry, or other food stuff. Separated garbage is kept in leak proof drums in the garbage room or on the stern until it can be dumped at sea. Under Lykes policy, food waste can only be disposed 25 miles or more from shore.

- Trash: All waste which, does not contain any plastics and does not contain any garbage, such as dunnage, wood, paper, lining, paper packing, natural fiber lines, rags, bottles, cans, glass, metal, crockery, and cardboard.

Individual containers for separated Garbage, Plastics, and Trash are provided in the galley areas and on the stern of each vessel. Individual containers for Plastics and Trash are provided in the crew's quarters, public area, store room, on the bridge, and in the engine spaces. Special 32-44 gallon plastic containers are provided for Chilled Galley Plastics. Waste separation occurs at the source. Responsibility for waste separation is assigned by work area, and for private quarters and the public spaces. Each individual, including passengers, has a role in separating waste properly. Food waste (garbage) is prohibited in the containers for Trash and Plastics in the crew and passengers quarters. Personnel who fail to comply with the company's directive on MARPOL Annex V regulations are subject to disciplinary action.

There are no trash compactors or incinerators on the Lykes fleet. Milk, meat, and dry stores cartons are flattened by cutting all four corners before being placed in the appropriate waste container.

Lykes policy prohibits disposal of plastics in any ocean, sea, bay, river, or waterway anywhere on earth. Further, garbage which contains no Trash or Plastics can only be disposed of at sea 25 miles or more from shore. Trash can only be disposed of at sea outside Special Areas and only 25 miles or more from shore. Special Areas for the Lykes fleet includes those designated by MARPOL Annex V, but also includes the Great Lakes. The fleet has been put on notice that the Gulf of Mexico may become a Special Area in late 1989 or early 1990.

MAERSK LINE LTD.

Overview

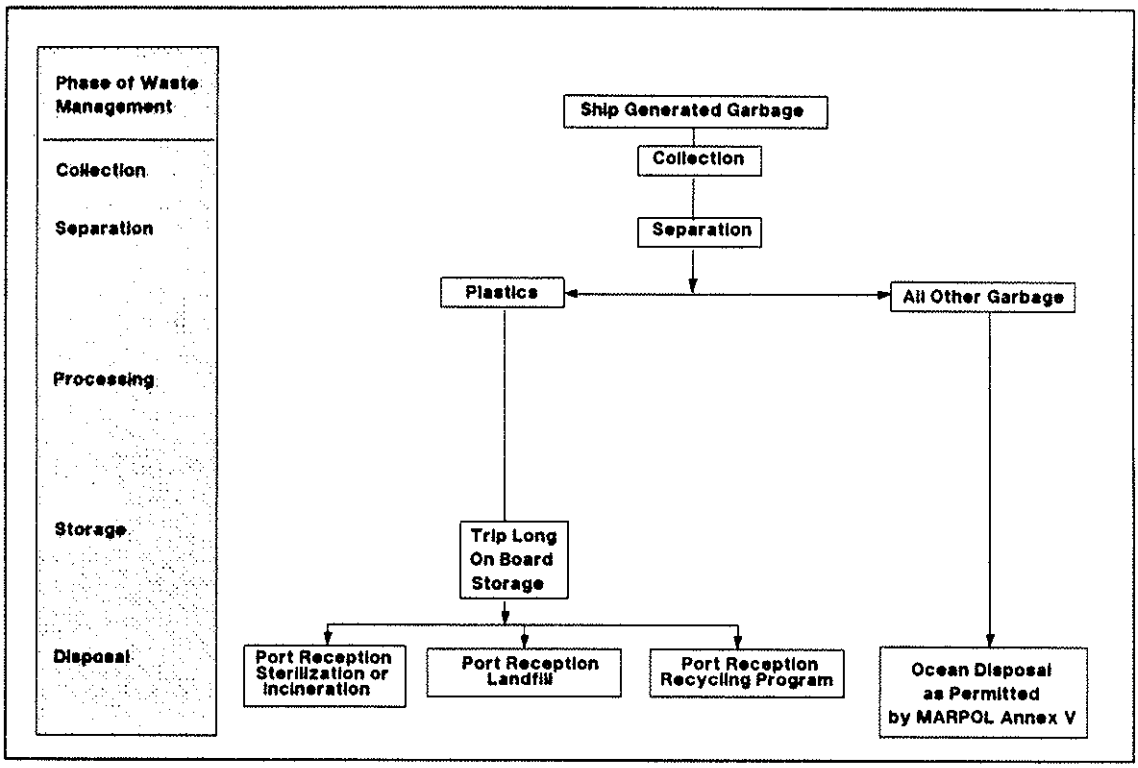
Maersk Line Ltd. (Maersk), headquartered in Denmark, has a fleet of about 150 container vessels. The fleet is primarily of Danish registry with trading routes to the U.S., the Far East, and the Middle East.

Characteristics of the Maersk approach to MARPOL Annex V compliance include:

- On board separation of plastics from non-plastic garbage, on board storage, and shoreside disposal.
- Arrangements with certified waste haulers at U.S. ports at least 24 hours in advance of the need for APHIS garbage disposal.
- At sea disposal of other garbage according to MARPOL Annex V.

Garbage Handling and Disposal Under MARPOL Annex V

Garbage handling and disposal procedures for the Maersk fleet include:



- Plastics are: 1) separated from all other garbage by vessel personnel, 2) stored on board, and 3) disposed of in port.
- All other garbage is disposed of according to MARPOL Annex V at sea disposal limitations.
- No trash compactors or incinerators are used.
- Written directives were provided to each vessel for reference.

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TEXACO MARINE SERVICES, INC.

Overview

Texaco Marine Services (TMS) developed the MARPOL Annex V implementation strategy for 51 vessels. This includes 31 of its own tankers, 9 barges, 8 tug boats, and 2 integrated tug barges (ITB). It also manages three tankers, one of which in May 1989 was not in operation. The tanker fleet includes U.S. and foreign flag vessels. Some of the foreign flag vessels are registered in countries which are not signatory to MARPOL Annex V. The U.S. flag fleet trades within U.S. waters. The international fleet trades worldwide including areas designated as Special Areas under MARPOL Annex V. The number of personnel on the tankers operated and managed by TMS ranges from about 25 to 30.

Characteristics of the TMS approach to MARPOL Annex V compliance include:

- Purchase and installation of compactors for all tankers and the two ITBs.
- Use of existing incinerators or purchase and installation of incinerators on selected tankers.
- Development and implementation of a shipboard waste management plan.
- Product substitution for plastic.
- On board sorting of plastic garbage from other garbage, retention of plastic garbage on board for shoreside disposal or on board incineration of plastic garbage, and disposal of other garbage according to MARPOL Annex V.

Pre-MARPOL Annex V Garbage Disposal Practices

Before December 31, 1988, TMS owned and managed vessels generally disposed of all garbage at sea. Shoreside disposal of garbage was used when it was readily accessible and there was accumulated garbage. This might have been the case if a ship had been in port for several days. Shoreside disposal was, however, the exception rather than the rule.

Preparations for MARPOL Annex V Implementation

Anticipating the implementation of MARPOL Annex V in the near term, in 1987 the company set aside money for the purchase of garbage handling equipment. The specific method of compliance with MARPOL Annex V and the type of equipment to be purchased were, however, not identified at the time. In October 1987, MARPOL Annex V compliance was elevated to project status within the Technical Group, organizationally the group responsible for tracking MARPOL Annex V regulations and developing and implementing compliance strategies.

In 1988, TMS monitored the Coast Guard regulatory activities on MARPOL Annex V and increased in-house activities related to MARPOL Annex V implementation. A technical and cost analysis of incinerators was undertaken. The study identified certain ships, which for cost reasons, would require incinerators. The long term potential cost for shoreside garbage disposal for these ships was found to justify the investment in incinerators. The study led to a competitive bid process for the purchase of incinerators. A similar study was conducted on compactors.

