

# Waste Management in Cruise Ships & Effects on Marine Environment

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## Abstract

Over the past few decades the cruise industry has seen varied growth in terms of business and tourism, destinations and number of passengers. On the other hand it has also impacted the Marine Eco system adversely. There are close to 300 ships sailing on the sea and most shipping companies have taken a certain amount in keeping with Environmental Impact and marine pollution control measures. In this presentation we will be discussing those Pollution Control Practices and Regulations used by MARPOL (The International Convention for the Prevention of Pollution from Ships). With the implementation of certain regulations the Cruise industry has been able to adopt sustainable practices and few issues remain critical. In addition we will be discussing how this Pollution Act came into being and what impact it had on the Marine Environment and Cruise Industry. Some of the most popular tourist destinations in the world and most sensitive to environmental damage have always been under the constant radar of environmental disturbances by the authorities and geologists and scientists. This growing problems have led to the introduction of new laws and are trying to curb their impact. However the laws are sadly lacking when it comes to overseas waters. Furthermore we will also be discussing about the various causes of Marine Pollution and Waste Management System on board a cruise vessel.

**Keywords:** Pollution; Environment; Cruise Industry; Waste Management; Cruise Vessels; MARPOL.

## Introduction

Cruise industry has seen a considerable amount of growth within the past two decades. It's become one in all the fastest growing sectors in travel and tourism industry. They carry uncountable tourists annually across the globe to numerous destinations and few of them being sensitive to environmental disturbance. (<https://www.everycrsreport.com/reports/RL32450.html>)

In the early 90's sailing on the ocean liner was a privilege which only the elite and also the wealthy could render. This dynamic sector is expanding ever since and offering its services and products within the global markets. With the ships sailing with a capacity of more than 1000-

5000 passengers they aim to make available the best of facilities to their guest including swimming pool, laundry, sauna and steam, dry cleaning theatre, restaurants, etc. But all of this activities generate an oversized amount of waste and garbage which are dumped into the ocean. Few of these destinations have a very delicate ecosystem and therefore leaves a negative impact on the environment and the surroundings. The degree of wastes that they produce is comparably large, consisting of sewage; wastewater from sinks, showers, and galleys (greywater); hazardous wastes; solid waste; oily bilge water; ballast water; and air pollution. In comparison to the land based industry, ships are minor contributor to the marine pollution. Ships are accountable for around 12% of the discharge of waste & residues baffled. It is calculated that a cruise ship of 2000 passenger capacity can generate approximately 1000 tonnes of waste per day. This suggests that approximately 350-400 litres of waste is generated by each individual. (Vincenzo Asero et al., 2017)

The International Convention for the Prevention of Pollution from the ships is the main international convention covering prevention of pollution of the marine environment by ships by operational or accidental cause. The MARPOL was adopted on 2<sup>nd</sup> November 1973 and International Maritime Organization (IMO). The MARPOL convention was incorporated to deal with the issues regarding pollution stumped and in coastal waters and find solutions to cut back the incidents of pollution. The MARPOL convention has 6 annexes covering all different types of pollution and are updated regularly. ([https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx))

The purpose of this paper is to present the problems caused by the marine pollution, waste management policies on board the cruise lines and impact does it has on the environment. We will also discuss the various laws that IMO & MARPOL have enacted regarding the removal of sewage from various parts of the world

## **MARPOL (International Convention for the Prevention of Pollution from Ships)**

IMO (International Maritime Organization) a body of the United Nations sets the international maritime vessel marine pollution standards. In 1973 IMO implemented MARPOL, the main convention covering the prevention of pollution of the marine environment by ships from operational and accidental causes. It initially implemented in response to the oil pollution caused by the accidents of the oil tankers in 1976-1977. It was later modified in 1978 and became known as MARPOL 73/78. 152 major maritime countries represents in the MARPOL convention and cruise ships flagged under these countries have to adhere to the convention principles and comply with its requirements. There are six Annexes which focus on prevention and minimizing of pollution from the vessels that occur by accidental damages or daily operations. Some of the areas mentioned have also been mentioned in these waste disposal annexures.

