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Real impact of oil tankers as opposed to other sources of oil in the marine environment

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REAL IMPACT OF OIL TANKERS AS OPPOSED TO OTHER SOURCES OF OIL IN THE MARINE ENVIRONMENT

By

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Dedication

To my beloved Children
Pierre-Yves & Noémie Priscille
And their father
Hiné Daniel DOUE

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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World Maritime University has played an immeasurable rule as my training is concerned and I will always be grateful that. Of course when I say WMU, that includes the teaching staff, the administrative personnel as well as the librarian personnel.

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ABSTRACT

Technological developments have increased the need of oil and consequently the development of oil transportation in very sophisticated tankers. The important volume of oil transported every day through the seas doubled risks of accidents and pollution. Some famous spills are; Torrey Canyon (1967), Amoco Cadiz (1978), Exxon Valdez (1989), Haven (1991), Braer (1993), Sea Empress (1996) and the most recent one, Erika (December 1999).

Because of that record, oil tankers very quickly became the first targets for environmentalists and the general public. Indeed, there is no doubt that oil tankers play an important role in the pollution of marine environment, both through their normal operations and their accidents. Aware of that, the International Maritime Organization together with the flag states adopted some international rules in order to regulate among other things to prevent pollution from those vessels or at least minimize the impacts of their spills. The main instrument in that matter is MARPOL 73/78, that has proved to very efficient after twenty-five of active implementation.

Studies have shown that in 1990, oil tankers account for 12% of all oil pollution as opposed to 30% before 1970.

Despite that important decrease of pollution from oil tankers, marine pollution still suffers from oil pollution because the main source of that type of pollution has not been tackled with the same dynamism as people did with oil tankers. Today, it is clear that even if oil tankers continue to pollute the seas, there is no doubt that oil pollution from land is the most important.

Unfortunately, land- based pollution has that specific characteristic, which makes its global management almost impossible. Indeed, land-based pollution occurs within the territory of each country, which involves the notion of preservation of sovereignty.

It is clear that oil pollution is not the fact of only one sector and it is a global or an integrated management of all involved sectors that can lead to the best results.

KEY WORDS: Oil tankers, marine pollution, control & prevention, land-based pollution

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List of abbreviations

COW……………………………………………………Crude Oil Washing

DSC……………………………………………Digital Selective Calling

EEZ…………………………………………..Exclusive Economic Zone

GESAMP…..International Group of Experts on Scientific Aspects of Marine Pollution

IMO………………………………...International Maritime Organization

INMARSAT……………… International Maritime Satelite organization

IOPP…………………..International Oil Pollution Prevention Certificate

ISM code…………………International Management code for the safe operations of ships and for pollution prevention

LOT…………………………………………...Load On Top system

MARPOL73/78…………International Convention for the Prevention of Pollution from ships 1973 as modified by the protocol of 1978

OPRC……….International Convention on oil pollution preparedness, response and co-operation

PCB……………………………………………Polychlorinated Biphenyl

SBT…………………………………………..Segregated Ballast Tank

SMS………………………………………Safety Management System

SOLAS…………International Convention for the Safety Of Life At Sea

STCW………………International convention on Standards of Training, Certification and Watchkeeping for Seafarers

TBT…………………………………………………..Tributyltin

VHF……………………………………………..Very High Frequency

VLCC……………………………………..Very Large Crude oil Carrier

UNED………………………………United Conference on Environment Development

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CHAPTER I
INTRODUCTION

"Safer ships, cleaner oceans"

The sentence ahead quoted has become one of the most famous mission statements in the maritime field that the International Maritime Organization (IMO) has been spreading since several decades. Actually, that is a kind of alarm bell that the secretary general of that institution is ringing, as the problem of marine pollution has become so serious. Indeed, pollution in general is undoubtedly one of the major issues of the twentieth century but also one of the most difficult to deal with. Marine pollution became the most important component of this concept, as seas are in a way or another the receptors of the various types of pollution.

As a matter of fact, due to the huge water masse of the oceans (71% of the earth surface) and their capacity of natural dispersal and biodegradation, oceans have been for a long time the natural receptor of wastes generated both on shore and on board ship. Those physical aspects make oceans difficult to be really appreciated until recently. And even though technology allows scientists to evaluate the impact of pollution in the seas, results cannot go further as to the exact degree of that pollution, meaning that some negative effects of human activities will still keep on going until they are discovered.

The International Group of Experts on Scientific Aspect of Marine Pollution (GESAMP) has defined marine pollution as "The introduction by human activities of substances or energy into the marine environment resulting in such deleterious effects as harm to living resources, hazards to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities". The unfortunate fact is that people have created a link between marine pollution and shipping activities as the main source of marine pollution, especially oil tankers.

As a matter of fact, it is well recognized that shipping has witnessed an important development over the past several decades. That type of transport, which was at the beginning so homogenous (in the sense that there were not many types of ships and the transport requirements were quite simple and identical), has become so huge and risky that it attracts public's attention. The general notice was that as the global commerce has grown so too the world's hunger for oil. The amount of oil it takes to satisfy this demand on just a daily basis is staggering. Every day, it is estimated that 100,000,000 tons of oil is ferried between the ports of shippers and consuming nations.

Subsequently, that growth led to a specialization process and the apparition of new types of oil tankers. Within a short period of time, tankers have developed in size and design as well. In 1960, it was estimated that more than half of the ships in the world fleet was under 50,000 deadweight tons with only a few numbers of "supertankers". By 1970, 45% of the world tanker fleet were ships of more than 105,000 deadweight. Ten years after, more than half of the fleet consisted of tankers of more than 200,000dwt, with several ships over 500,000dwt. These changes have unfortunately made significant impacts on pollution risks factors. Giving the volume of oil shipped over the oceans, as well as the scale of supertankers involved, it is not surprising that some oil makes its way into the oceans. Disasters such as Torrey Canyon, Amoco Cadiz and recently Exxon Valdez provided gripping illustrations of the problem of vessel pollution. The frequency with which public hears about of environmental bad news seems to be increasing. Since large coastal spills are both newsworthy and accessible, television regularly treats viewers up to the minute pictures of the ensuing ecological harm.

As a result, the idea of "marine transportation is the seas' polluter" is so incrusted in people's mind that if a journalist asks a non- scientist anywhere in the world what he or she thinks is the main cause of marine pollution, he or she will certainly say “oil spills”. However, these tanker accidents, while damaging are not the only threat. An additional source of vessel pollution comes from operational discharges on the high seas. Away from the watchful eyes of television, many vessels discharge water contaminated as a result of normal ship operations. Of the oil released by ships, seventy-five percent is reported to have come from operational discharges and twenty-five percent from accidental spills.

However, if it true is that oil tankers greatly pollute the seas, it is also true that people have always ignored or should we say tolerated other sources of marine oil pollution such as land-based oil pollution and pollution from ships other than oil tankers. Indeed, studies have revealed that of the oil in the seas, more than fifty percent come from land. Unfortunately, this has no impact on the public even though the effects on the marine environment are likely the same. Also, ships such as chemical tankers, dry bulk carriers, passenger ships can be source of serious pollution even if right now people do not pay due attention to them.

This state of fact leads the author to wonder why people have such a bad opinion about oil tanker. Also, what is done right now to prevent and control pollution from oil tankers?

These are the questions that will guide the author of this study. There is no doubt that this topic has been treated under different angles (legal, economic environmental etc), but because the same mistakes and misunderstanding of the topic are still existing, there is a need to keep on writing about, for as people used to say, repetition is harmless and can always help.

Objective and scope of the study

The author's contribution as the topic is concerned is to refresh people's mind but also draw the attention to the particular problem of land-based oil pollution that people seem to take less seriously as they do with the oil tankers.

The specific objectives of the topic are;

-To distinguish the sources of oil pollution in the marine environment,

-To point out the ship-based pollution in general and mainly all kinds of pollution from oil tankers,

-To highlight land-based oil pollution

-To identify the preventive and combative measures that have been taken and that are related to oil tankers and their efficiency,

-To make some proposals in the sense of improvement of the safety of the marine environment.

Study Methodology

The study has involved literature research of published and unpublished materials relating to oil tankers pollution. This includes an analytical review of oil tankers in terms of their operations, accidents that they involve and human element as well. Further literature researches and has been undertaken to examine how other ships can pollute the marine environment. Resident professors and visiting experts' views in the field have been analyzed and incorporated.

Outline of the study

Chapter II distinguishes the ship-based pollution from the land-based one, then, goes deeply in each part. In the first part related to ships, pollution is described according to the types of ships, with a glance at ship scrapping operations that are spreading. In the second part, land-based pollution is also treated according to its sources; industry, municipal, coastal pollution.

Chapter III focuses on the effects of oil tankers in their normal operations and in case of accident as well as the clean-up operations after accidents. The accidental part describes the effects of three recent and significant oil spills.

Chapter IV deals with the international conventions adopted to prevent and control oil pollution. These measures go from the construction, the equipment on board ships to the enforcement ones such as Port State Control (PSC), Flag State Control (FSC). This chapter also points out the human factor that is said to play an import role in the maritime safety and the marine environment pollution as well.

Chapter V sums up the main points of the study as pollution of oil tankers is concerned. It also goes further by analyzing the limits of MARPOL 73/78 as it is considered as the principal convention dealing with prevention of oil pollution, mainly the operational pollution since it is by far more important than accidental pollution. Recommendations are then made to improve both the ship source pollution but principally land- based pollution that is generally neglected.

CHAPTER II

THE SOURCES OF MARINE POLLUTION

Over twenthienth century human activities on land and at sea have increasingly altered the balance of fluxes between land and sea, increasing others and generating new chemicals that the seas have never had to deal with. So, by the middle of the century, it become clear that human activities could contaminate the oceans and alter their chemical composition in a measurable way, but the media inevitably selected items that were particularly striking and visual, so oil spills became a popular heading in the news papers and oil was seen (and seen) as the major marine pollutant. It is therefore worth looking at the other sources of marine pollution apart from oil tankers.

2.1 Ship-based pollution

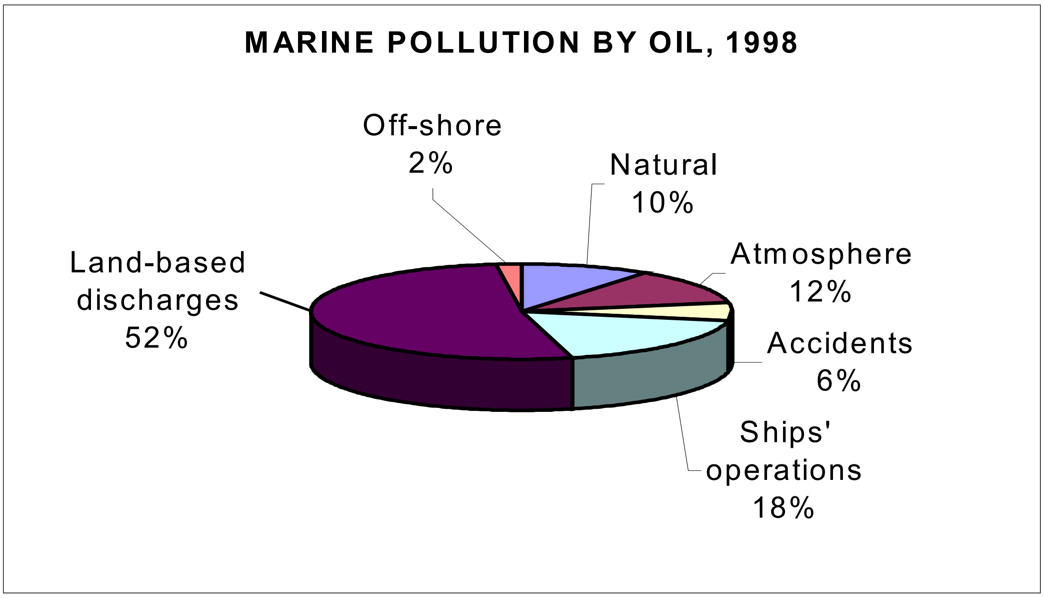


Figure 1: Sources of marine oil pollution

The technological improvement has given birth to a variety of ships both in size and in purpose. Unfortunately, this change will increase the pollution risks in many ways:

- Increase of traffic concentrations, particularly in coastal waters, channels and harbors approaches that pose higher collision risks.
- Carriage of an increasingly wide range of dangerous and noxious substances that could not be transported before.
- The prevalence of commercial practices taking precedence over safety consideration. Now, only the annual number of voyage is really important for shipowners. So, they will make ships sail as much as possible, retaining seafarers on board for several months.