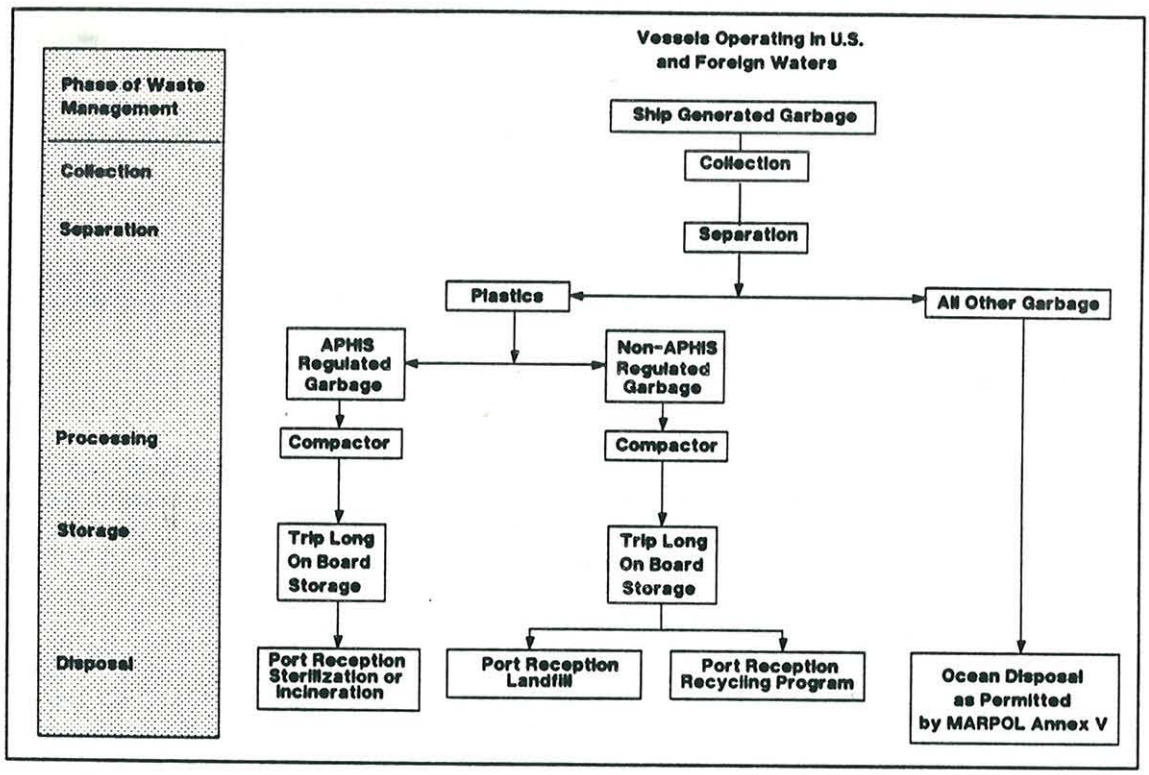
A company representative attended a workshop on The Shipboard Engineering and Environmental Aspects of Implementing MARPOL 73/78 Annex V (Garbage). The workshop was sponsored by Panel M-17 (Disposal of Shipboard Wastes) of the Society of Naval Architects and Marine Engineers. Following the workshop, the decision was made to retrofit the fleet with compactors and to use incinerators on the larger ships which trade worldwide. Ship personnel on vessels scheduled to be retrofitted with incinerators were asked to conduct a survey of their vessel to determine the location for the equipment.

Garbage Handling and Disposal Practices Under MARPOL Annex V

Overall Approach

Garbage handling and disposal procedures for the TMS fleet fall into one of three categories depending on the vessel type and trading routes. These are:

1. Vessels with Compactors Only

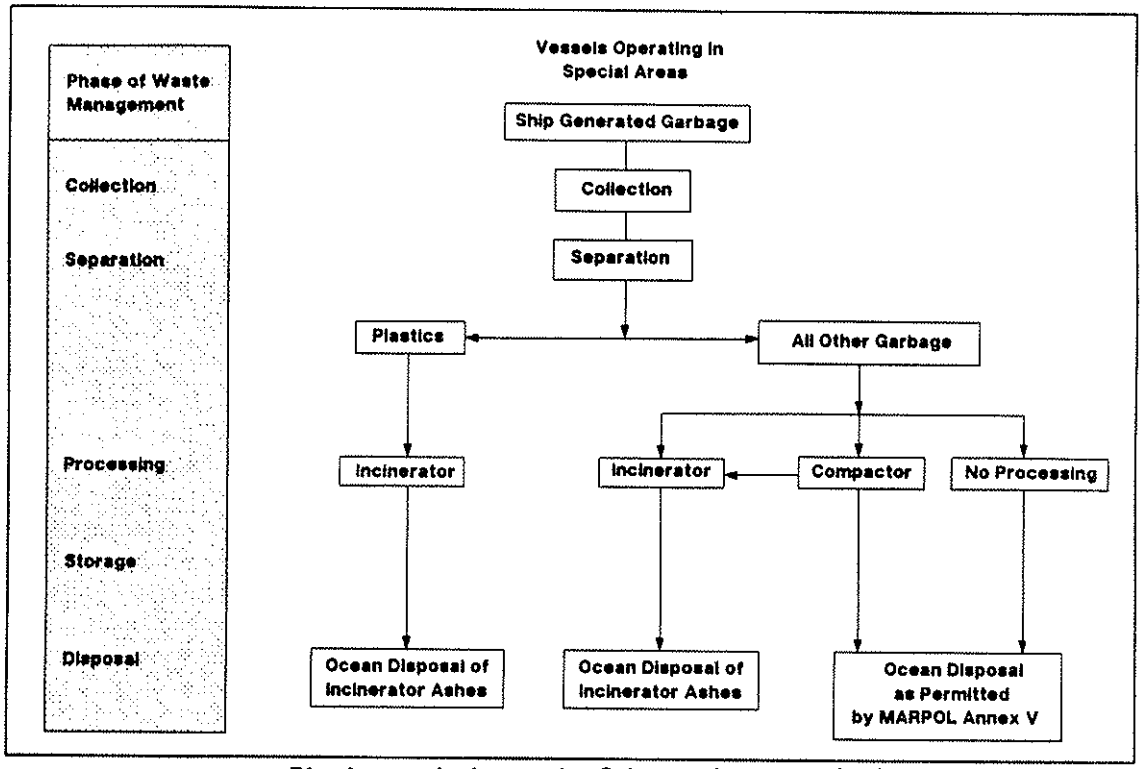


- Plastics are: 1) sorted from all other garbage by vessel personnel and 2) compacted and stored for shoreside disposal into port garbage reception facilities. For vessels travelling to the U.S. from foreign waters, food contaminated plastics are separated from other plastics and garbage for disposal at an APHIS approved facility.

- All other garbage is disposed of according to the MARPOL Annex V at sea garbage disposal limitations.

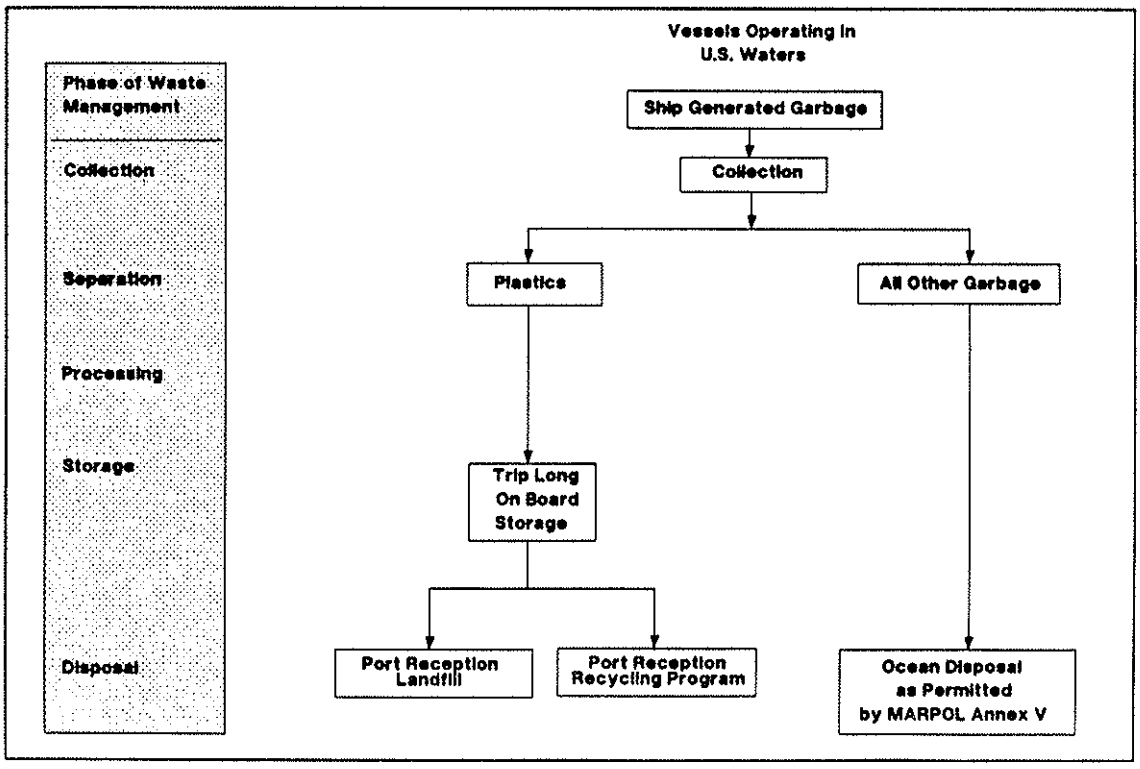
- Vessels maintain refuse log books.