### **ANNEX I (Regulations for the Prevention of Pollution by Oil.)**

The Annex-I came into force on 2nd October 1983. The goal of MARPOL Annex 1 is to protect the marine environment by completely eliminating oil and other harmful contaminants and reducing the risk of accidental emissions of any such substance. (<https://www.marineinsight.com/maritime-law/marpol-annex-1-explained-how-to-prevent-pollution-from-oil-at-sea/>)

### **ANNEX II (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk)**

This Appendix was adopted on 6 April 1987 which deals with the control and prevention of land pollution due to hazardous liquids in bulk, intentionally or accidentally.

### **ANNEX III (Regulation for prevention of pollution by harmful substance carried at sea in packaged form)**

This appendix deals with those substances that are naturally harmful and that are carried in composite material. Identification of that information is provided by the IMDG code. MARPOL Annex III came into operation on 1 July 1992.

### **ANNEX IV (Regulation for the prevention of pollution by sewage from ships)**

Effective 27 September 2003, this Appendix focuses on the protection of sewage from vessels.

### **ANNEX V (Regulation for the prevention of pollution by Garbage from ships)**

Effective 27 September 2003, this Appendix focuses on the protection of sewage from vessels.

### **ANNEX VI (Regulation for prevention of Air pollution from ships)**

This MARPOL Annex deals explicitly with ways to prevent air pollutions from ships. It came into force on 19th May 2005.

## **Waste Generated on Cruise Ships**

In today's scenario it is very important ensure strict waste management practices onboard a cruise vessel. Various strategies have been implemented by the Cruise companies for the identification of sources and successful management of pollution. The waste generated from a cruise ships can be sorted into different categories. Generally, oily bilge water, oily sludge, oily tank washings, sewage, plastics, food waste, domestic waste, cooking oil, incinerator ashes, operational waste, cargo residues, ozone-depleting substances, and others are distinguished. The MARPOL Convention Annex IV & V discuss about these regulations for the prevention of pollution by sewage from vessels and garbage from the ships.

A mean cruise deliver with 3000 passenger capability produces thousands of gallons of sewage. This waste water contains microorganism's which can be harmful for the marine lifestyles and eco machine. The MARPOL Conference and home law prohibit the release of all garbage into

the ocean from constant or floating platforms and from all different ships when along facet or within 500 meters of such structures.

The special regions set up under annex V are:

The Mediterranean Sea place

The Baltic Sea area

The Black Sea vicinity

The Crimson Sea vicinity

The Gulfs place

The North Sea location

The wider Caribbean region and

The Antarctic location.

These are sea areas where for identified technical reasons relating to their oceanographic and ecological condition and the particular man or woman of site visitors, inclusive of heavy maritime site visitors, low water alternate, severe ice states, endangered marine species, and so forth the adoption of special mandatory techniques for the prevention of marine pollution by garbage is required.

## **Oil Discharge**

Discharge of oil or oily water into US navigable waters, adjacent seashores or waters which may also have an effect on herbal assets inside 2 hundred miles of shore is prohibited, except the oily water is exceeded thru an oil-water separator designed to lessen the oil awareness to fifteen components in keeping with million (ppm) inside 12 miles of shore or inside one hundred ppm past 12 miles from shore. Ships are required to hold Oil Record Books to file their disposal of oily residues and bilge water. ([http://www.beachapedia.org/Cruise\\_Ship\\_Pollution](http://www.beachapedia.org/Cruise_Ship_Pollution))

## **Ballast Water**

The ballast water management convention was adopted in 2004 with the aim to prevent the spread of harmful aquatic organisms from one region to another by establishing standards and procedures for the management and control of ships ballast water and sediments. All ships sailing in international waters are required to manage their ballast water and sediments up to a certain standards and will have to maintain a ballast water record book and an International Ballast Management Certificate.

## Greywater

Greywater is generally the waste water that is generated from the taps, bathrooms, showers, or through laundry which is without fecal contamination. The water can be easily recycled and used again for washing and cleaning purposes. This is known as processed water. According to Cruise Lines International Association 2013a this processed water is been further more filtered and can be used as a drinking water and this practice is been followed by many Cruise ships. (Sarah Kamitz 2014)

## Blackwater

Black water is highly polluted with bacteria. Having said that, it is obvious that black water sewages cannot be recycled as easily as grey water sewage. Black water can be divided in yellow and brown water. For the recycling of this kind of sewage this additional separation is important. The physical separation is only possible with special toilets. It separates urine and feces right away before rinsing (Lange, J. & Otterpohl, R. 2000a)