2.1.1 Specific pollution from HNS tankers

Specialized Vessels have become a fast growing sector of the shipping industry, their growth, a direct reflection of the industry that they serve. It is estimated that more than 50 per cent of the cargoes transported by see can be regarded as dangerous, hazardous and /or harmful under the IMO classification criteria.

Through the International Maritime Dangerous Goods Code (IMDG Code), IMO has divided dangerous goods into the following classes:

Class1 Explosives

Class2 Gases regrouping compressed, liquefied or dissolved under pressure gases

Class3 Flammable liquids

Class4.1 Flammable solids

Class4.2 Substances liable to spontaneous combustion

Class4.3 Substances which, in contact with water, emit flammable gases

Class5.1 Oxidizing substances

Class5.2 Organic peroxides

Class6.1 Poisonous (toxic) substances

Class6.2 Infectious substances

Class7 Radioactive materials

Class8 Corrosives

Class9 Miscellaneous dangerous substances, that is any other substance which experience has shown, or may show to be of such a dangerous character that the provisions of the above classification.

Those goods are generally transported in ships that have also been classified according to their hazard. Three types of ships have been identified;

A type 1 ship that is intended to transport products with very severe environmental and safety hazards, which require maximum preventive measures to preclude an escape of such cargo.

A type 2 ship is a ship that is intended to transport products with severe environmental and safety hazards, which require significant preventive measures to preclude an escape of such cargo.

A type 3 ship is intended to transport products with sufficiently severe environmental and safety hazards, which require a moderate degree of containment to increase to increase survival capacity in a damaged condition

It is estimated that a number of approximately 400 types of products is carried by sea in sophisticated tankers. And each of these products requires specific precautions as to their handling as well as their loading. As a matter of fact, chemicals when being loaded, consideration shall be given as to their compatibility with other cargoes, compatibility with tank coatings, methods of containment, heating requirement, reactivity, pumping and venting arrangements, fire fighting techniques tank cleaning procedures etc.

The hazards coming from cargoes carried by HNS tankers are very diverse and may involve explosibility, flammability, toxicity, corrosivity, and suffocation. A number of severe accidents involving substances carried by HNS tankers have taken place in the past. Some famous examples of devastating accidents are the followings:

The “Mont Blanc”case

In 1917, during the First World War, the allies were concerned with an important quantity of ammunition within a very short time. The freighter “Mont Blanc” has been chosen to deliver 2,600 tons of explosives. She was about to enter the harbor of halifax (Canada) on her way from the United States to Europe when she collided with another ship. Due to the type of cargo she had on board, the “Mont Blanc” caught fire and shortly after exploded. The explosion is still considered as the biggest man-made explosion until the event of the atomic bomb. The consequences were disastrous as there were about 3,000 people killed, 9,000 others injured and 6,000 homes destroyed.

The “Fort Stikine” case in 1944 in Bombay (India) killed 1,250 people and destroyed 15 other ships in the vicinity.

The “Taquari” case; In 1971, this ship, which had on board toxins in containers grounded on the coasts of Urugway. Several years later, the containers began cracking, which killed the fauna and the flora in a very big area.

From what precedes, one can see that in addition to the immediate disastrous effects from accidents involving chemical tankers, there are the long-term negative effects on the marine environment. It is also reported that some coastal populations had been obliged to flee inland.

2.1.2 The specific pollution from bulk carriers

The term “bulk carrier” here should be understood as vessel intended to for the carriage of unpacked dry cargoes such as iron ore, coal, grain, bauxite and phosphate. Some other products like; agricultural and forest products, fertilizers, cement, salt, manganese, chrome and nickel are part of the group of bulk cargoes.

The International Association of Classification Societies (IACS) reported a number of 4,500 bulk carriers on the high seas in 1998. Some of these ships are equipped with their own gears (handy-sized and mini-bulkers) and some are not.

Most of dry bulks such as grain, coal are not real pollutants, but products like fertilizers, cement may become so. Indeed, it has been reported that due to the physical characteristics of their cargoes, bulk carriers use to loose an important part during loading and discharging operations.

By considering the important number of bulk carriers sailing on the seas, their impact within the port areas where those operations take place may be significant in a long run.

In addition, while chemicals carriers and oil tankers are submitted to severe restrictions as regard their tank washing, dry bulk carriers keep on throwing their tank washing waters into the seas. And this will continue until scientists find in five or ten years that these waters are also polluting the marine environment.

Furthermore, some reports have related a significant number of casualties in total loss to the old age of these bulk carriers.

2.1.3 The specific pollution from passenger ships

By international law, any ships with space for more than 12 passengers are passenger ships. These ships range from roll-on/roll-off ferries to luxurious cruise ships that carry as many as 2,500 passengers plus the crewmembers around the world.

At the end of 1991, the world’s ocean-going merchant fleet included 80,030 ships of more than 100 gross tons among them 4,284 ferries and passenger ships. Huge roll-on/roll-off ferries carrying thousands of people undoubtedly produce important amounts of garbage and sewage. Indeed, according to some statistics provided by the World Bank in 1998, each passenger can produce from 0.35 to 3.5 kilograms of garbage a day. If this quantity has to be multiplied by 2500 (representing the number of passengers), the amount of waste may be very important. Although these items are regulated by IMO through MARPOL73/78, Annex 4 and 5, it is not useless to question about the effectiveness of the equipment that those ships have to use in order to prevent the pollution of the marine environment. Furthermore, the Annex 4 dealing with sewage management is not in force so far meaning that some ships keep on throwing overboard their sewage.

Another possibility offered to passenger ships is to discharge their waste in the reception facilities that each port should provide. But even though so provided by MARPOL73/78, not all the port authorities have adequate reception facilities. In this case, what can a ship, which has stored its garbage or sewage on board do if it can not discharge them at a loading port? It will simply discharge them into the sea before the following call port.

2.1.4 Other marine environment problems

Air pollution

Observations have found that a certain number of pollutants from ships have a bad impact on the air. These substances can be divided into three main groups:

- Ozone depletion elements coming from firefighting operations, refrigeration and air-condition systems and the cargo vapor. These elements as their name indicates deplete the stratospheric ozone layer. The ozone layer is defined by scientists as the region of the stratospheric containing the bulk of atmospheric ozone. It lies approximately 15-40 kilometers above the Earth's surface in the stratosphere and has as a main role to protect the Earth against most of ultraviolet radiation B coming from the sun. Therefore, the depletion of this layer will inevitably lead to higher ultraviolet radiation B levels, which in turn will cause increased skin cancers and cataracts and potential damage to some marine organisms plants. Indeed, Phytoplankton known as the foundation of aquatic food webs is easily affected. Their productivity is limited to the upper layer of the water column in, which there is sufficient sunlight to support net productivity. The position of the organisms in this zone is greatly influenced by the action of wind and waves. In addition, many phytoplankton are capable of active movements that enhance their productivity and, therefore, their survival. Exposure to higher solar UVB radiation has been shown to affect both orientation mechanism and mobility in phytoplankton, resulting in reduced survival rates for these organisms. Scientists have demonstrated a direct reduction in phytoplankton production due to ozone depletion-related increases in UVB. One study has indicated a 6-12% reduction in the Antarctic zone. Also, solar UVB radiation has been found to cause damage to early developmental stages of fish, shrimp, crab, amphibians and other marine living resources.

- Nitrogen Oxides (NOx) and Sulphur oxides (SOx) are two main substances, whose use on ships has been regulated in Annex VI of MARPOL 73/78 in order to reduce their effects on the ozone layers. Regulation 13 of Annex VI prohibits the operation of diesel engine of ships with a power output of more than 130kw and whose Nitrogen Oxide emission is more than 17.0g/kw. However, the Annex allows the use of diesel engine under the sole condition that an exhaust gas cleaning system approved by the Administration is used to reduce onboard NOx emission to the required limits. As for the SOx, Regulation 14 of the ahead mentioned Annex states that "the Sulfur content of any fuel oil used on board ships shall not exceed 4.5%m/m". Also, in special areas such as Baltic seas, ports' zones the regulation requires that either the sulfur content of fuel oil used on board be less than 1.5% m/m or, an exhaust gas cleaning system or any other equivalent technology be used. Like the requirements for oil discharges, Nox and Sox emission have to be monitored by the flag states and port states as well. Flag States have to undertake an initial survey that will allow the ship to get the International Air Pollution Certificate followed by periodical or intermediate surveys to ensure that the equipment, systems, fittings, arrangements and material fully comply with the requirements of the Annex.

As for the port states, if there is clear ground that the crew is not familiar with essential shipboard procedures related to the prevention of air pollution, they should take necessary measures to ensure that the ship shall not sail until the situation is brought to order in accordance with the requirements of the Annex.

- Microtoxic pollutants generated by the incineration operations of garbage from ships. They contribute to over-all air pollution. That is why, Regulation 16 of Annex 6 of MARPOL 73/78 prohibits these operations in areas such as harbors, estuaries and ports but also urges ships to confine these operations only in a shipboard incinerator. However, substances of Annex II and III of MARPOL PCBs and garbage containing more than traces of heavy metal shall not be incinerated

Anti fouling paints

Marine growth on marine structures and the bottom of boats and ships is a constant source of energy consumption and expensive maintenance. Naval vessels, commercial ships and recreational boats waste significant amounts of energy due to the drag imposed by marine growth. As a matter of fact, it is estimated that there are over 4,000 marine fouling species.

Thus, biocides used in anti-fouling paints such as Tributyltin (TBT) must have a wide spectrum of activity to cover such a diversity of species able to colonize a ship's hull. However, TBT from the paints migrates into the surrounding seawater and accumulates in sediments around harbors and along shipping lanes. It is then ingested by marine animals and becomes a part of the food chain. The World Wide Fund for Animals reported that sea otters are dying off the coast of America and that dolphins, whales, sea lions, sea birds and fish are being contaminated in the Atlantic Oceans. The poison affecting them all is TBT. TBT became the most popular anti-fouling remedy after the World War II, because of its efficiency (4,000 species to combat). Indeed, ships that use it can go up to five years before requiring a hull cleaning.

But the problem with this product and certain other paints is that they are sources of severe environmental damage to marine species that do not foul ships hull. The Netherlands report of the Marine Environment Protection Committee says that

TBT toxicity is such that a spoonful is enough to cause damage if dissolved in a swimming pool six miles long.

In response to calls from several governments to ban the use of TBT as an anti-fouling biocide throughout the world, the 42nd meeting of the IMO-MEPC (November 98) unanimously passed a "draft assembly resolution" calling for a global ban on the application of anti-fouling products containing TBT by January 1, 2003 and a complete prohibition on their presence on ships hulls by January 1, 2008.

In Marsh 2000, IMO went further by the adopting a basic structure for a convention to ban certain antifouling paints. That instrument will be called "International Convention on the Antifouling Systems on Ships". However, before the adoption of that future convention, some questions need to be considered such as;

- Types of ships that will fall under the scope of the coming convention;
- The suitable system for its entry into force;
- Shall shipowners remove all traces of TBT or can they simply apply a sealant to the hull of their ships?
- What are the criteria that should be used to evaluate the performance?
- And finally, will the convention outline an evaluation plan for alternative antifouling paints or must ships owners assume that all non-tributyltin alternatives are environmentally sound

Organisms in ballast waters

In order to maintain stability, all cargo ships and in particular oil tankers on their ballast voyage fill dedicated tanks with water. Large ships may carry millions of gallons of ballast water. This water is taken from coastal port areas and transported with the ship to the next port of call where it may be discharged or exchanged. Coastal port areas are known as home to a wide variety of organisms that live in the water and bottom sediments.