2. Vessels with Incinerators



- Plastics are incinerated. Other garbage may be incinerated as well. The ash is disposed of at sea.
- Garbage which is not incinerated is disposed of according to the MARPOL Annex V at sea garbage disposal limitations.
- Vessels maintain refuse log books.

3. Vessels with No Compactors or Incinerators (i.e., the barge and tug boat fleet)



- Plastics are: 1) sorted from all other garbage by vessel personnel and 2) stored for shoreside disposal into port garbage reception facilities.

- All other garbage is disposed of according to the MARPOL Annex V at sea garbage disposal limitations.

- Vessels maintain refuse log books.

The TMS approach to MARPOL Annex V compliance includes changes in supply practices, technology used, shipboard operations, and efforts to make the crew aware of these changes. These changes are incorporated in a waste management plan which was prepared and distributed to all vessels. Highlights of the changes made and the waste management plan are outline below.

Changes in Supply Practices

Reducing the amount of plastics on ships is one of the techniques TMS is using to comply with MARPOL Annex V. TMS sent all suppliers (both food and non-food suppliers) a letter requesting them to use non-plastic containers and packaging. Ship personnel have been instructed to request non-plastic products and packaging when ordering for the ship's stores. The company is moving towards a computerized ordering system in which each vessel will order its parts and supplies directly. Since purchase orders will no longer be centrally processed, each ship will be responsible for requesting non-plastic items. The policy of requesting non-plastic items when ordering for the ship's stores is included in the TMS waste management plan.

Changes in Technology

The TMS owned tanker fleet and ITBs have been retrofitted with compactors. The same model compactor is used on all vessels except the ITBs, which have smaller compactors than those on the tankers. The first compactor was installed in September/October 1988. The last compactor was installed in March 1989.

In 1989, TMS will purchase 11 incinerators for its ships and perhaps 1 for one of its managed ships. The same model incinerator will be purchased. On three ships, because there is space available, the incinerator will be in a self container on the deck. The first incinerator was installed in April on the Texaco Delaware. This ship will be used as a demonstration or test vessel for learning how to obtain all necessary and final approvals and certifications for the incinerator.

It will take up to 2 1/2 months from the time the incinerators are ordered to the time of delivery. For those ships scheduled for shipyard work in 1990, the incinerators will be installed at that time. For the other ships, the incinerators will be installed as it can be scheduled using contractor or in-house teams during normal operations.

Five of the TMS tankers and one of the managed tankers already have incinerators, although they have not been used. The existing incinerators are not all well suited to handling garbage, however. Some are located in the engine room creating the need to transport the garbage through the vessel. Two of incinerators have very small doors which will make it difficult to use for burning solid waste. Ship personnel have been asked to become familiar with operating their equipment and to develop shipboard procedures for waste separation and waste handling. It is expected that the incinerators will be used about once a week.

Changes in Shipboard Garbage Handling

Shipboard sorting of plastic from all other types of garbage is used on the TMS fleet. For those ships which generate foreign garbage, plastics which must be processed through an APHIS approved

facility are separated from other plastics. The specific methods used to separate plastics from other garbage, the storage places used, and procedures to move garbage to the compactors or incinerators, for those ships with incinerators, are determined by the personnel of each vessel.

Crew Awareness of MARPOL Annex V Requirements

Packets of information on MARPOL Annex V and the company's approach to compliance were sent to each ship in 1988. These packets included the draft regulations from the Coast Guard, a summary of MARPOL Annex V requirements, descriptions of the compactors, and if appropriate, the incinerators which were to be purchased. Each vessel also received a copy of the TMS waste management plan and its update.

Posters which say "Stow It, Don't Throw It, It's the Law" and "Don't Teach Your Trash to Swim" were provided to the company through the Marine Entanglement Research Program for distribution to all TMS owned and managed vessels. These serve as a reminder of the ban on at sea disposal of plastics.

TMS Waste Management Plan

The TMS fleet operates under a waste management plan prepared and implemented at the beginning of 1989. (This was before Coast Guard regulations on Waste Management Plans were published.) The plan was distributed to all vessels. The plan includes a copy of the Coast Guard regulations, a summary of the MARPOL Annex V at sea garbage disposal limitations, and a statements of procedures. The statement of procedures uses an outline form. Some of the procedures reiterate the MARPOL Annex V regulations. Examples of the procedures include: 1) all plastics are to be retained on board and 2) ships must notify ports at least 24 hours in advance of the need for APHIS regulated garbage disposal. Other statements are company developed procedures. These include: 1) the requirement to flush chemical containers with water before incineration, 2) not to put plastics into the boilers, and 3) to specify non-plastic when ordering for the ship's stores.

The waste management plan also requires a refuse log book. This procedure is in anticipation of Coast Guard regulations requiring log books on garbage disposal on certain size vessels beginning in 1990. Under the TMS waste management plan, when garbage is offloaded in port, the weight and type of garbage must be noted in the log book and the log book must be signed by a ship's officer and by a representative of the agency receiving the garbage.

The waste management plan was originally distributed to all vessels at the beginning of 1989. An update to the plan was prepared and distributed when the interim Coast Guard regulations on MARPOL Annex V were published in late April.

Problems Encountered

- Logistics of getting equipment to ships. In one case, a compactor shipped to a vessel operating off of Mexico was returned to the U.S. initially. Only on the second try did it clear Mexican customs and reach the ship for installation.

- Lack of garbage reception facilities at some ports. Not all ports have facilities to offload garbage. The cost of offloading garbage in some ports is more costly than at others.

- APHIS regulated garbage. Ship's personnel with foreign garbage must understand that food contaminated plastics must be separated from other plastics. These personnel have to learn, understand, and comply with the MARPOL Annex V regulations at the same time as they learn the APHIS regulations.

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CRUISE LINES

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PREMIER CRUISE LINES

Overview

Premier Cruise Lines (PCL) has three vessels which sail out of Port Canaveral to destinations in the Bahamas. PCL offers 3 and 4 night cruises and package trips which combine a cruise with a visit to Walt Disney World. PCL is the official cruise line of Walt Disney World. Passenger capacity ranges from 950 on the Majestic to 1,600 on the Atlantic. The third ship, the Oceanic, has a capacity of 1,500 passengers. The Atlantic is registered in Liberia, a non-signatory nation to MARPOL Annex V. But, because of its sailing route in the Bahamas and the United States, waste management practices on the Atlantic comply with MARPOL Annex V at all times.

Characteristics of the PCL approach to MARPOL Annex V compliance include:

- On board separation of garbage into three categories -- wet trash, bottles and cans, and plastics.
- Incineration of garbage on the Majestic.
- On the Atlantic and the Oceanic, on board storage of plastic garbage, and disposal of plastic garbage in port in Nassau, Bahamas.
- At sea disposal of other garbage from the Atlantic and the Oceanic.

Preparations for MARPOL Annex V Implementation

Before MARPOL Annex V, PCL vessels disposed of all garbage at sea. In 1987, PCL began to study equipment and disposal options for MARPOL Annex V compliance. Two approaches to dealing with garbage disposal were developed based in part on the sailing routes of PCL's three vessels. On the Atlantic and the Oceanic, the waste management approach is to use shoreside disposal of plastics in Nassau, Bahamas and at sea disposal of other wastes. Shoreside disposal in Nassau avoids the special handling required for APHIS regulated garbage in the United States. Incineration is used on the Majestic. The Majestic sails to the Abacos, which is a group of islands in the northeastern part of the Bahamas. It sails primarily in waters less than 12 miles from land. The Majestic was re-fitted in early 1989 and an incinerator was installed at that time.