The black water recycling cycles need a lot more work than the greywater procedures. Different kinds of filters as well as special kind of bacteria are required to treat this sewage thoroughly. The main resource used to treat black water might also be time. As one can imagine it takes a while until this highly polluted sewages are cleaned and usable again. Space is also a resource required to treat black water carefully. Having mentioned all this it is reasonable that all cruise ships only collect this kind of sewage and leave it for treatment in the harbors around the world (Lange, J. & Otterpohl, R. 2000b)

## Domestic Waste & Food Debris

A cruise ship produces different kinds of waste. Domestic waste means basically the same kind of disposals everybody produces at home. A cruise ship produces a lot more of this waste as a lot of people are living on it. This kind of waste is mainly things like paper, cardboard, plastics, packaging and cans (Bavarian ministry of environment 2013).

As there are hundreds of persons on a cruise ship, one can imagine the tons of food which are on the ship as well. Although the cruise ship companies and the kitchen brigade try to calculate the food consumption as detailed as possible, it is quite hard to succeed. (Berlin City cleaning 2013)

There are also laws that produce a lot of food debris as well. If a cruise ship is traveling within American coast waters the crew has to keep an eye on the milk. If they opened a package of milk they have to label it with the exact time. Once four hours passed after the opening the whole package of milk has to be thrown away. It does not even matter if it is stored chilled or not, or if it is fresh milk or long life milk, it has to go to the trash. This regulation also includes other dairy products, like cream for example (Busi-ness ethics 2011)

## **Hazardous Fluid Waste**

This category of fluids is heavily polluted or really hard to dispose. It is not categorized through the grade of pollution but the kind of contamination. Basically it describes water that is polluted with several other fluids, mainly speaking of heavy oil, diesel fuel and other oily fluids (United States Environmental Protection Agency.2012a). The treatment of this sewage needs a lot of time as well as bacteria and chemical solutions. The ships are supposed to collect all of these fluids and deliver them for disposal to the next harbor. In the past, meaning twenty to thirty years ago, the ships were still allowed to dispose even these heavily polluted fluids to the ocean while not being close to the coast lines (United States Environmental Protection Agency.2012b)

## **Chemical waste water**

This chemical waste water category includes water that is polluted through chemical substances for example from photo shops or copy shops on board. The chemical waste water is probably the smallest category of waste that is produced on and within a cruise ship. As the disposal and treatment of this kind of sewage is quite laborious it is still worth mentioning it, although the amount produced through a cruise compared with the other waste categories is vanishingly low (Cruise Lines International Association 2012).

## **Other Fluids**

This category of waste water includes all the fluids that cannot be counted to other categories. Mostly this means fluids which are polluted with chemicals and oil, as well as feces (Cruise Lines International Association 2012).

Dishwater is a good example for this kind of fluids. Processing this kind of water is quite hard as it has to be treated with several different filters, bacteria and chemicals. The process is time-consuming and needs a lot of resources as well (Cruise Lines International Association 2012). The disposal of other fluids on the other hand is quite expensive as it cannot be counted on any other fluids and needs the previously mentioned special treatment (Cruise Lines International Association 2012).

**Table 1. Summary of Cruise Ship Waste Streams**

Type of waste	Estimated amount generated (typical one-week voyage)	Content/type	
Sewage (black-water)	210,000 gallons	Waste water and solids from toilets.	
Gray-water	1 million gallons*	Wastewater from sinks, showers, galleys, laundries. Contains detergents, cleaners, oil and grease, metals, pesticides, medical and dental wastes.	
Hazardous wastes	110 gallons	Photo chemicals.	
	5 gallons	Dry-cleaning waste (chlorinated solvents).	
	10 gallons	Used paint.	
	5 gallons	Expired chemicals, including pharmaceuticals.	
	Unknown		Other wastes, such as print shop wastes.
			Used fluorescent and light bulbs.
		Used batteries.	
Solid waste	8 tons	Plastic*, paper, wood, cardboard, food, cans, glass.	
		Under international regulations, the discharge of plastics is prohibited.	
Oily bilge water	25,000 gallons	Liquid collected in the lowest point in the boat when the boat is in its static floating position.	

Source: MARAD (2002).