Therefore, as a ship loads ballast water, it also loads all of the aquatic life found at the specific port; everything from bacteria and algae to worms and fish have been found in ballast water. As ships travel faster and world trade grows, species are better able to survive the journey, and the threat of invasive species from ballast water increases. The United States alone is said to receive at least 21 billion gallons of ballast water each year from around the world, leading to problems like that of the well-known Zebra mussels.

Eurasian Zebra mussels, Dreissena polymorpha are said to be introduced via ballast to the Great Lakes in the mid 80's. Able to thrive, the mussels spread throughout the lake, as well as the Mississippi and Hudson River. The mussels have had a number of negative effects: because they rapidly reproduce, the have clogged up water and drainpipes at municipal water supplies and at industries. They are expected to cost US 5 billion in control efforts and reparation. They have displaced native freshwater mussels of the area, and drastically altered the food web. The Zebra mussel population continues to grow and no immediate end is foreseen.

Another example of an exotic species, which has invaded an area after introduction via ballast water, is the American comb jelly, Mnemiopsus leidyi. A comb-jellyfish is a small marine invertebrate superficially resembling a jellyfish. It is carnivorous and preys on tiny aquatic animals, such as plankton. Transported in ballast possibly from New England, the American comb jelly invaded the Black and Azov Seas in Europe. The rapidly expanding population preyed so heavily on plankton that its biomass declined by as much as 90 percent. Anchovies, which feed on plankton, sharply declined as well, causing local fisheries to suffer.

The impact of introducing non-indigenous species can be divided into two areas: ecological and economic. These categories, however, are inter-dependent because, if for instance specific exotic species exterminate local species in a given area, and it is known that the exploitation of those species represent an important part in the national income of a concerned country, the economic impact is obvious. Even though, it is sure that not all species introduced in new environment survive, but most of survive and cause far reaching economic and ecological impacts.

Indeed, these invaders are able to alter the geographic level structure, displace or eliminate native species. They also carry with them the threat of new diseases, which can destroy vulnerable native inhabitants. In some areas, observations showed that native species are the brink of extinction due to the introduction of exotic species.

Biologists also recognize that exotic species can reproduce with natives and produce hybrids. These hybrids not only can change the gene pool of an area, but they can also simplify an ecosystem. By simplifying an ecosystem, as well as causing population declines and species extensions, exotic species can reduce biodiversity. Biodiversity is defined as the variation and variety of genes, organisms and species found in an ecosystem. As biodiversity decreases, the vulnerability of an ecosystem to pests and diseases decreases.

In order to solve the problem, an international legal instrument under IOM is being finalized. The proposed of the new regulations are intended to address the environmental damage caused by the introduction of harmful aquatic organisms in ballast water through the following issues;

- The preferred approach to application whether globalized, via the designation of ballast water management areas, or other approaches;
- Development of a range of standards, e.g, for evaluation and acceptance of new ballast water management and control options;
- Development of regional concept;
- The extent of application of the provisions to some categories of vessels, such as fishing vessels, pleasures boats, etc.

Options for the introducing the proposed regulations include among other things;

- A new Annex to the International Convention for the Prevention of Pollution from ships, 1973, as modified by the protocol of 1978;
- A completely new Convention on ballast water management, under which the terms for entry into force would be determined by a conference, instead of having to comply with existing terms established by MARPOL73/78

As seen above, all ships are pollution generators, each with its specific pollution and for an efficient management of marine environment pollution, it is paramount that no area is neglected.

2.2 Ship scrapping operations

Ship breaking has become a veritable booming industry during the shipping recession years in the mid-80's (Ma Shuo, Maritime Economics, p 122). And Asian countries, mainly India, Bangladesh and Pakistan are actually the leading ship breakers right now. In 1997, statistics showed that they obtained 90 percent of the world market. How do ship breakers operate?

Compared to shipbuilding, shipbreaking is considered by shipping operators to be a rough operation. Most of the world's ship scrapping industries uses manual labor to break ships in whatever facilities are available, often a beach. The process of this non-mechanized shipbreaking methods are said to fall into three stages:

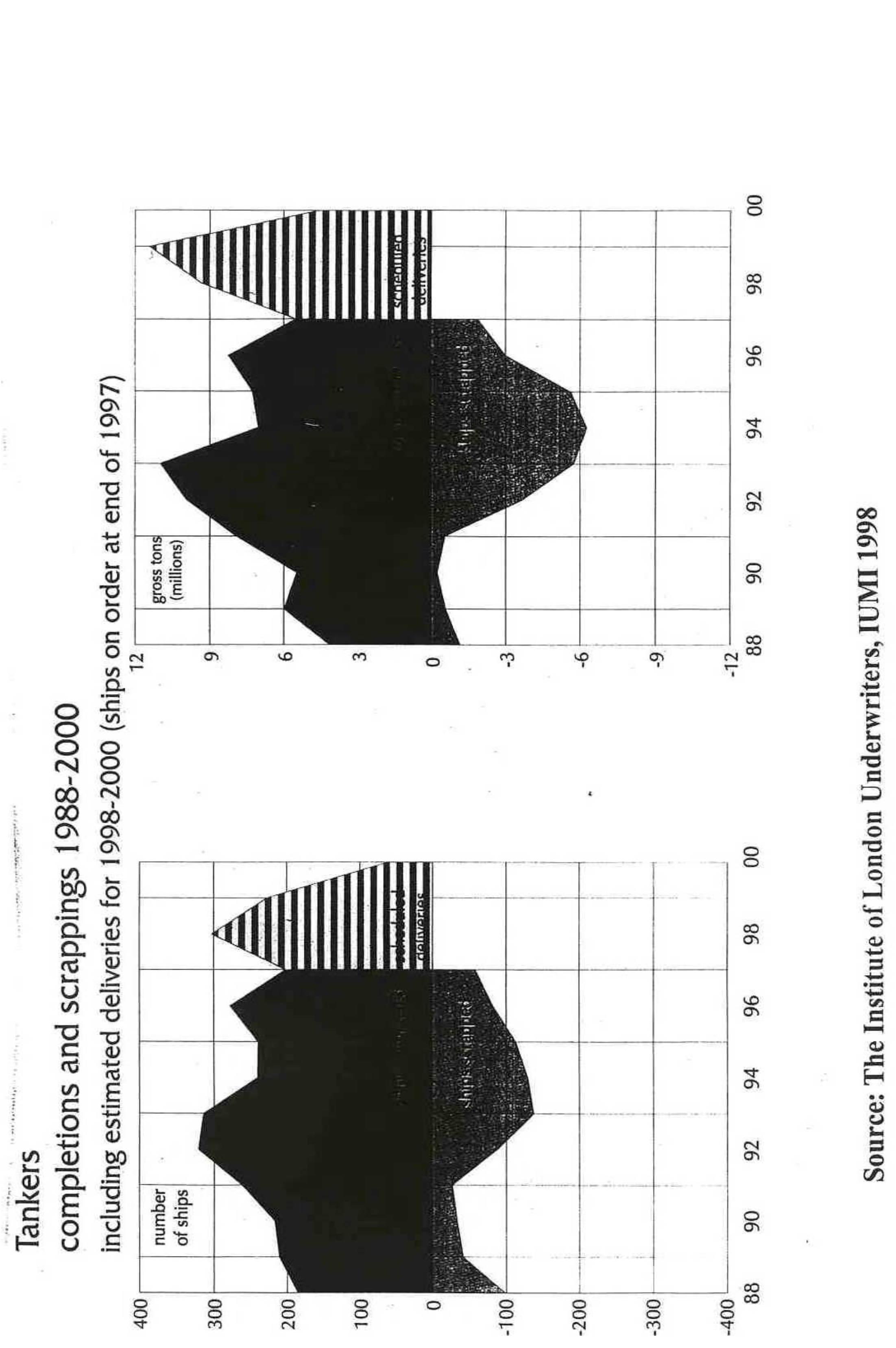
First of all, the owner of the vessel undertakes various operations including stopping up all intake apertures, pumping out all bilge water, blocking off intakes and valves and removing all non-metal objects together with potentially explosive materials. If the vessel is a tanker, it must be cleared of potentially explosive gas.

The second stage is that the vessel is sent to a beach. There, all large metal structures, such as mats, pipes, platforms, main engine etc are removed. The remainder of the vessel is then hauled or lifted on dry land by means of slipways, ramps or dry docks and cut into large sections. In some of the less sophisticated shipbreaking operations, the ship is simply winched on to the beach.

The third and last stage consists in cutting the panels and sections obtained from the ship into small pieces as required and transporting it to the ultimate destination.

Unfortunately, countries dealing with these operations seem to fail in the compliance with environmental laws and worker safety requirements. Indeed, some surveys revealed that workers in shipbreaking yards in Baltimore (USA) have been found tearing asbestos out of ships with their bare hands and without proper respirators.

In places like India and Alang, the situation is said to be worse where almost 35,000 workers scrap vessels without any protective gear except their scarves and sandals. In these places, death from work-related injury and disease is also said to be a daily occurrence due to pollution of all kinds coming from Polychlorinated Biphenyls (PCBs), chromate, lead and other severe environmental hazards remaining in the ships. All these noxious elements are washed into the sea with unknown consequences to sea life.



In order to overcome these new problems in the shipping industry and get to effective and permanent solutions, the Shipowners' Association together with the Norwegian authorities have taken an initiative for IMO to develop international regulations for scrapping to apply to all ships regardless of flag.

In the meantime, ships scrapping will continue with all its unknown consequences on the workers as well as on the marine environment.

2.3 Land-based pollution

Because of the importance of oil spills and waste dumping, early international efforts to protect the seas were concentrated on controlling marine sources of pollution, which threatened mainly the open seas. Sources say that not only until 1980's did the world community seriously begins to tackle the problems of land-based sources of pollution.

Now, the bulk of scientific opinion is that the open seas are contaminated but not yet seriously polluted as many coastal areas. And this is because coastal waters are generally shallower and less well mixed than areas far from the shore. As a matter of fact, some studies have found that 80 percent of the contaminants introduced by man into the sea comes from land via rivers, pipelines, groundwater seepage or fallout from the atmosphere.

Also, it is worth noting that the mayor sources of coastal and marine pollution originating from the land vary from country to country. The nature and intensity of development activities, the size of the human population, the state and type of industry and agriculture are the factors contributing to each country's unique pollution problems.

But for the purpose of this study, which intends to give a general overview of land-based sources of marine pollution, three sources will be examined.

2.3.1 Industrial discharges

The industrial development in general and the migration of industries to the coasts is an important factor in the coastal zone pollution. The term "industrial activities" includes;

- Fishing industry and mariculture

-General industry

-Tourism and recreation

- Oil and gas exploration and exploitation

- Exploration and extraction of mineral from the sea-bed

- Construction activities.

If all the above mentioned activities are not well planed and co-ordinated (as it is usually the case in most developing countries), it may happen that the control of effluents is not satisfactory and may originate a lost of the equilibrium of the system with the possible occurrence of severe impacts on the marine environment.

Industries dealing with petrochemical, chemical, wood, pulp, pesticides, metal and electroplating are point sources of toxic pollutants characterized by their persistence in the aquatic environment, their bio-accumulation in marine organisms and their highly toxicity to human via the consumption of sea-food.

Toxic substances are generally released as a result of manufacturing operations, effluent discharges and accidental spills.

In the Baltic and North Seas for example, the situation is said to be alarming as organic matter, Nitrogen, Phosphates, chemicals, heavy metals have found their way to the Seas.

2.3.2 Agricultural waste

Continued economic growth and development has drastically changed the traditional land patterns. The rapid agricultural development is now source of problems to the marine environment. As matter of fact, the technological development, which allowed the realization of the extensive agricultural production has brought into the market an important number of pesticides (insecticides, herbicides, fungicides…) and fertilizers.