Garbage Handling and Disposal Under MARPOL Annex V

Overall Approach

Garbage handling and disposal procedures on PCL vessels include:

- On all vessels, separation of garbage into wet trash, bottles and cans, and plastics.
- Use of color coded garbage bags by the crew to assist in garbage separation.
- Treatment of wet trash by a macerater on the Atlantic and the Oceanic, before at sea disposal as permitted by MARPOL Annex V.
- Use of a bottle crusher to reduce bottles and cans to sizes smaller than 1 inch, and at sea disposal as permitted by MARPOL Annex V.

- Incineration of garbage on the Majestic.
- Shoreside disposal of plastic garbage from the Atlantic and the Oceanic in Nassau.

Equipment

PCL spent $1.6 million for new equipment to comply with MARPOL Annex V. For the Atlantic and the Oceanic, this equipment includes a macerater that operates as a giant garbage disposal, a bottle crusher, and an extractor to remove water and reduce the volume of all garbage. A state-of-the-art incinerator was installed on the Majestic when the vessel was re-fitted in early 1989. In the event of equipment failure on the Majestic, PCL will contract for steam sterilization service in Port Canaveral or use landfill services in the Abacos.

Separation of Trash

Separation of garbage is seen by the company as a key to the success of its waste management program. Among other things, proper separation of garbage decreases incidences of equipment failure. On all PCL vessels, garbage is sorted by wet garbage, bottles and cans, and plastic garbage.

Passengers are requested to use the on board trash receptacles. Color coded garbage bags are used by the crew for each of the three types of garbage. Wet garbage is treated by the macerater and the extractor to remove the liquid content and reduce the volume. Bottles and cans go into the bottle crusher where they are reduced to sizes smaller than 1 inch. They are then placed in a hopper for storage until they can be disposed of at sea according to MARPOL Annex V. Plastic garbage is stored on board and disposed of in port at Nassau at 20 cents per pound.

Supply Practices

PCL contracts with Stellar catering services for all food handling operations. To reduce to the amount of plastics on board, Stellar attempts to purchase items that do not include plastic. Stellar has found its efforts to be about 50 percent successful. There is little flexibility in determining the amount of plastic that comes with bulk orders. In most cases, the driving force behind bulk orders is the economic savings associated with large orders. The type of packaging can not be specified for such orders. Amenities such as shampoo and shoe polish are economical to buy in large quantities. These items only come packaged in individual plastic bottles. Stellar has been successful in replacing plastic coasters with paper ones.

Personnel

Stellar catering services is also responsible for on board storage and operation of garbage disposal equipment. PCL and Stellar are negotiating the legal, monetary, and supervisory responsibilities of the two companies about waste management practices. The PCL sanitation officer visits each ship on a rotating schedule of inspections which include all sanitary aspects of garbage disposal. The chief engineer maintains the garbage handling equipment.

Education

Shipboard waste management practices are taught through new crew orientation and through on the job training by department heads. Specific instruction on MARPOL Annex V is not included in these sessions. Copies of the Popeye marine debris education poster have been provided to PCL for display on each vessel.

ROYAL CARIBBEAN CRUISE LINES

Overview

Royal Caribbean Cruise Lines (RCCL) operates four vessels out of Miami, Florida to the Caribbean basin and one vessel that operates between New York and Bermuda. The size of the crews on these vessels ranges from 325 to 800. Passenger capacity ranges from 800 on the Sun Viking to 2,600 on the Sovereign of the Seas.

Characteristics of the RCCL approach to MARPOL Annex V compliance include:

- Separation of trash into burnable items and non-burnable items.
- Designation of one crew member on each vessel who is responsible for ensuring that garbage is sorted appropriately.
- Use of incinerators for burnable items, discharge at sea of non-burnable items, and port disposal of oversized plastic or burnable items which do not fit into the incinerator.

Preparations for MARPOL Annex V Implementation

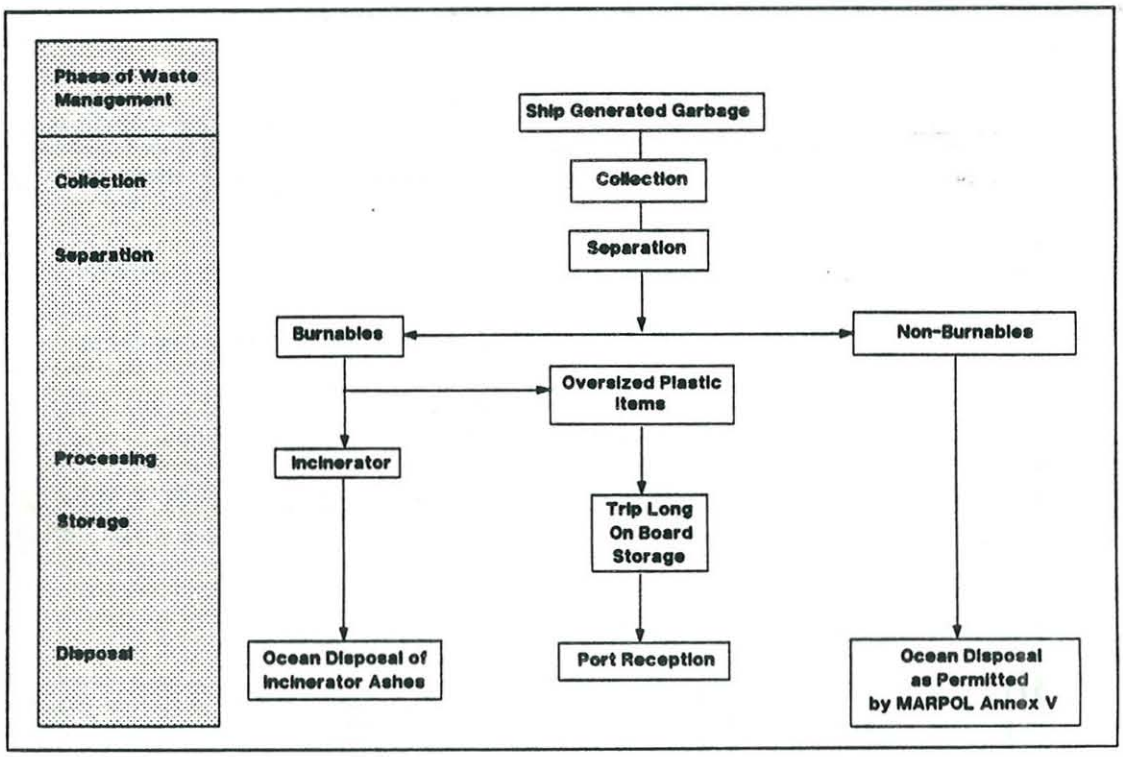
RCCL vessels, which are registered in Norway, have complied with MARPOL Annex V since the early 1980s. Before then, RCCL vessels disposed of all garbage at sea. Norway ratified MARPOL Annex V in 1980. Domestic legislation to regulate at sea garbage disposal was implemented in March 1981. In anticipation of Norway's ratification of MARPOL Annex V, RCCL, in the late 1970s, evaluated garbage disposal alternatives in the Caribbean basin. As a result of this evaluation, RCCL decided to use incinerators to comply with MARPOL Annex V. Two factors contributed to the company's decision to replace its at sea garbage disposal policy with an incineration program. Very few ports in the Caribbean basin are able to receive substantial amounts of garbage. The cost to offload garbage on a continuing basis would be prohibitively expensive.

Garbage Handling and Disposal Under MARPOL Annex V

Overall Approach

Garbage handling and disposal procedures for the RCCL vessels are as follows:

- All garbage is sorted into burnable (including plastics) and non-burnable items.
- Burnable items are burned in on board incinerators.
- Non-burnable items are disposed of at sea according to MARPOL Annex V provisions.
- Plastic items which are too large for the incinerator, such as 2-3 gallon pickle and mayonnaise jars, are stored on board and disposed of in port.



Equipment

Each RCCL vessel is equipped with an incinerator. Two vessels (Song of Norway and Nordic Prince) were retrofitted with incinerators. The Sun Viking, Song of America, and Sovereign of the Seas were built with an incineration system on board. For the Sovereign of the Seas, completed in 1988, $2.5 million was spent for an incineration system with two burners in addition to pulpers to grind food and extract the water before burning. This system includes a "waste-to-energy" component that allows conversion of the combustion energy into steam for all the vessel's hot water needs.

Separation of Garbage

All garbage is sorted into two categories -- burnable (including plastics) and non-burnable. In instances where non-burnable items are incorrectly put into the incinerator, they are removed by vessel personnel, crushed, and discarded overboard.