## Impact of Waste Disposal on Marine Environment

Cruise ship spillage can contain toxic substances, hydrocarbons, organic residue and pathogen agents, and the potential impact on sensitive areas of which is considerable. A study carried out in Alaska corroborated that 68 of the 70 samples taken from the effluent of cruise ships using standard treatment systems exceeded the levels of coliforms in fecal water and/or suspended solids (ACSI, 2001). Prior to this, another study carried out in the same American state confirmed that concentrations of pathogens in this spillage may exceed federal limits by between 10,000 and 100,000 times. (ACSI, 2000). High levels of coliforms were also detected in greywater, as well as heavy metals and dissolved plastics (ACSI, 2000), something that is particularly worrying given that this kind of waste is not regulated.

The generation of garbage is another pressing problem, as cruise ships produce 24% of the total solid waste generated by world maritime traffic (NRC, 1995). Unfortunately, many ports lack the proper installations to receive and process this and other waste generated by vessels.

A report by the US government revealed that of the 87 indictments for illegal dumping by cruise ships in its waters between 1993 and 1998, 93% included the dumping of hydrocarbons (GAO, 2000). The report also revealed that 69 cruise ships from 42 different companies were chronically

involved in illegal dumping, submitting false information or not keeping the required records of dumping and processing. And these illegal dumping practices have continued.

Many of the richest and most varied ecosystems in the oceans, such as coral reefs, have seen the threat to their existence increased by the presence of cruise ships in the places where they can be found.

In addition to climate change, dumping from land, deforestation and abusive and destructive fishing, coral reefs also have to contend with the damage caused by the anchors of recreational vessels and now the enormous anchors of cruise ship. (Smith S.H, 1998)

In the Caribbean, the island of Grand Cayman has witnessed the destruction of 1.2 million square metres of coral reef by cruise ship anchors (Pattullo, L., 1996); in the Cancun National Park (Mexico), 80% of the coral sea beds have been damaged by these vessels (Schultz, S. 1998); and in areas such as Jamaica and Florida, the coral reefs, which now only have between 5% and 10% of their coral left alive (Action Atlas, 2000), are also being faced with this threat.

Another study carried out in the Caribbean, this time in the Virgin Islands, came to the conclusion that with a single casting of a cruise ship anchor over a Coral Sea bed, some 190 square metres of coral could be destroyed (Rogers, C. S. et al 1988).

## **Controlling Measures**

The adoption of technologies to considerably reduce the impact of cruise ships on the environment is not only possible but can be achieved at a relatively low cost. Installing systems to treat sewage in these vessels would represent some 2-2.2 million dollars per ship.

To reduce the volume of waste, there are compacting, shredding, dehydrating and pulverizing systems already available which make it easier to store and manage waste until it can be optimally treated.

With regard to air pollution, some new ships are already being manufactured with gas turbines which can reduce emissions into the atmosphere by 90%. Proposals have also been made to use less contaminating fuel and to link up to an electrical system when in port to reduce dependency on fuel-burning.

IMO conventions such as MARPOL Annex 5- Garbage from Ships and other related guidelines have to some extent been able to streamline the waste and garbage management onboard marine vessels by implementing methods such as Garbage Management Plan for Ships . This also makes it vital for the vessels' waste management teams to work together in order to understand and comply with waste reduction, recycling and management. (Bikram Singh, 2019)



## Conclusion

Ecological consciousness is on the rise in last decade, since the lack of environmental regulations in past century took its toll on the environment. Luckily, with rising popularity of cruise ships, environmental regulations are rewritten and became stricter. Today MARPOL regulations ensure no cruise ship present a potential danger for the environment due to inappropriate waste disposal. As the latest cruise ships are built bigger, waste management equipment manufacturers are keeping up by designing more advance systems. Most of those systems are completely autonomous and have no need for additional crew on board for maintenance. Anyhow, biggest threat to marine pollution comes from smaller vessels not falling under MARPOL convention (smaller of 400 tons brut, carrying less than 15 people). Especially in closed seas as the Mediterranean, with plenty of touristic destinations on its shore. Those vessels regularly discharge untreated waste waters same as solid waste since there is no storage areas on board. During the touristic seasons, number of those vessels is drastically high and causes a rising pollution problem. Therefore, a special set of regulations should be made, dealing with this problem. Possibly in form of waste disposal logbooks and installation of waste water tanks as an obligatory feature.

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