These substances in the marine environment may affect living organisms and through contamination of seafood may become a public problem. Actually, it has been estimated that 90 percent of the pesticides that are applied do not reach the targeted species. Pesticides are highly toxic and tend to accumulate in the coastal and biota, making pesticide contamination a serious concern. The negative effects of pesticides in the marine and coastal environments include changes in reef community structure, such as decreases in live coral cover and increases in algae and sponges and damage to seagrass beds and other aquatic vegetation from herbicides. Marine organisms may be affected either directly, as the pesticide moves through the food chain and accumulate in the biota, or by loss or alteration of their habitat. This, in turn, will lead to decreased fisheries production. Pesticides may cause fish kills in areas of poor water circulation, and groundwater and drinking water supplies may be contaminated. In addition, fertilizers are also known as one of the main source of eutrophication.

2.3.3 Municipal wastewater and coastal population pressure

It is generally accepted that towns and agglomerations have a net of pipes or conducts to collect treated wastewater to be discharged into the river or coastal waters. Hence, a survey made in 1972 found that coastal communities discharged untreated sewage into the sea. Domestic sewage is a significant contributor to marine pollution. Typical pollutants in sewage effluents are suspended solids, oxygen demanding substances, nitrogen, phosphorous, oil, grease and pathogens. Industrial wastewater has a wide range of pollutants depending on the type of industry producing the waste. Wastewater from the food processing industry, distilleries and soft drink industries is also high in oxygen demanding substances, as is chemical industry wastewater, which also frequently contains toxic substances.

As far as the population impact is concerned, it is estimated that more than half the world's human population lives within 60 kilometers of the coasts and that the proportion is still rising, for people have long relied on coastal waters as a source of food. Indeed, research and observations show that about 95 per cent of the world's fish catch come from sea and half the population of the third world depend on seafood for more than 30 per cent of its dietary animal protein. But the physical impacts of the coastal zones are very much due to the increasing population and their activities on land. Impacts are seen for instance in the form of spreading occurrences of harmful algae blooms, growing concern for food security with respect to marine produce, changing conditions in estuaries, severe degradation of coral reefs and mangroves. Erosion and subsidence problems have also been found in some coastal zones due to the massive use of sand for construction and the physical pressure of the coastal land.

Because of what precedes, coastal pollution must cause concern but also because it is estimated that coastal waters are the only marine environments with significant biological productivity.

2.3.4 Land-based oil pollution

Studies carried out have found that oil pollution of the sea from land is more important than the total oil pollution from ships. In 1998, land based discharges of oil were a total of 1,260,000 tons while the ship sources of oil pollution contributed with only 582,000 tons. Offshore oil and gas exploitation can become sources of pollution, either in the form of accidental oil spills or from the release of "produced water" from the oil-bearing strata with the oil and the gas at the time of production. The "produced water" is discharged into the marine environment together with waste drilling chemicals and mud, and may contain substances that exert high oxygen demand, together with toxic poly-aromatic hydrocarbons, benzene, ethylbenzene and heavy metals, such as lead, copper, nickel and mercury. Accidental oil spills from offshore operations are often caused by pipeline breakage, well blowouts, platform fires overflows and equipment malfunctioning. In addition to the accidental oil spills there is also a significant amount of natural seepage of petroleum hydrocarbons from submarine oil deposits, which contributes to marine pollution. Unlike the previously described sources of oil pollution, natural oil seepage is very difficult for scientists to estimate. Oil refineries and petrochemical plants are also seen as the mayor sources of coastal oil pollution.

It is clear that all types of ships are sources of pollution capable of endangering the marine environment and by extension human being's life if the food chain is to be considered. But also as seen above, pollution from land turns to be the most important part. Unfortunately, regulations to prevent pollution from land are not as developed as those used for ships. Still, pollution from oil tankers remains the best well known and the most important threat to the marine environment for multiple reasons.

CHAPTER III
THE IMPACT OF OIL TANKERS ON THE MARINE ENVIRONMENT

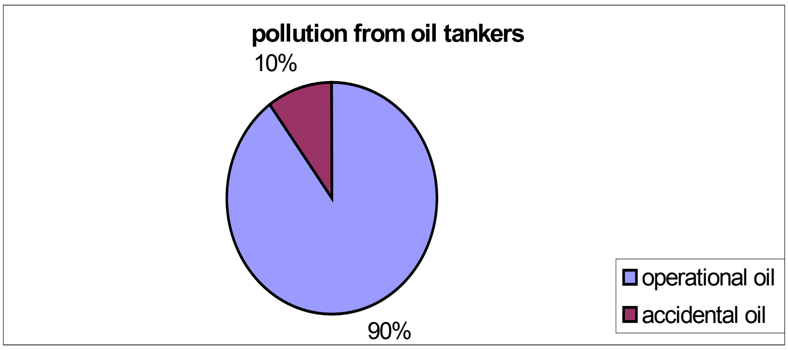
MARPOL 73/78 defines oil tanker as "a ship constructed or adopted primarily to carry oil in bulk in its cargo spaces …" while oil is defined as "petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products…"

Among the 82,890 ships of more than 100gross tons counted in 1985 by Lloyd's Register of Shipping, there were 6,153 oil tankers with a total of 132,438,195 gross tons, an evidence of the importance of oil tankers in the maritime industry.

As a matter of fact, the growth of the world sea-borne trade in oil in the post-world war II period has been striking. This growth has largely occurred in exports from the Middle East to Europe, Japan, and North America. The deployment of the world tanker fleet occurred at the same period, sign from the industry to meet with the growing demand. This development occurred both in size and number increasing subsequently the risks that these vessels represent. According to the United Nations statistics, in 1997, the total sea-borne trade reached 4,953 million tons of this total 2,172 million tons (44%) was oil. The reason that oil has been the biggest cargo in maritime transportation is not only that it is the principle source of energy, but also because world production and consumption are by large concentrated in different parts of the world, relatively far away from each other and separated by oceans.

3.1 The accidental oil pollution: the most recent serious accidents

Figure 2 Oil Pollution from Ships (tankers)



Source; International Tankers' owners' pollution Federation

Accidents involving oil tankers have always attracted people because of the visible effects on the marine environment. Actually, the severity of the oil spill is closely related to the area within which the spillage occurs. It is generally accepted that the nearest the accident is, the more catastrophic are the consequences. An important number of oil spills have been counted so far but for the purpose of this study, only the most recent serious ones will be analyzed.

3.1.1 Haven case (1991)

Haven is an oil tanker of 109,700 gross tons with 232,162 tons deadweight built in 1973 and registered in Cyprus. In January 1991, the vessel was chartered by the National Iranian Tanker Company in order to carry crude oil from Kharg Island to Europe. On April 7th 1991, the tanker moored at the oil platform off Multedo Harbour in order to discharge 90,000 tones. On April 8th, Haven left the platform and proceeded to Genoa Roads, where she anchored the following day in position named "M" about 6 miles off the coast, still having on board 144,000 tones of cargo, awaiting for orders. Then, suddenly, there was an explosion followed by a second one and a moment later, the vessel was up in flames. The rescue of the crew took place while burning slick oil was surrounding the ship. 31 of the crewmembers were picked up by a salvage craft, all suffering from burns, smoke inhalation and shock.

Unfortunately, the master and a technician had been found dead, while three crewmembers were missing. The threat of an ecological disaster was enormous, not only because of the quantity of oil that could be dumped into the sea, but also for the kind of oil. Indeed, the Iranian crude oil is well known by specialists for its thickness due to the high quantity of sulfur that it contains. This characteristic make an oil turn rapidly into tar, capable of reducing the evolution of the flora and killing any marine animal that digests it. Also, the threat was greater as spillage was taking place at just a shot distant from one of the most scenic coasts in the country (Italy) spotted with various very small towns having summer tourism as their only resource.

Owing to the efforts of prompt firefighting operators, the vessel sank in a sandy seabed, only 195 feet down. Its tanks remained intact after sinking and at the site of the wreck, there was no sign of surging. On the basis of the surveillance carried out by helicopters overflying the area, the quantity of oil spilled was estimated as being less than 5,000 tones out of the 144,000 tones that the vessel still had on board. The catastrophe had been avoided owing to the firefighters who had had the ingenious idea to direct their water jet to the oil escaping from the tanks in order to push it towards the burning surface. That is how they achieved in burning 6,000 to 8,000 tones of the oil, whose residue in the seabed has been checked later on by the local authorities and which has been declared non-toxic due to the effects of fire.

3.1.2 Braer case (1993)

The 18 years old Braer, a Liberian registered motor tanker of 44,989 gross tones, 89,730 deadweight and chartered by Ultramar was on voyage from Mongstrad, on the West coasts of Norway to Quebec in Canada with an 89,730 tones cargo of Gulfak's crude oil.

On the third day of her sailing (05-01-1993), she sustained an engine breakdown in heavy seas after seawater had entered her fuel supply off the coast of Shetland Islands. That same day, she ran aground, while the entire crewmember (34) had been airlifted to safety before the grounding. The entire cargo of the Braer was then spilled into the sea off an area of spectacular beauty, polluting not only the sea and adjacent beaches, but also the farmland of the southern mainland due to the oil vapors spread by the wind. After the incident, locals stated that the air was thick with oil at times and as is usual in similar mayor marine pollution incidents, it was the seabirds that took the full impact. Over a thousand were reported to have perished.

However, pollution and environmental damage subsequently proved to be much less serious than was originally feared. The slick caused by the Braer is said to have extended some 30 or 40 miles west of the Shetlands at its maximum, with traces of oil also found 25 miles North of the wreck. The interim report on the disaster from the Ecological Steering Group found that the immediate impact of the oil spill was less harmful than had been first been expected. Indeed, the effects of the seas had dissipated the light Norwegian North Sea oil. Nevertheless, 1,500 birds died and the Shetlands, three main industries were badly affected, namely, fishing industry, tourism and salmon industry.

A diving survey in April 1993 (four months later) concluded that the wreck no longer any pollution threat. Four divers who carried out a survey concluded that the tanker’s crude oil cargo, along with heavy fuel oil and diesel bunkers had been completely dispersed.

All these conclusions did not prevent the IOPC Funds to pay, by the end of November 1995, 73 million US Dollar to entities that had been affected by the spill. The Braer incident ranks second after Torrey Canyon disaster as the United Kingdom biggest oil spill.

3.1.3 Sea Empress case (1996)

The third worst marine pollution disaster to affect the British Isles occurred in February 1996 with the multiple groundings of the three-year old 147,273 deadweight, Liberian motor tanker. As a matter of fact, the Sea Empress incident resulted in the leakage of about 65,000 tones of her North Sea crude oil. As reported by investigators, the named vessel had loaded some 130,000 tones of crude oil at the River Forth terminal of Hound Point on February 13th 1996. Unfortunately, on the 15th February, at the entrance to the Milford Haven estuary, she ran aground spilling half of her cargo (65,000 tones out of 130,000 tones) into the sea. Owing to the efforts of the salvers, the vessel did not spill all her cargo. Yet, at 65,000 tons, the Sea Empress spill is still almost twice the size of the Exxon Valdez spill in March 1989 and according to the World Information System Oil Spill database, Sea Empress ranks as 16th largest tanker spill in world history.

Because the spilled oil from Sea Empress was relatively light, the oil reported to evaporate or dispersed in the stormy conditions that prevailed after the grounding. Hence, the spillage can be qualified as an environmental disaster as it killed over 2,500 birds of 19 different species. The fishermen were prevented from catching crabs, lobsters, whacks, cocks, plaice, and cod within the area. Almost 3,000 persons of the local industry and those employed on 60 fishing vessels had been affected. According to oil industry sources, the environmental and economic cost of the disaster was reported to have been 99 million US Dollar.

Even though the public still fear oil spills, one can admit that nowadays, those incidents are very well managed. And most in cases, areas affected recover after two or three years. The relatively important discharge of oil from tankers actually comes from the normal operation of these vessels.

3.2 The operational pollution from tankers

When a tanker is sailing, the main operations, which can give rise to pollution if not properly conducted are; ballasting, transferring bunkers, de-ballasting and discharging bilge water from machinery spaces. Indeed, the common pollution incidents are said to occur during terminal operations when oil is being loaded or disboarded. According to figures published by the International Tanker Owners' Pollution Federation, these operations sometimes contribute up to 92% of oil spills from oil tankers.