RCCL divides its vessels into three areas for garbage disposal purposes: galley, machine, and accommodations. The galley areas have sorting tables that allow the crew to direct garbage into a wet garbage chute or into a chute that deposits refuse into the incinerator room. Garbage from the machine area or engine room is generally steel. Steel waste is placed in a holding deck until it is taken ashore. Other machine area waste such as rags go into the incinerator. In the accommodations area, passengers are requested to put their trash into multi-purpose garbage cans placed around the vessel. Vessel personnel sort passenger trash into burnable and non-burnable items. On a few of its vessels, RCCL attempts to have the passengers deposit glass and plastic trash into containers marked for those items only. This system has not been very effective. Generally, crew members must sort the trash deposited in these containers as well as other passenger trash.

Personnel

There is one individual designated as the "incinerator man" on each RCCL vessel. This individual is responsible for ensuring that all garbage is sorted appropriately and that no plastic items are discarded overboard. Improper garbage disposal by any crew member is grounds for dismissal.

Education

RCCL personnel represent over 35 countries. All crew members are required to speak and understand English. Crew members are informed about company policy and shipboard garbage disposal methods through ongoing on the job training. The company does not, however, educate its crews specifically on MARPOL Annex V or domestic legislation. There are no plans for a formal crew or passenger education campaign on MARPOL Annex V. Copies of the Popeye marine debris education poster have been provided to RCCL for display on each vessel.

Problems Encountered

- Rapid turnover of crew creates the need for constant education on proper shipboard garbage disposal practices.

- Equipment breakdown is the most costly problem encountered. In February 1989, the incinerator on one of the vessels stopped working. The vessel held all plastic and mixed plastic trash on board. A waste handler in San Juan, Puerto Rico charged $24,000 to offload the ship's garbage.

- Some items need to be stored until they can be properly discarded. These include metal hangers which do not burn in the incinerator, and must be stored until they are taken ashore. On each cruise, passengers use and discard thousands of these hangars. Large pickle and mayonnaise jars which are too big to pass through the incinerator door must be stored for disposal in port. These must sometimes be handled as APHIS regulated garbage.

- APHIS regulated garbage requires coordination by the cruise line and a handling fee.

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PORTS

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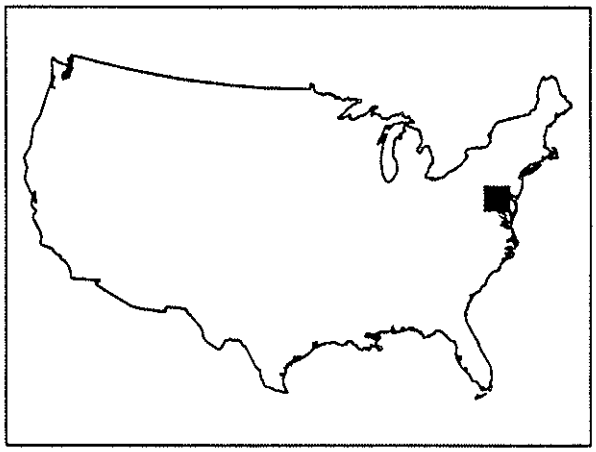
PORT OF BALTIMORE, MARYLAND

Garbage from vessels calling at the Port of Baltimore is handled by contractors. The process is essentially as follows:



- The Port provides information on certified waste haulers to terminal operators and shipping companies.
- The shipping company arranges with a contractor to have garbage picked up from their vessels.
- The contractor loads plastic bags of APHIS regulated garbage from vessels into a van and takes them to a USDA approved incinerator. Non-APHIS garbage is taken to a local landfill.
- The contractor provides a receipt to the shipping company verifying proper disposal of garbage.

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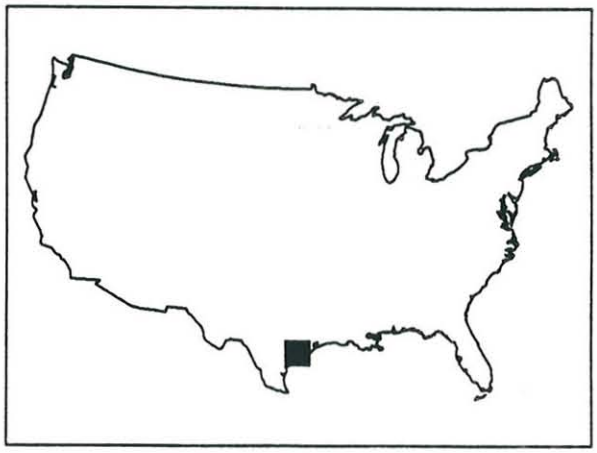
PORT OF CORPUS CHRISTI, TEXAS



The Port of Corpus Christi has 17 terminals that primarily accommodate oil tankers. The terminals are both privately and publicly owned. Of the ships using the Port, approximately 80 percent are oil tankers (this includes sea going barges), 15 percent are bulk (ore and grain) carriers, and 5 percent are general cargo carriers.

The Port of Corpus Christi operates its own APHIS waste processing facility. The Port built a sterilizer that processes APHIS garbage by injecting steam into a container to boil garbage. It was not feasible to build an incinerator because air quality standards could not be met. The Port worked closely with the Coast Guard and APHIS inspectors in developing the steam cleaning facility. The Port has a Certificate of Adequacy from the Coast Guard.

The process for disposing of APHIS garbage at the Port includes:

- A dumpster for APHIS regulated waste is provided by the Port's sterilizing facility;
- APHIS inspectors monitor the discharge of garbage from the vessel into the dumpster;
- The APHIS regulated garbage is hauled to the steam cleansing facility where steam is injected into the container to boil the garbage for the appropriate amount of time; and
- The garbage is taken to a local landfill by a private contractor after it is treated.

The process costs approximately $400 per container of garbage. Each container holds about 3 cubic yards. The steam facility can process 6 loads a week. In order to minimize the amount of APHIS regulated waste to be processed, the Port encourages shipping companies to have their vessels separate regulated from non-regulated garbage. In September and October 1989, the treatment facility processed seven containers of garbage. Non-APHIS garbage is offloaded to dumpsters. Private waste haulers take the load to local landfills.

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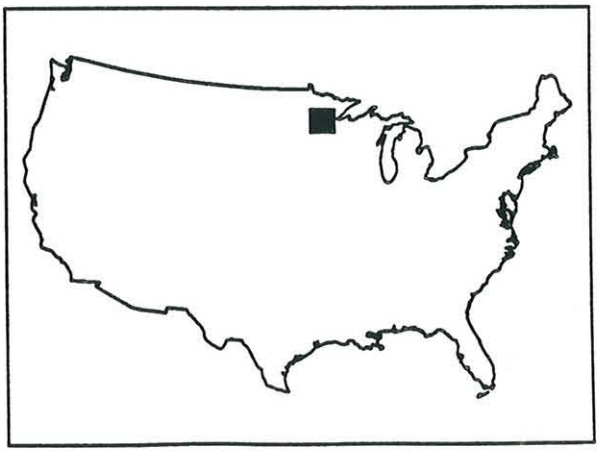
PORT OF DULUTH, MINNESOTA

The Port of Duluth on Lake Superior has a Certificate of Adequacy (COA) from the Coast Guard. Handling of vessel garbage at the Port generally follows the following process:



- The Port provides a list of certified waste haulers to the shipping companies.
- The shipping company arranges with one of the certified contractors to have garbage picked up at the vessel.
- The contractor offloads garbage into a truck which transports APHIS garbage to a USDA approved incinerator. Non-APHIS garbage is transported to a local landfill.
- The contractor provides a receipt to the shipping company verifying the proper disposal of garbage.

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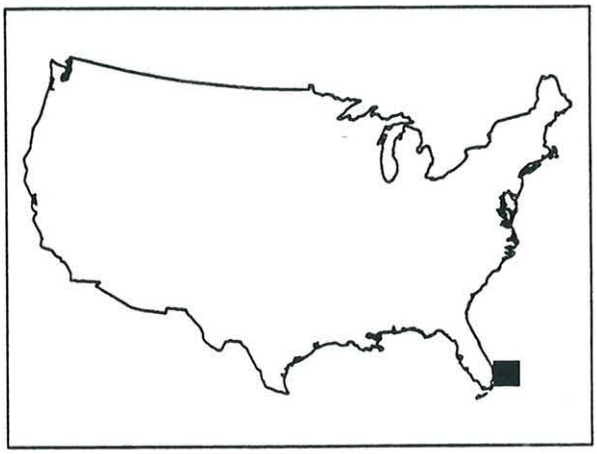
PORT OF MIAMI, FLORIDA



The Port of Miami is one of the busiest U.S. ports in terms of number of vessel calls. Merchant ships and cruise lines use the port. Prior to MARPOL Annex V, the Port of Miami collected and processed non-APHIS garbage, but did not process APHIS garbage. Just before MARPOL Annex V entered into force, the Port notified shipping companies using its facilities that they would be responsible for arranging for the disposal of their garbage (both APHIS and non-APHIS garbage).

Three waste hauling companies provide APHIS and non-APHIS dumpsters for the ships calling at the Port of Miami. Only one of the companies, however, is USDA approved to handle APHIS garbage. The two others can handle only non-APHIS garbage. Shipping companies arrange with one of these waste haulers for the pickup of garbage from their vessels. APHIS garbage is hauled to a nearby incinerator where it is incinerated.

The Port of Miami provides a "depot" where the waste hauling companies' empty dumpsters are stored. No garbage is stored on the premises, however. Periodically, the dock superintendent at the Port checks to see that ships have been provided with the appropriate dumpsters.

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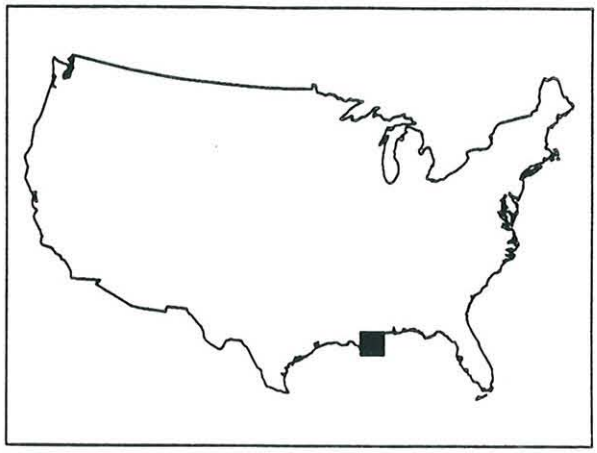
PORT OF NEW ORLEANS, LOUISIANA



The Port of New Orleans handles ocean shipping, river barge traffic, and a small amount of sea going barge traffic. It is a landlord port that leases terminals to independent operators. The Port has filed for a Certificate of Adequacy from the Coast Guard.

Prior to MARPOL Annex V taking effect, the Port assessed its role under the new regulations and concluded that it was not in the waste hauling business and did not want to be in the waste hauling business. The Port turned to private industry to provide the needed waste hauling services. Currently, the waste haulers serving the Port process APHIS and non-APHIS waste as an add-on to other local waste hauling activities. The Port provides a list of certified waste haulers to the terminal operators and shipping companies. Shipping companies arrange with a contractor to have garbage picked up from their vessels. The contractor offloads the garbage into a truck. APHIS regulated garbage is transported to a USDA approved incinerator. Non-APHIS garbage is taken to a landfill.

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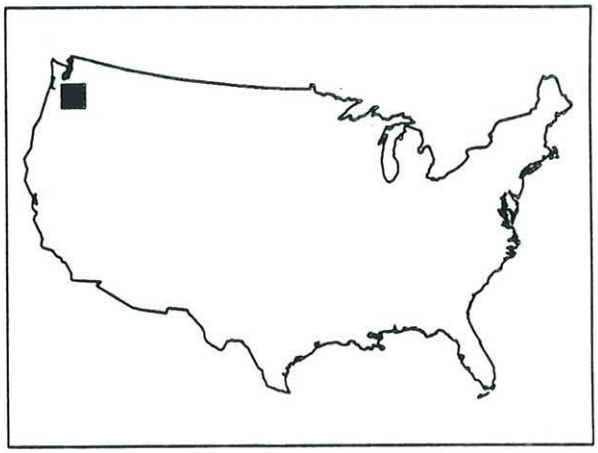
PORT OF PORTLAND, OREGON

The Port of Portland leases three of its four terminals to private companies, and maintains control of the fourth terminal. The Port has a sterilizer in its boat yard which was installed in 1979 to process garbage from foreign vessels using the Port's marine repair yard. After MARPOL Annex V entered into force, the Port had the sterilizer approved by the USDA to handle APHIS garbage. The sterilizer can handle four 55 gallon drums of waste at a time. After the garbage is sterilized, it is transported to a landfill for disposal. The sterilizer is available for use by the waste hauling companies serving the Port.



Shipping companies arrange for pickup of garbage from their vessels through private contractors. The Port provides shipping companies with a list of waste haulers certified by the USDA. The contractor transports the garbage to either the sterilizer at the Port's boat yard or to an incinerator approximately 45 minutes away. There is a $200 fee to use the sterilizer. As of early November 1989, only one load of garbage had been processed at the Port's sterilizer. All other APHIS garbage had been taken to the incinerator.

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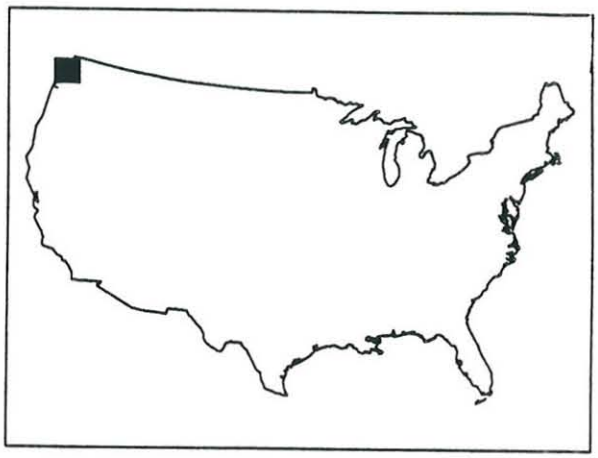
PORT OF SEATTLE, WASHINGTON



The Port of Seattle receives vessels carrying a variety of cargo including grain, break-bulk, steel, ore, oil, cattle, containers, and automobiles. Cruise ships also call at the Port. Before MARPOL Annex V entered into force, the Port contracted with an environmental/solid waste consulting firm to assess its options for providing coordinated garbage reception facilities at economical costs. Because of the level of international vessel calls at the Port (about 1,300 expected in 1988), the study focused on managing USDA regulated APHIS waste.

After reviewing the study results, the Port chose not to provide USDA approved facilities for APHIS waste. Instead, the Port sought out private waste treatment companies to provide the waste-hauling service for vessels. Only one company responded. This company has set up a special truck with a steaming apparatus to treat APHIS garbage onsite at the Port.

Arrangements with the contractor for APHIS garbage pickup are made by the shipping company. The contractor picks up the garbage in the dumpsters at each terminal and treats the garbage using its USDA approved steam treatment process. Steam cleaning is used primarily because the closest incinerator is about 80 miles away.

The Port of Seattle has a recycling program for commercial fishermen and recreational boaters. The recycling program was set up by providing easily accessible bins on the piers with each bin marked for a specific type of trash i.e., glass, plastics, and paper. There is also an ongoing education program to inform recreational boaters and commercial fishermen about the ramifications of their marine debris and ways to minimize this pollution. Posters and pamphlets are used to increase awareness of the problems caused by marine debris and remind fishermen and boaters to bring their garbage back to shore for disposal.

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OTHER

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CONTICARRIERS & TERMINALS, INC.

Conticarriers owns 10 river barges that carry primarily dry bulk goods (i.e., grain). These barges travel from New Orleans to St. Louis and from St Louis to St. Paul. Conticarriers barges also travel on the Illinois and Ohio rivers in the winter. The tow boat for each barge has a crew of about 10. Conticarriers does not own any sea going barges.

MARPOL Annex V has had no effect on the way garbage is handled on Conticarriers barges because earlier U.S. laws prohibited garbage disposal on the inland waterways. Garbage is stored on the barge until it is refueled or comes into port. The fueling flat which fuels the tow boat takes the garbage to shore for a fee (often $75) where it is disposed of in the local landfill.

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U.S. NAVY INITIATIVES FOR SHIPBOARD PLASTICS CONTROL AND MINIMIZATION

Background

Annex V of the International Convention for the Prevention of Pollution from Ships excludes military vessels. However, the Marine Plastic Pollution Research and Control Act of 1987, P.L. 100-220, the legislation which implements MARPOL Annex V in the United States, requires U.S military vessels to be in compliance with MARPOL Annex V within 5 years (December 31, 1993), except in times of war or a declared national emergency. The legislation requires the U.S. Navy to develop a plan, report to Congress in 3 years on their compliance progress, and to make every effort to comply with MARPOL Annex V within the 5 year horizon.