3.2.1 Loading and unloading operations

Bunker transfer

The fuel used by the ship for its normal movements is taken from setting tanks in the engine room where it is treated to remove water and unwanted sediments. These tanks are topped up at regular intervals from the bunker tanks, which are commonly located between the cargo pump room and the engine room. For ships sailing for long period, it is necessary to transfer oil from the forward bunker tanks to those aft in order to replace the bunker consumed. This operation also contributes in the maintenance of the stability of the ship as it avoids the ship not to trim too far by the head. The most common cause of spillage during these operations is the overfilling of tanks receiving the bunkers. The simplest explanation of this cause is that the operations often take a long time (some hours) and the rate of pumping is sometimes misjudged. Nonetheless, it is common nowadays that, big ships are equipped with high level alarms fitted to bunker tanks. The role of these alarms is to give an audible warning when the oil reaches a pre-selected level, which allows ample time for the operation to be stopped safely.

Other potential sources of spillage may be failure to shut the bunker manifold valves or leakage from the line due to corrosion or through the expansion joints.

Cargo transfer

Once the oil loaded in tanks, generally, it is not transferred any more until the unloading port. However, it may happen that oil is transferred at sea in the event of a leakage developing or, in some very large crude oil in order to maintain an even keel and minimize the draught at the arrival port. Here again as the transfer of bunker, spillage will happen if due care is not taken to avoid overflow as the tanks receiving the oil are likely already to contain cargo and have small ullages.

Ship to ship transfer

Oil is very often transferred from ship to ship or to barge in harbors or estuaries. A recent development that has been reported is that oil is transferred in the open sea from Very Large Crude oil Carriers (VLCC) to smaller tankers principally in order to lighten the VLCC's draught and allow them to get into ports for which their draught is too great. Specialists qualify this operation as a sophisticated one requiring lightening tankers specially equipped with large pneumatic fenders and cranes for handling the cargo hoses. There are three aspects of the operation which have, if not properly handled, the potential to cause pollution. These are;

- The berthing of the two ships alongside one another where hull damage is the risk,
- The connection of hoses, ullaging etc during which safety precautions are observed to prevent the ignition of oil or vapors and
- The transfer of the oil itself. The oil transfer is actually a normal discharging operation for the VLCC and a normal loading operation for the transfer tanker. However, if the transfer tanker has been modified and is regularly employed lightening ships, she may have segregated ballast tanks or retains cargo on board as ballast. If not, she will either clean tanks alongside her discharge berth or retain the dirty ballast on board while loading her cargo.

3.2.2 Tanks washing operations

The loading operations of oil are done in a number of tanks within the hull of the ships. When the oil is discharged, some of it is left clinging to the sides of the tanks. These deposits have to be cleaned off before fresh cargo is loaded and up to the 1970's, the normal practice was to use high-pressure hot-water cleaning machines and the mixture of waste oil and water that resulted was simply pumped overboard into the sea. The quantity of this waste oil has been estimated as much as 800 tones of oil on a large tanker and more than 8 million tones a year.

Fortunately, technical advances in the early 1970's resulted with an alternative known as "load-on top " system; a process, which has the double advantage of saving money for the cargo owner and protecting the marine environment from this operational pollution.

Despite the introduction of the load on top system, researches have demonstrated later on that the system does not completely eliminated pollution resulting from tank cleaning operations. This result led to the introduction of a new method of oil tanks cleaning called "crude oil washing". The main difference with the new system is that instead of using water, the tank-cleaning machines use crude oil. And this method is the one used for tanks washing nowadays.

From the above information, it could be said with certainty that any level of the oil management is in a way or another source of pollution. However, as compared to the total amount of land-based oil pollution (1,260,000 tons), the tankers' source oil pollution is quite "less important" (582,000 tons). Also, not only the relatively small contribution of oil tankers in the marine pollution is highly criticized by the public opinion, but even the different techniques used to face oil spills do not have the approval of many people who, despite their significant efficiency, find those techniques more polluting.

3.3 The clean-up operations

The same way IMO has qualified the Port State Control (PSC) the last safety net, the same way cleanup operations can be qualified as the last countermeasures to marine oil pollution. As a matter of fact, when prevention efforts have failed and an oil spill occurs on the water, spill responders use a number of tools at their disposal, depending on the particulars of each situation. Those methods are generally into two groups: - The mechanical cleanup methods such as containment booms and skimmers,

- The non-mechanical methods such as dispersants, in-situ burning, the use of bacteria.

For the purpose of this study, focus will be put on the second group of methods, subject of so much controversial.

3.3.1 Use of dispersants

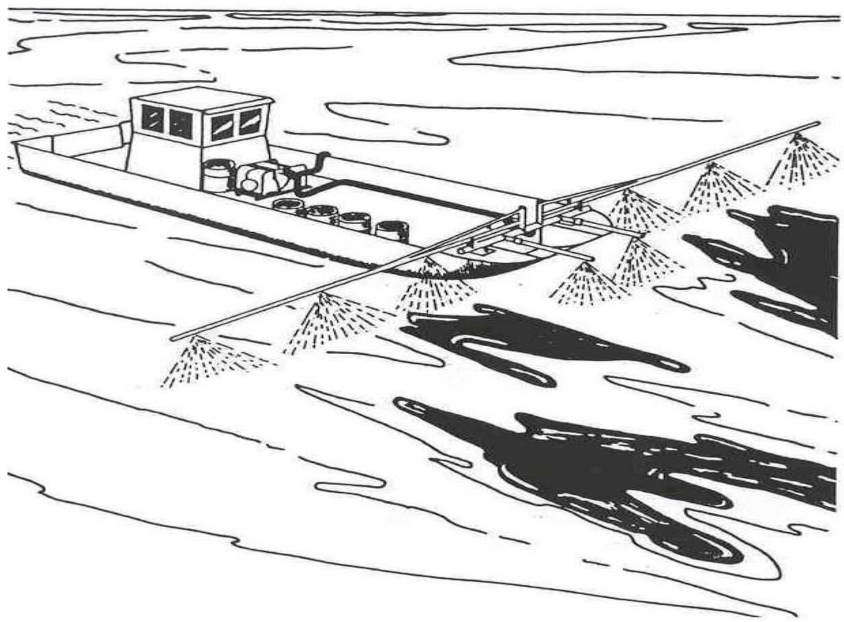


Figure 3: Application of dispersants

Dispersants are described by scientists as products composed of detergent-like surfactants in low toxicity solvents. Actually, the role of dispersants is not to remove oil from the water but only to facilitate its introduction into the water in order to render the water surface clean and safe enough for the pelagic animals. The dispersants have the capacity to break the oil slick into small particles, which disperse into the water , where they are further broken down by natural processes. Dispersants also have the advantage of preventing the oil droplets from coming up again and forming another surface slick. Fire and explosion hazards are lessened as dispersants reduce evaporation of volatile oil components. The evidence from six spills treated with dispersants in United Kingdom waters since 1980 is that dispersion of oil into the water can minimize overall environmental impacts by reducing damage to the shoreline and sea surface ecosystems. The limited environmental damage from 1993 Braer incident, where large volumes of oil were dispersed, provides particularly strong evidence that dispersion of oil can minimize the overall effects of a spill. Also, chemical dispersion in the Sea Empress spill in 1996 was found to reduce environmental damages and cleanup intrusiveness, cost and duration.

Effective oil dispersal will require some equipment such as airplanes, helicopters or vessels for the spraying of the products. And like other spill response techniques, dispersants are not 100% effective in dispersing surface oil but the effectiveness is greatly dependant on the type of oil, the environmental conditions and the way they are used.

As a matter of fact, the use of dispersants is not necessary when the spill involves light oils such as diesel oil or light crude oils as their natural characteristics allow them to disperse very easily. But the problems come when the spills involve heavy crude oils, heavy fuel oils or lubricants that are characterized by their viscosity and that are likely to easily crystallize in cold sea waters. Indeed, according to laboratory tests, viscosity has two effects in the dispersal of oil. Not only it retards dispersant migration to the oil-water interface but also, it increases the energy required to shear off a drop from the slick. That is why timing is said to be very important in the dispersal of heavy oils.

In order to avoid environmental disaster, experts recommend the use of dispersants in shallow waters, port, bays…where the concentration of dispersed oil may reach a dangerous level for the species living in the area.

But people against the use of dispersants will argue that the introduction of those products can affect some marine organisms, which will not otherwise be reached by oil the latter had to remain on the surface of the water. The threat of increase quantity of extraneous substances into the marine environment is also usually evoked.

The dispersants issue is as serious as the related policy will differ from one country to another. Form the "Bonn Agreement", one can see that in Belgium and UK, the combating capability is largely based on the use of dispersants, whereas the Netherlands have simply stopped their (dispersants) use. On the other side, France, Denmark and Norway have decided to use dispersants if according to the case, the latters prove to be more effective than the mechanical means.

The use of dispersants leads to a serious concern for two reasons; their toxicity and the toxicity of the dispersed oils. The toxicity of the dispersed oil actually frightens common people who do not have enough knowledge about the dispersal operations. However, some laboratory tests showed that the toxic effects per unit of dispersed oil are usually the same for oil dispersed chemically as those for naturally dispersed oil.

Unfortunately, it has been reported that many earlier laboratory studies of the joint toxicity of oil and dispersants had erroneously concluded that dispersed oils were more toxic than oil alone.

In any case dispersal operations' results depend on the type of oil and on the fauna of the concerned area as well. But one can not deny that the most effective dispersants are also more toxic. Also, it has been demonstrated that water temperature has a profound influence on the toxicity of dispersants. And the warmer the water is the highly sensitive local organisms are to the dispersed oils.

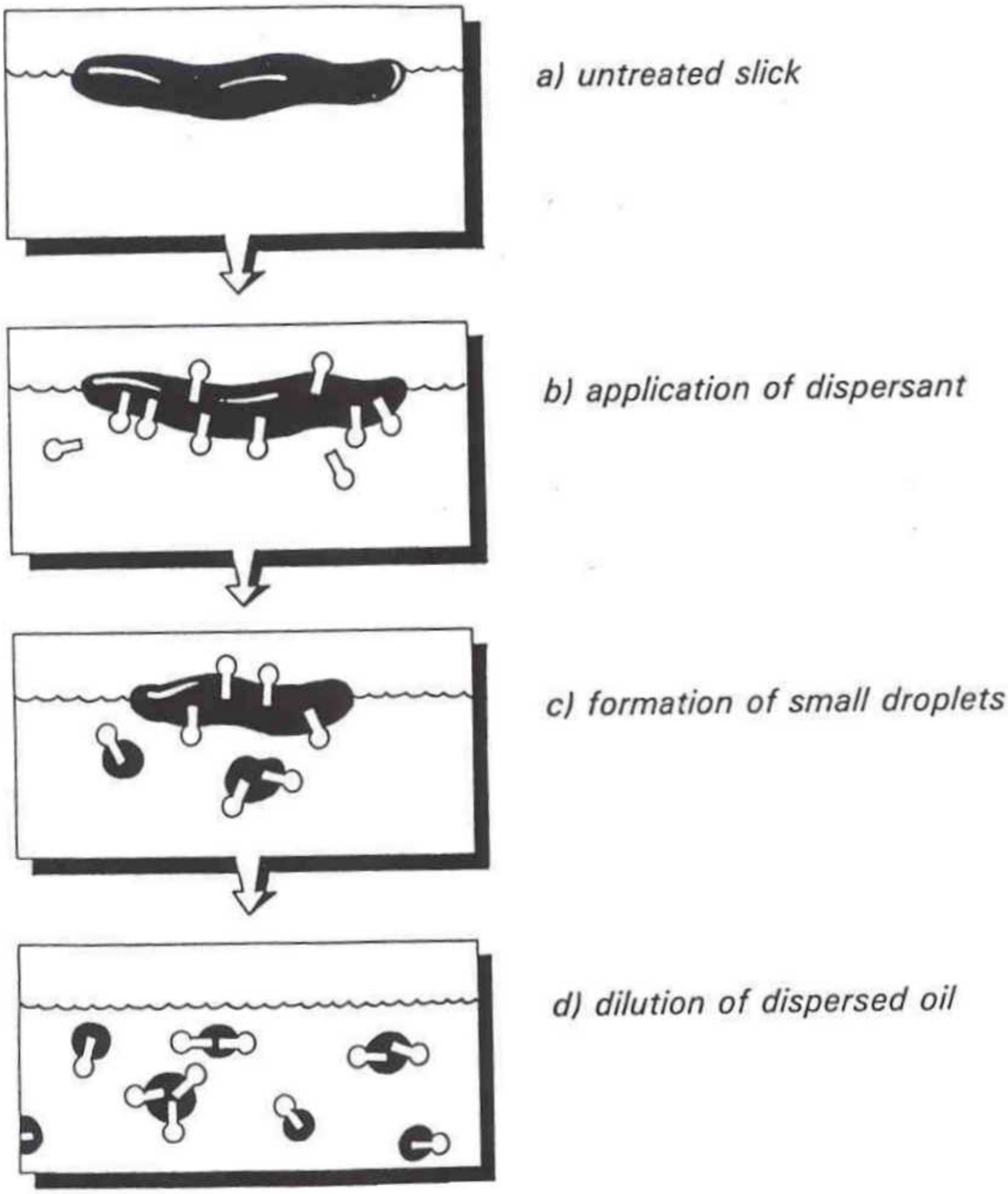


Figure 4: Mechanism of dispersion

3.3.2 Bioremediation

Biodegradation is a natural process of decomposition of a substance into separate components or elements. This process is performed by bacteria and is not harmful to the environment. The natural biodegradation, because it is slow process, can only helps in the elimination of oil from water on a long term basis, in particular for oil existing naturally in the sea. Indeed, research demonstrated that petroleum could be biodegraded by a wide range of naturally occurring microorganisms such as bacteria, marine and soil fungi, cyanobacteria (blue green algae) and algae. But in case of oil spills, because of the important amount of oil involved, the natural biodegradation process cannot be of good help. In order to solve the spills' problem, scientists have had recourse to an artificial technique of biodegradation, which aims to enhance the natural biodegradation and whose name is: Bioremediation.

Yet, bioremediation is not a panacea for oil contamination. As a matter of fact, a successful cost-effective of this technique will greatly depend on factors, such as hydro-geologic conditions, microbial ecology and other spatial/temporal factors that can widely vary. As far as oil spills are concerned, different types of techniques have been used so far;

- The use of nutrients. Here, the aim of this technique is to introduce nutrients rich in nitrogen and phosphorous so as to make the existing bacteria to quickly proliferate themselves and degrade the oil.
- The use of oil-degrading bacteria plus nutrients. This system consists in the introduction of oil-degraders microbes, preferable prepared from selected indigenous species, jointly with nutrients in the oil-polluted area. The aim of that technique is to create artificial organisms, which act as "oil eating bacteria".

The problem with the bioremediation is that it involves too many chemicals and the presence of those genetically modified organisms into the sea can be source of unwanted or uncontrolled species, which can originate dangerous diseases.

3.3.3 In-situ Burning

In-situ burning is defined as the controlled burning of oil “in place “ meaning in the area where the spill occurred. The use of this method can be traced back to the early 1970’s, where it has been used as an oil spill countermeasure for a variety of type oil spills. The objective of this technique is to ignite and burn thick slicks that are trapped in ice and /or contained and thickened by fire-resistant booms in open water spills.

The advantages of this technique is that it requires less labor than most other methods and can be applied to areas where other countermeasures can not be used because of limited access to the spill location or ice conditions. Because of the rapid consumption of the oil burn, this system can reduce the impact of surface oil on shorelines, sensitive habitats, birds, mammals and other wildlife. But also, it avoids oil storage and disposal problems. In-situ burns have typically removed over 90% of the contained oil during experiments and accidental burns of petroleum on water. The results of the research also say that only a small percentage of the original oil volume left unburned. And because the remaining material was a viscous, taffy-like one that could float for a long enough period time to be manually removed.

Another advantage of this method is that it eliminates the air quality impacts of the volatile hydrocarbons that would have otherwise evaporated.

Unfortunately, this technique presents some disadvantages that attract more the public. Indeed, among the air pollutants produce by the in-situ burning, one type pollutant is said to be of great concern as these particulate can cause respiratory disease in the elderly or those with impaired lung function if they are inhaled at high levels. There is also the possibility of causing flashback to the source of the spill or causing secondary fires.

Despite those disadvantages, one can maximize the effectiveness of this method by always containing the burning oil with fire-resistant booms, also by using this technique only on at least two-millimeter slicks and finally by always collecting the burnt oil residue in order to avoid it’s sinking, to a certain degree may of concern.

CHAPTER IV
THE INTERNATIONAL AGREEMENTS ON THE PREVENTION AND CONTROL OF OIL POLLUTION BY OIL TANKERS

From the information given in the previous chapters, one can remember two things: first that the sources of marine oil pollution are various and second that even the methods used to control oil spills are not generally tolerated by the public opinion due to their potential negative effects on the marine environment. This sad observation makes the author looks back to the international instruments that have been adopted to prevent oil pollution at sea with a glance at some combating measures.

4.1 The preventive instruments

Most of the instruments related to the matter have been adopted under the auspices of IMO. All of them are in a way or another dealing with safety at sea and the marine environment protection. For a detailed study, six (6) of them directly connected to our topic will be dealt with in that part of our research;

-The International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL73/78),

-The International Convention for the Safety Of Life At Sea 1974 (SOLAS),

-The International Convention on Standards of Training, Certification and Watchkeeping for the Seafarers (STCW), 1978, and Amendments of 1995

-The International Safety Management Code (ISM Code),

-The International Convention relating to the Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION), 1969,

- The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC).

4.1.1 The SOLAS Convention 1974

The SOLAS Convention is considered as the most important of international agreement concerning the safety of merchant ships. Indeed, the main objective of the said convention is to specify the minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States in that case are responsible for ensuring that ships under their Flag comply with their requirements and a number of certificates are prescribed in the convention as proof that this has been done. That convention even if dealing with ships' safety in general is considered in this dissertation under the "structural solution to pollution" that it brings in the maritime industry.

4.1.1.1 The structural requirements

Two chapters; Chapter II-1 and Chapter II-2 deal with the structural requirements. An important requirement is that the subdivision of the ship shall be such that after assumed damage to the ship's hull, the vessel will remain afloat and stable. The degree of subdivision measured by the maximum permissible distance between two adjacent bulkheads varies with ship's length and the service in which she is engaged. Ships that are more exposed to fire and explosion like passenger ships, oil and gas tankers, shall be constructed in a way that they are divided into main and vertical zones by thermal and structural boundaries so as to avoid the expansion of fire when started in a specific zone of the ship.

In the construction process, the SOLAS Convention requires that particular measures be taken so that even in damaged condition (in case one or two adjacent compartments are flooded), the ship is able to withstand the flooding.

The SOLAS Convention also requires seagoing ships to be fitted with double bottom. However, while this requirement applies to passenger ships differently according to their length, it applies to new cargo ships (including oil tankers) without any consideration of the length.

Requirements for bilge pumping arrangements are also laid down both for the passenger and cargo ships. As a matter of fact, SOLAS Regulation 21 requires that efficient bilge pumping system be provided to the above mentioned ships. But above all, the system shall "be capable of pumping from and draining any watertight compartment other than a space permanently appropriated for the carriage of fresh water, water ballast, oil fuel or liquid cargo".

Apart from the three points ahead mentioned, the SOLAS Convention deals with an important range of structural requirements such as the access to spaces in the cargo areas of oil tankers, the openings of watertight bulkheads etc.

4.1.1.2 Equipment requirements

A ship built according to the strength and stability requirement can not be qualified as seaworthy if she is not also properly equipped. That is why items like machinery, electrical and radio installations, life saving appliances should be provided in order to ensure that services which are essential for the safety of the ship, passengers, crew and the marine environment as well, are maintained under various emergency conditions. On the same line, the steering gear requirements after the AMOCO CADIZ incidence became very important as the related amendments introduced the concept of duplication of steering gear control systems on tankers. Therefore, all ships shall be provided with one main and one auxiliary steering gear in order to assure the safety of the ship.

Fire detection, protection and extinction appliances are essential equipment to have onboard a ship and particularly on oil tankers that transport very easy flammable product. In addition to those installations, the SOLAS Convention urges the concerned authorities to make sure that ventilation systems are provided in the areas of the ship subjects to easily catch fire such engine rooms or cargo spaces such as oil tanks.

Immersion suits, survival crafts, thermal protective aids, life boats, lifejackets, rescue boats are some of the equipment that all ships undertaking international navigation shall have onboard so that if an incident can not be avoided, at least human lives are protected.

Because shipping is a hazardous adventure that takes place in remote areas, far from land, it is necessary that vessels be quipped with efficient means of communication to ensure the ship-to shore, the shore-to-ship and the ship-to-ship connection. The internal means of communication between the different bridges of the ship shall be covered so as to ensure that any emergency situation in one area is quickly transmitted to the others. In that respect, the SOLAS Convention requires all ships falling under its scope to be provided with:

- A VHF (Very High Frequency) radio installation capable of transmitting and receiving,
- A Digital Selective Calling (DSC) on the frequency 156-525 MHz (channel 70),
- A Radiophone on the frequencies 156-300 MHz (channel 6), 156-650MHz (channel 13) and 156-800 MHz (channel 16),
- A Radar transponder capable of operating in the 9G Hz band,
- A receiver capable of receiving international NAVTEX service broadcast,
- A Radio facility for reception of maritime safety information by the International Maritime Satellite (INMARSAT) Organization,
- A Satellite emergency position-indicating radio beacon, which shall be able of transmitting a distress alert through the polar orbiting satellite service operating in the 406 MHz bad.

Every ship shall, in addition, be fitted with a radio installation consisting of a radiotelephony distress frequency watch receiver and a device for generating the radiophone alarm signal, both devices covering 2,182 kHz.

Those are some of the requirements established by SOLAS 74 and that are more related to our subject matter. A tanker vessel, which meets those structural and communication requirements from, SOLAS is well equipped and likely to face an emergency situation and avoid or mitigate spillage and pollution of the marine environment. Communication equipment for example can permit the master, in case of emergency to get in touch with the shipowner very quickly and take the appropriate decision. Also, it can allow the former to alert the coast guards, Search and Rescue Centers, vessels in the same vicinity, or any salvage company for help.

4.1.2 The MARPOL 73/78 Convention

That instrument is actually a combination of two treaties adopted in 1973 and in 1978, which can be considered as the international community's answer to the problem of vessel pollution. Since international commerce is greatly dependent upon sea transport, MARPOL73/78 attempts to strike a balance between the need to protect and preserve the marine environment and the desire not to impose laws, which will heavily increase shipping costs. Through its Annex I dealing with oil (and which is our main interest here), the convention prohibits the deliberate discharge of oil or oily mixtures from all seagoing vessels. That requirement is extended at least 50 miles from the nearest coasts. Even after 50 miles, special requirements should be followed when discharging.

At this point, MARPOL73/78 allows oil discharge if;

-The maximum quantity of oil to be discharged is done on a ballast voyage

-At 1/50,000 of the cargo carried for existing ships and

-At 1/30,000 for new ships that are supposed to be more equipped than the existing ones.

-The rate at which that quantity should be discharged is a maximum of 30 liters per miles traveled by the ship.

Those requirements aforementioned involve the provision of appropriate equipment including oil-discharge-monitoring system, oily-water separating equipment and filtering system slop tanks, sludge tanks, piping and pumping arrangements.

In order to allow maritime authorities to verify that ships have discharged their oils in accordance with the regulations, the MARPOL Convention prescribes that every ship which uses fuel oil and all tankers be provided with an Oil Record Book in which all the oil transfers and ballasting operations shall be recorded. Apart from the requirements previously mentioned, some are worth being studied in detail.