Following Congressional testimony on the implementing legislation, but prior to its enactment, an Ad Hoc Advisory Committee on Plastics was formed by the Assistant Secretary of the Navy . The purpose of this committee was to make recommendations to assist the Navy develop a strategy for solid and plastic waste management. The committee was chaired by the Deputy Director of Environment for the Navy. The 14 member committee was made up of representatives from 10 environmental groups and 4 Congressional staff members.[1] Representatives from different parts of the Navy acted as resource personnel for the committee and attended all committee meetings.[2] The Keystone Center, a non-profit organization that mediates environmental disputes, acted as the facilitator for the committee. This committee met for the first time in September 1987.

In June 1988, the committee submitted a report entitled "Reducing Navy Marine Plastic Pollution at Sea" to the Assistant Secretary of the Navy for Shipbuilding and Logistics. The report included 42 recommendations organized around four headings: supply, technology, operations, and education. The recommendations considered the Navy's mission, life at sea, and the organizational changes required. The committee worked closely with Navy staff to develop the recommendations.

Navy Efforts to Reduce Marine Plastic Pollution

The following are brief descriptions of some of the activities the Navy has undertaken to reduce plastics on board their ships and to reduce marine plastic pollution. Many of these activities implement the recommendations of the Ad Hoc Advisory Committee on Plastics.

Shipboard Plastics Waste Reduction Demonstration Project

In 1988, the Navy conducted a Plastics Waste Reduction Demonstration Project on nine ships. This project collected data on the nature and quantity of plastic wastes on Navy ships, assessed the feasibility of alternative shipboard waste management practices, and assessed the sailors' attitudes

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1 Members of the committee represented the following: American Cetacean Society, Animal Protection Institute of America, Audubon Society, Oceanic Society, Defenders of Wildlife, Center for Marine Conservation, Greenpeace, U.S.A., National Fish and Wildlife Foundation, Monitor Consortium, Texas Environmental Coalition, Senate Commerce, Science, and Transportation Committee, House Merchant Marine and Fisheries Committee, Senator's Chafee's Office, and Representative Schneider's Office.

2 These included: the David Taylor Research Center, Chief of Naval Operations, Commander in Chief, Atlantic Fleet, Naval Supply Systems Command, International Law Division, and the Office of the Assistant Secretary of the Navy for Shipbuilding and Logistics.

toward marine plastic pollution control. Procedures to eliminate at sea disposal of plastics and procedures to implement them according to the operational requirements and mission of the ship were developed for each demonstration ship. The Navy relied heavily on the imagination and creativity of the crew to develop these procedures. Prototypes of a trash compactor and a waste pulper for shipboard plastic waste were evaluated on two ships.

Navy researchers travelling on the demonstration ships collected waste generation rates and waste characterization data. Navy ships were found to generate the following quantities of solid waste while underway:

	lb/man/day	Percent
• Paper	1.11	35
• Food	1.28	41
• Plastic	0.21	7
• Other	0.55	17
Total	3.15	100

Changes in Supply

The Navy has initiated a 5-year program to reduce plastics on board ships. For example, the Navy:

- Requires canned drinks be delivered in packaging that does not use six pack rings. As of May 1989, about 60 percent of canned drinks were being delivered without the six pack rings;
- Eliminated plastic ship stores (exchange) shopping bags;
- Will substitute non-plastic items for common plastic items such as hot drink cups, garbage bags, and wooden coffee stirrers;
- Uses paper garment bags in ships' laundry;
- Requested manufacturers of items such as ship ball caps to eliminate plastic packaging;
- Discourages use of plastic gloves in food service; and
- Encourages substitution of alternative sizes and/or containers for individually wrapped food items such as crackers and condiments. (A substantial number of individually wrapped food items and condiments were used in 1988. Of 22 food or condiment items counted in a Navy study, the number of individual items ranged from a high of 44.8 million dairy creamer containers in 1988 to a low of 0.1 million containers of honey.)

Changes in Technology

The Navy has developed new technology for use in its waste management program. Examples include:

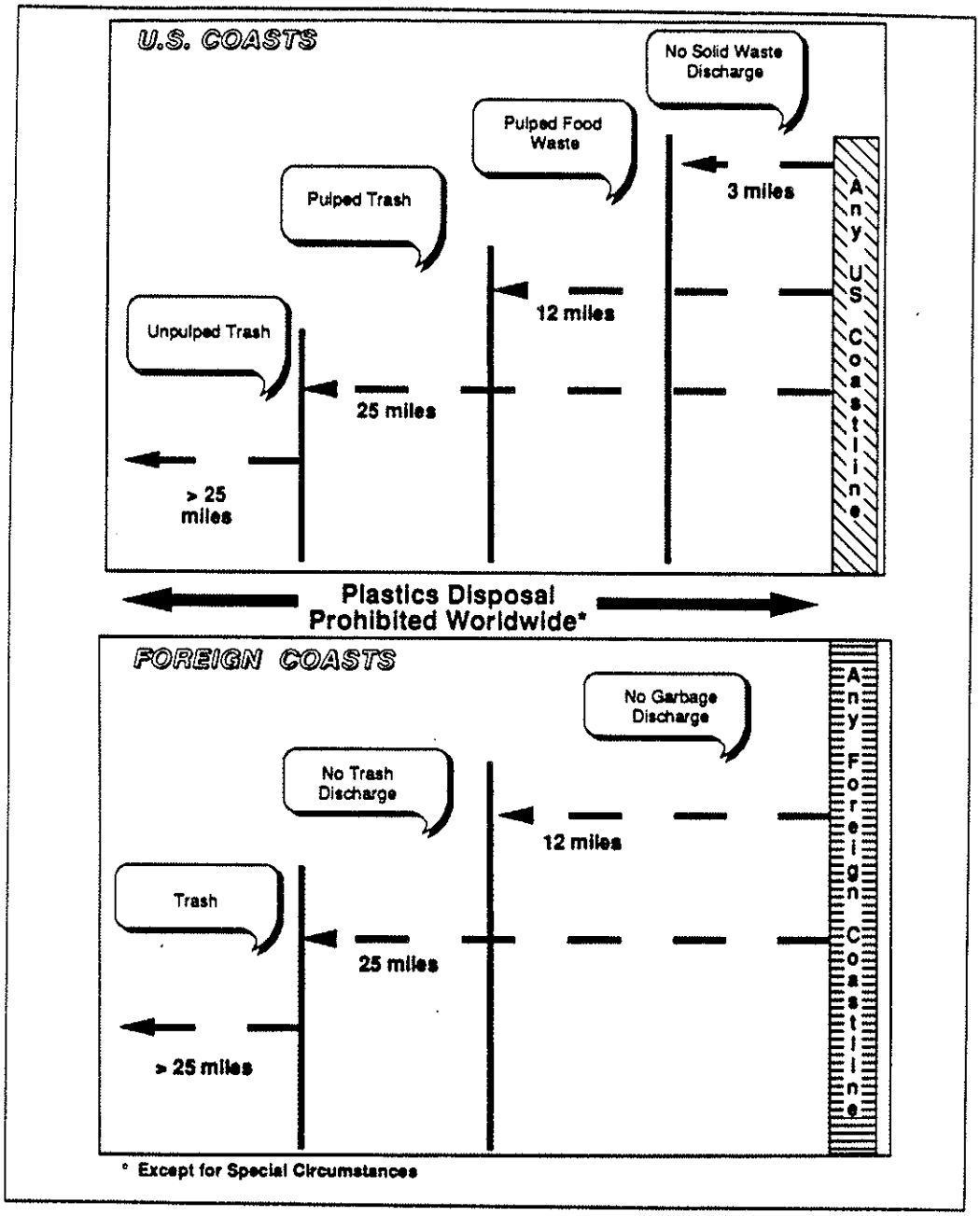
- A waste pulper developed by the David Taylor Research Center (DTRC) for processing routine shipboard solid waste such as paper and soft galley wastes. No plastics will be processed with this equipment. Plans call for the waste pulper to be installed on carriers, tenders, amphibious ships, and auxiliaries.

- A vertical trash compactor, also developed by DTRC, which produces 30 to 50 pound sinkable slugs from compactable solid wastes such as metal, glass, loose paper, and cardboard. Again, this equipment will not be used for plastic waste. The compactor, which will be ready for installation in FY 91, will be installed on all surface ships.

- An approach to processing shipboard plastic waste to reduce its volume and to convert plastic wastes to safe forms for storage. This equipment, called a plastic processor, is under development. The plastic processor will heat and melt plastics into bricks for storage on board. The plans are to install plastic processors on all surface ships. The units are not expected to be ready for installation until FY 94.