As statistics have demonstrated that ballasting and cargo tank washing are the main source of tankers' operational pollution, MARPOL 73/78 requires ships to utilize some or all of the following methods: Load On Top (LOT), Crude Oil Washing (COW) and Segregated Ballast Tank (SBT) in order to minimize or eliminate that pollution.

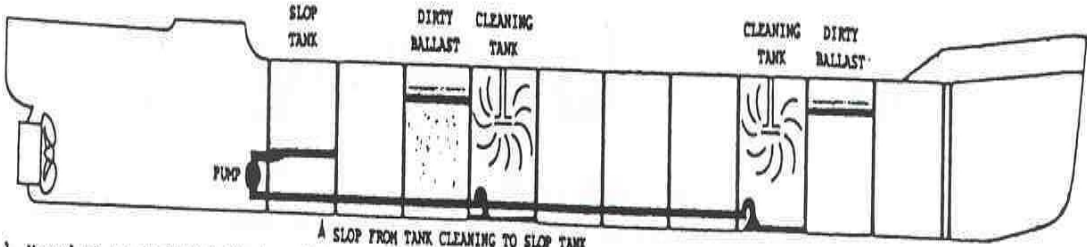
4.1.2.1 **Load On Top, Segregated Ballast Tanks and Crude Oil Washing**

Load On Top

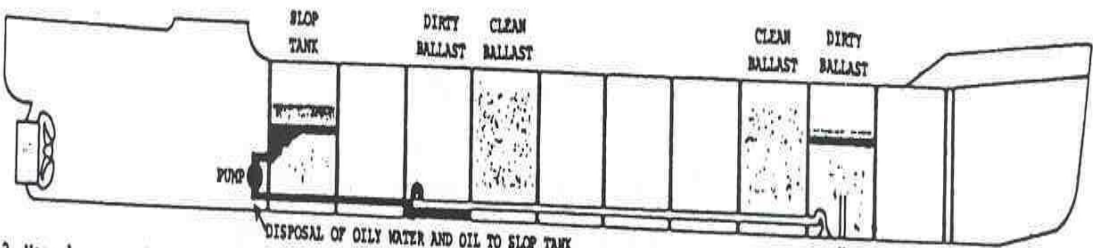
In the past, when tankers had discharged their cargo, they used to clean the dirty tanks by using high-pressure hot-water cleaning machines. The mixture of waste oil and water that resulted was simply pumped overboard. Then a new washing system came under which the mixtures of the tank cleaning process are not pumped over the side anymore but stored into a slop tank instead. During the return voyage, the oil will come up and the water at the bottom of the slop tank will be pumped into the sea. Once at the loading port, the new oil will be loaded on top of the remaining oil. That process is called Load On Top (LOT). Studies have showed that without this system, the amount of oil being dumped into the sea as a result of tank cleaning could have reached more than 8 million tons a year.

Unfortunately, a few years later, observations and analysis will demonstrate that despite the great contribution of that cleaning process to the marine protection, it did not completely eliminate pollution resulting from tank cleaning operations. In order to solve the problem, the oil industry has developed a new cleaning system for new ships called Crude Oil Washing (COW).

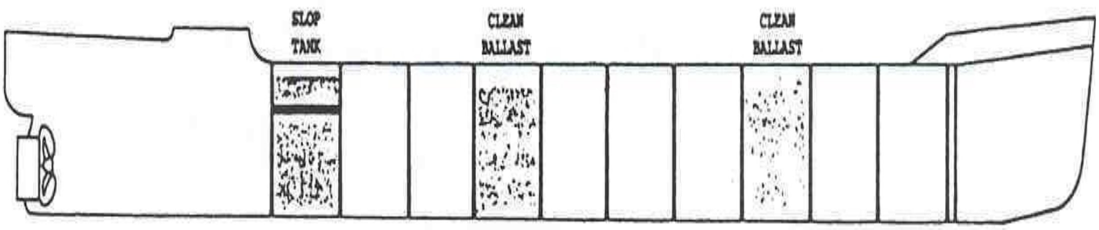
The following figure sums up the different phases of that system as provided by the convention.



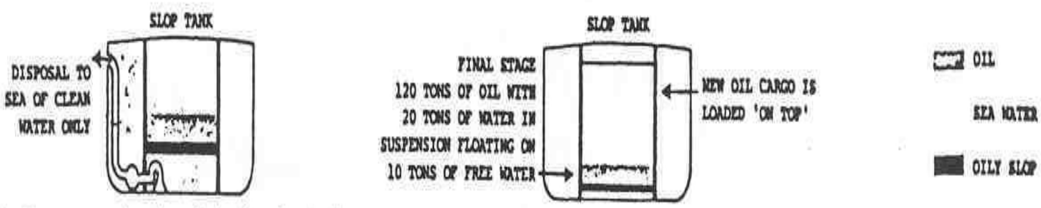
1 Vessel at sea in dirty ballast condition and cleaning tanks.
All oily washings are transferred to the slop tank, aft -- Oil in the dirty sea water ballast floats to the top.



2 Vessel at sea when tank cleaning complete and with clean ballast in washed tanks. Disposing of dirty ballast.
Clean sea water under the floating oil is returned to the sea from the dirty ballast tanks.
Oily slops from the dirty ballast tanks are pumped to the aft slop tank.



3 Vessel at sea in clean ballast condition, all polluted water and oil secured in slop tank.
The oil in the slop tank is given time to separate from the water.



4 The water under the oil in the slop tank is carefully pumped into the sea.

5 At the loading port oil cargo is loaded 'on top' of the oil in the slop tank.

Courtesy of Shell International Petroleum

COW

With this technique, dirty tanks are not washed with water any longer but with crude oil (the cargo itself). When sprayed onto the sediments clinging to the tanks' walls, the oil simply dissolves them, turning them back into usable oil that can be pumped off with the rest of the cargo. The advantage of this system is that it increases the cargo out turn, the ship has less dead freight and the operational pollution is reduced. It is worth noticing that COW is accepted as alternative to SBTs on existing tankers and an additional requirement for new tankers (the delivery of which is after 31 DEC 1979). Also, unlike LOT which takes place at sea away from supervision, COW takes place at the unloading port where a governing body is likely to conduct an adequate inspection.

SBTs

Under its policy related to the mitigation operational pollution, the MARPOL 73/78 convention has made some requirements with regard to the use of tanks.
The convention defines segregated tanks as tanks in which only water ballast is pumped. The objective being to avoid risk of cargo being mixed with ballast that can result to pollution when the cargo is pumped out. SBTs are required on crude oil tankers of 20,000 tons deadweight and above. The convention also requires that SBTs be protectively located, that is, they must be positioned in such a way that they will help to protect the cargo in the event of a collision or grounding.

It is worth mentioning that the alternative that was to use dedicated clean ballast tanks in lieu of being provided with SBTs is out of date since October1985 for Crude oil tankers of 70,000 tons deadweight and above and since 1987 for those of 40,000 tons deadweight e.g. four years the entry into force of the related annex.

4.1.2.2 Reception facilities

The reception facilities requirement also participates in the prevention of operational pollution. As a matter of fact, in order to make the use of sludge tanks on board ships more effective, governments parties to the MARPOL 73/78 Convention are required to ensure that their oil loading terminals, their ship repair yards and their tank cleaning facilities are provided with facilities for the reception of residues and oily mixtures. The capacity of those facilities shall be enough in number and capacity to receive oil and oily mixtures, oily bilge waters and other residues, which cannot be discharged according to the regulations related to this matter in Annex I of MARPOL 73/78.

Unfortunately, today, shipowners are finding themselves in a curious dilemma with that requirement. Indeed, while ships are obligated to run their operational wastes through a LOT procedure, retaining the oil residues on board for later transfer to reception facilities, many states can not or are simply reluctant to build these facilities because of the expense involved.

4.1.2.3 Shipboard oil pollution emergency plan

That requirement is more related to the combating side of oil incidents. Indeed, the shipboard oil pollution emergency plan is nothing more than a reduced contingency plan aboard ships. MARPOL through its regulation 26 of Annex I states that; “Every oil tanker of 150 tons gross tonnage and above and every ship other than an oil tanker of 400 tons gross tonnage and above shall carry on board a shipboard of pollution emergency plan approved by the Administration”. Such a plan shall be written in the working language of the master and officers and shall consist of the following items:

- The procedure to be followed by the master or other persons having charge of the ship to report on oil pollution incident,

- The list of authorities or persons to be contacted in the event of oil pollution incident,
- A detailed description of the actions to be taken immediately by persons on board to reduce or control the discharge of oil following an incident,
- The procedures and point of contact on the ship for co-ordinating shipboard action with national and local authorities in combating the pollution.

4.1.2.4 Effects of MARPOL 73/78

After twenty-five years of existence, statistics have demonstrated how successful the MARPOL Convention has been in reducing the quantity of oil pollution from ships.

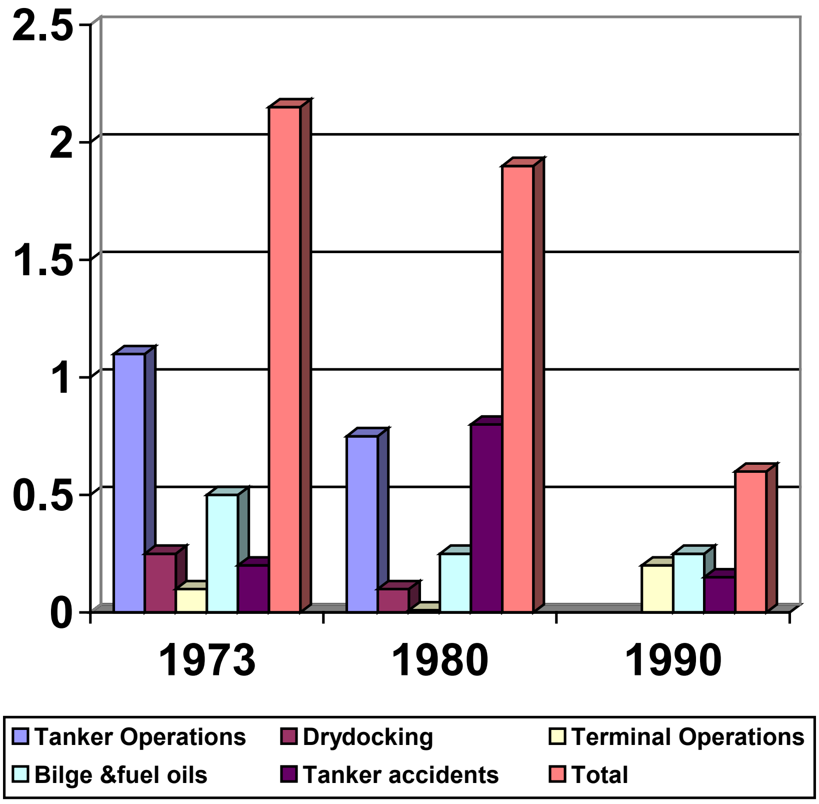


Figure 6; Effects of MARPOL73/78

Source: United States National Academy of Science (1990)

Today, With MARPOL 73/78, in force, tanker accidents account for only 5% of all oil pollution at sea, tankers' operations for 7%, other ships for 14 % and the remaining 74% comes principally from land.

The most important advantage of the MARPOL 73/78 Convention is that it has an enforcement regime that can be used in three ways; through the ship inspections to ensure that vessels meet minimum technical standards, monitoring ship compliance with discharge standards, and by punishing ships which violate the standards. Responsibility for seeing that these standards are met lies with the Flag States. Under the enforcement framework, every state has the duty to make sure that ships flying their flag or which are under their control comply with MARPOL73/78.

For tankers, and large ships, flag states are periodically to conduct thorough inspections of ships to guarantee that their structures, equipment, fittings arrangements and material fully comply with the applicable requirements. The convention requires flag states to conduct inspections or surveys before a ship is put into service or when issuing a five year International Oil Pollution Prevention Certificate (IOPP). After, the timing of the surveys varies, but at minimum, one must be conducted every five years. The idea behind the survey is that a ship, which fails to pass the quality test, cannot sail until it has been brought up to MARPOL's standards.