Changes in Operation

The Navy has changed its approach to solid waste management on ships. Plastic waste is now separated from non-plastic waste and stored on board as storage space permits. The at sea garbage disposal requirements are summarized below:



Office of the Chief of Naval Operations. 1988. Ship's Guide to Recent Navy Initiatives for Shipboard Solid and Plastics Waste Management. November.

All surface ships are instructed to:

- Retain all plastic waste on board for disposal ashore when at sea for 3 continuous days or less;
- When at sea for 4 or more continuous days,
    1. Retain all food contaminated plastic on board for the last 3 days before returning to port;
    2. Retain all non-food contaminated plastic waste on board for a minimum of 20 days (and longer if storage space permits);
- If at sea for longer than 20 days and plastic waste must be disposed of at sea because of a lack of storage space, dump only plastic waste generated after the 20th day; and
- Dump plastic waste, if packaged for negative buoyancy, beyond 50 miles from any shoreline, if retention of the plastic waste would:
    1. Endanger the health or safety of the crew;
    2. Create unacceptable nuisance conditions; or
    3. Compromise combat readiness.

At sea disposal of plastic waste must be approved by the Commanding Officer, and appropriate Deck Log entries must be made which indicate the amount, time, and position of overboard discharges. At the conclusion of the underway period, a report by routine message must be filed with the Fleet Commander which includes: the date underway, date at sea disposal began, date the ship entered port, the number of people on board during the underway period, and the reason for dumping plastic waste.

Crew Education

The Office of the Chief of Naval Operations prepared a document called "Ship's Guide to Recent Navy Initiatives for Shipboard Solid and Plastics Waste Management." The guide provides background information on the nature of the marine debris problem, relevant legislation, actions being taken by the Navy to control and minimize plastic waste, actions needed by each ship, and actions needed by each crew member. The guide also includes examples of successful approaches to plastic waste management programs used on Navy ships. One section of the guide is devoted to medical wastes and outlines new Navy directives for shipboard handling of these wastes.

Accompanying the guide are several educational materials. These include:

- A videotape called "Plastics in the Ocean: More than a Litter Problem" prepared by the Navy which explains the problems of marine debris and entanglement, the Navy's program for shipboard solid and plastic waste management, and the actions needed by each ship and crew member for its success. The tape includes a series of video commercials about the waste management program to be shown between feature length films.
- Posters which describe the consequences of plastics in the marine environment.
- Reading material on the problems of marine debris and entanglement.
- Plan of the Day Announcements which highlight the Navy's program and the problems caused by plastics in the ocean.

COAST GUARD MARPOL ANNEX V VESSEL SURVEY

Background

The U.S. Coast Guard Marine Safety Office in Honolulu, Hawaii surveys vessel operators during routine boardings on their knowledge of MARPOL Annex V and their present method of compliance.[1] The surveying began in January 1989. Between January and the end of April 1989, surveys were completed on 102 commercial vessels of all sizes. Of these vessels, 45 (44 percent) are merchant ships. The survey responses from the personnel of these 45 vessels are the focus of this discussion. These vessels include: 26 freighters, 9 tankers, 6 bulk carriers, 1 car carrier, 1 cable layer, 1 cable repair, and 1 mobile oil drilling unit. These vessels fly the flag of 14 countries. As shown below, eight of these countries are signatory to MARPOL Annex V and six of the countries are not signatory to MARPOL Annex V.

Nation of Registry of Surveyed Vessels

Nation of Registry	Vessels Surveyed		MARPOL Annex V Signatory Nation[2]	
	Number	Percent	Yes	No
Bahamas	1	2	X	
Burma	1	2		X
Chile	1	2		X
China	2	4	X	
Fiji	2	4		X
Greece	1	2	X	
India	1	2		X
Japan	6	13	X	
Liberia	6	13		X
Norway	1	2	X	
Panama	13	29	X	
Philippines	3	7		X
United States	6	13	X	
Yugoslavia	1	2	X	
	45	100[3]	8	6

[2] As of February 8, 1989.
[3] Percent does not total 100.0 due to rounding.

Awareness of MARPOL Annex V

All but six (86 percent) of the vessel masters surveyed said they were aware of MARPOL Annex V. The vessels of the masters who were not aware of MARPOL Annex V were registered in the Bahamas, Liberia, and Panama. The Bahamas and Liberia are not signatory to MARPOL Annex V[4]. Panama has signed the treaty.

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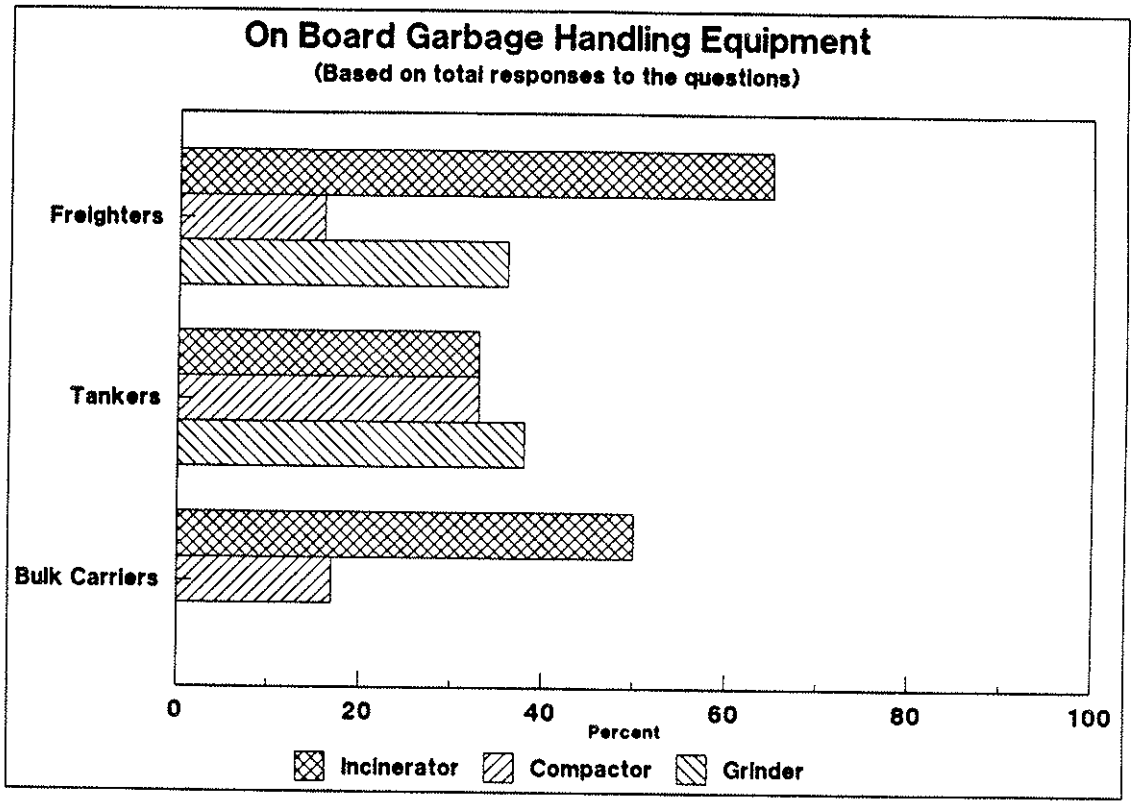
1 The survey was developed and is administered under the direction of LCDR Kenneth Keane, Chief of Port Operations.

4 As of February 8, 1989.

On Board Garbage Handling Equipment

Garbage on almost 75 percent of the vessels surveyed is separated by type. Over half of the vessels had separated plastic garbage on board at the time of the survey. There were incinerators on 53 percent of the vessels surveyed. About 21 percent of the vessels surveyed had compactors and about 31 percent had grinders. The type of on board garbage handling equipment on the freighters, tankers, and bulk carriers surveyed is shown below. Three of the remaining four types of vessels had a piece of garbage handling equipment on board, but the type of equipment varied by type of vessel. The car carrier surveyed had an incinerator. The cable repair vessel surveyed had a compactor. The cable layer surveyed had a grinder. The mobile oil drilling unit had no garbage handling equipment.



Garbage Handling Upon Arrival

Personnel on only two of the vessels surveyed indicated that there had been difficulty in arranging for garbage disposal upon arrival in Hawaii. Arrangements for foreign garbage disposal had been made through the Department of Agriculture for about 14 percent of the vessels surveyed.