In addition to the flag states'control, port states can also have some authority to survey ships from other countries and confine those, which fall below the convention's requirements. Their authority is contingent on whether a ship at a port or an offshore terminal has an IOPP certificate. If a ship does not have any, a port state may conduct a full survey. If on the contrary, a ship is carrying a valid certificate from it's flag state, the port state is obligated to accept the document as if it were it' own.

A second item of the enforcement regime is the "state monitoring of vessel discharges". Indeed, MARPOL requires all parties to cooperate in detecting ship violations and to use "all appropriate and practicable measures of detection and environmental monitoring, adequate procedures for reporting and accumulation of evidence". If a state has evidence of a MARPOL73/78 violation, it must forward this proof to the Flag State responsible for the deviant vessel.

The last component of the enforcement regime is the punishment of vessels, which have illegally discharged oil. Once a flag state has received notice or evidence that one of its ships has violated MARPOL73/78, it must conduct an investigation. If this investigation turns up sufficient evidence to bring an action against the vessel, then, the Flag State must initiate a legal proceeding to judge the matter. In the spirit of cooperation, it must then promptly inform the party that has reported the violation of the action taken. When punishing a ship, the MARPOL Convention requires Flag States to impose penalties that are "adapted in severity to discourage violations of the present convention and shall be equally severe irrespective of where the violations occur"

4.1.3 Human factor

The human element is a complex multi-dimensional issue that affects maritime safety and marine environmental protection. It involves the entire spectrum of human activities performed by ships'crews, shore-based management, regulatory bodies, recognized organizations, shipyards, legislators and other relevant parities. As a matter of fact, statistical analysis confirm that 80% of the accidents are labelled as the human failure, which also can be named substandard practice and only 20% falls into the category of failing technology also known as substandard conditions. But on the side of conventions, the ratio is completely different; 80% of the conventions deals with technical matters while less than 20% deals with the human element. It was (and it still is) necessary that the shipping industry addresses the human side of ship management in a new and better way. That is what IMO did through two important instruments: The STCW Convention and the ISM Code.

4.1.3.1 The STCW Convention

As the Secretary- General of IMO put it; “People are the key to any real efforts to improve safety and prevent pollution”. That is why IMO has adopted the STCW Convention in order to minimize the negative aspects associated with the human element in the operation of ships. The convention establishes basic requirements on training, certification and watchkeeping for seafarers on an international level by clarifying the skills of seafarers on one hand and the competence of monitors, trainers and surveyors on the other hand.

The effective impact of the convention is assured by the requirement that makes parties accountable to each other through IMO for the proper implementation of their training and certification activities. The idea is that each party should send a report to IMO in connection with their maritime institutes standards. Moreover, parties are required to provide information on the maritime institutes to each other if asked or necessary. Through the convention, maritime administrations have seen their responsibility getting higher. Indeed, each administration has;

- To establish record system for the endorsements and issues of certificates,
- To approve the education and training programs of their Maritime institutes and arrange for their own external independent evaluations,
- To ensure that lecturers, instructors and assessors are duly qualified and have relevant experience,
- To ensure that companies have taken necessary measures to have their vessels manned in compliance with the applicable safe manning requirements with regard to the qualification and experience of the seafarers.
- To stay on the same line, the convention has laid down;

  Mandatory minimum requirements for the certification of masters, chief mates and officers in charge of navigational watches on ships of 200 gross tons or more and minimum standards requirements for the group cited above but on vessels of less than 200 gross tons,

- Mandatory minimum requirements for certification of chief and second engineers of ships with main propulsion machinery of 3,000 kW or more and for ships of between 750kw and 3,000 kW,
- Mandatory minimum requirements of certification of radio officers and radio operators.

Additional mandatory minimum requirements have been made for the training and qualification of masters, officers and ratings of oil tankers chemical and liquefied gas tankers. These are some of the requirements that the STCW Convention has laid down in order to enhance the role of the human element in the shipping industry.

4.1.3.2 The ISM Code

Although the ISM Code is cited amongst instruments dealing with the human factor, it is more oriented on the management aspect of that industry which is maritime industry. Through the STCW Convention, efforts were focused on safety of ships and crews' competence. But a deep observation on the human element shows that companies in charge of those ships and crews were not really involved in the whole safety management system. Generally, once at sea, the shipmaster and his crew were just like abandoned to their once mercy. But with the ISM Code, things have greatly changed at the seafarers' advantages, as shipping companies do not have passive role anymore.

As a matter of fact, in order to ensure safety at sea and avoid damage to the environment, the convention has decided to strengthen co-operation between ships' and shore-based activities.

To achieve that objective, the ISM Code encourages every shipping company to establish, implement and maintain a safety-management system (SMS) that includes two main policies set up in accordance with the relevant international and national legislation; a safety policy and an environment-prevention policy.

The ISM Code also defines the levels of authority and the lines of communication between and amongst shore and shipboard personnel. The specific requirement on the communication matter is the obligation of companies to design a person (or persons) ashore whose sole task is to ensure the safe operation of each ship at sea. That person should also have direct access to the highest level of management of the company. That requirement is obviously very important in the management of emergency situations when ships are sailing and it is undoubtedly going to help shipmasters as they can get technical advice from those designated persons since they are supposed (even required to) to be highly qualified and experimented.

Again, companies should ensure that their shipmasters and crew are qualified and competent and can effectively communicate in the execution of their duties. That requirement can significantly reduce the risks of misunderstandings and fatal errors in emergency conditions.

4.2 Oil spills control

If despite all the preventive measures, an accident still happens, how to deal with it? That is the question we are going to answer in this part of our research.

4.2.1 The OPRC Convention

It is worth noticing that even if the OPRC Convention treats both the preparedness as well as the combating sides of oil pollution. The fact that it is one of the two conventions treating the control of oil incidents has guided the author’s choice to insert it in that part of this sub-chapter.

Three main words may be remembered as the OPRC Convention is concerned; prevention, control and co-operation. Indeed, the convention has as a main objective to provide a global framework for international co-operation in preventing and combating major incidents of marine pollution.

Parties to the convention are required to establish measures for dealing with pollution incidents, either nationally or in co-operation, by mutual assistance in the event of pollution emergency. Specific provision has been made to encourage international assistance by reimbursement of any assistance provided. The mutual assistance in question includes technical support, sharing of equipment, exchanging information, joint research and development programs and exchange of reports of incidents. Parties to the convention are encouraged to commit themselves in bilateral as well as multi-lateral co-operation as preparedness and response of oil pollution is concerned, for, the more they are, the more power they will have to fight their common enemy that is oil incident.

The convention also encourages parties to establish a national contingency plan for preparedness and response, which should include the organizational relationship of the various bodies involved, whether public or private.

By doing so, parties are also required to set up, in accordance with their possibilities, through bilateral or multilateral co-operation, a minimum level of pre-positioned oil spill combating equipment, commensurate with the risk involved. An appropriate program of exercises for oil pollution response shall be determined.

4.2.2 The Intervention Convention 1969

The origin of the Intervention Convention may be traced back to the Torrey Canyon disaster of 1967. Indeed, the incident revealed doubts that coastal states had with regard to their right to intervene on the high seas in case of incident. In particular questions were raised as to which extent a coastal state could take measures to protect its territory from pollution where a casualty threatened that state with oil pollution, especially if the measures necessary were likely to affect the interests of foreign shipowners, cargo owners and even flag states. The convention somehow solved the problem by giving right to coastal states to "take all measures as may be necessary to prevent, mitigate or eliminate danger to their coastlines or related interests from pollution by oil (or other) following a maritime casualty."

The coastal state is, however, empowered to take only such action as is necessary, and after due consultations with appropriate interests including, in particular, the flag state or states of the ships involved, the owner of the ship or cargoes in question. From what precedes, if a coastal state takes measures beyond those permitted under the convention, it will be liable to pay compensation for any damage caused by such measures.

Like the OPRC Convention, the Intervention convention is a multi-dimensional one as it covers both the preventive as well as the remedial aspects of oil incidents at sea. In fact, both conventions are complementary as the geographical scope of application of Intervention convention starts where the OPRC's scope stops, that is the limits of the Economic Exclusive Zone (EEZ).

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

If taking into account all information aforementioned, it is clear that oil tankers bear an important responsibility with regards to marine pollution, both through their operational discharges and incidents that they unfortunately witness sometimes. In order to minimize such pollution, OILPOL convention 54 that will become later MARPOL 73/78 has been internationally adopted. To some extends, one can say that MARPOL73/78 has greatly participated to the reduction of oil tankers' pollution. Indeed, statistical analyses say that today, owing to MARPOL, tanker accidents account for 5% of all oil pollution at sea, tanker operations account for 7%, other shipping accounts for 14%, and the remaining 74% comes from industrial waste.

Unfortunately, despite that success, marine pollution remains first in the ranking of today issues faced by the world. Meaning that the problem has not been treated adequately. As a matter of fact, while oil tankers are submitted to stringent restrictions with regards to marine pollution, other sources of pollution that are actually the most important are not submitted to the same restrictions. These are; activities from factories, tourism, fisheries, the increasing population pressure on the coastal zones.

In conclusion, it may be said that much has been done to get oil tankers safe to the marine environment. Therefore the same should be done against other sources, mainly, the land-based pollution. Convinced that something should be done, environment experts are speaking more and more about **integrated management** of oceans for, no other issue highlight the notion of interdependence like protection of the world's marine environment.

Through many international agreements, some positive actions have been taken in that sense. These are the followings;

- The 1972 conference on the human environment in Stockholm. There, the inadequacy of efforts to control and manage land-based sources of marine pollution has been recognized.
- The United Nation Conference on Environment Development (UNCED) in Rio de Janeiro in 1992 has stimulated the process of integrating the environment into the development, and has achieved involvement of practically all governments and a large number of non-government bodies including indigenous people and cultural aspects as well. Through the chapter 17 of 500 pages action plan known as Agenda 21, the conference has stepped up the need for an integrated approach as the matter is concerned.

- The adoption by the United Nations of the 1998 International Year of the Ocean in order to create awareness of the ocean challenge and to raise commitments to address it adequately.

  Some encouraging trends in those directions are the growing environmental awareness, the increasing participation and co-management approach at local and national levels. Unfortunately, only developed countries in Northwestern Europe and North America have witnessed that noticeable progress where research, observations, legislation, resources inventories, institutions and capacity-building have been on-going for decades before the summit of Rio de Janeiro. Meanwhile, developing countries are still on the observation level with limited resources for research, resource inventories etc.

Recommendations

Even if remarkable progress has been done through international agreements in order to prevent pollution from vessels generally under IMO, much more remains to be done and may be three times more for developing countries.

Possible improvements to MARPOL 73/78

The partial implementation of the SBT requirement is one of the limitations of this convention. If all ships were required to be equipped with SBTs, the problem of oil ballast water would be eliminated. But Annex I stopped short of such a sweeping requirement as it made SBTs mandatory only for new ships while existing ships were exempt. This was a mistake because it slowed down the process of upgrading the environmental quality of the fleet as a whole. Faced with the prospect of purchasing expensive new vessels equipped with SBTs, many shipowners opted instead to hold onto their existing vessels for longer than usual. Had SBTs been required on existing vessels, many would have been retired earlier than usual since retrofitting would have not been cost efficient.

Form what precedes, a device should be found in order to make uniform the storage of ballast water on board vessels or MARPOL 73/78 should require all vessels, both new and existing to have these tanks

The second weakness of MARPOL 73/78 may be the reliance on flag states to as the primary enforcement agents. Under the convention, a flag state is vested with the exclusive right and duty to inspect and certify its vessels. A flag state is also exclusively responsible for investigating and punishing its ships when they violate MARPOL 73/78's operational standards. Coastal states and port states, on the other hand, generally have limited jurisdiction over the ships flagged by other countries. If a ship discharges within the territorial waters of a coastal state, then the ship would be subject to the coastal state's jurisdiction. Beyond these territorial waters, however, the role of nonflag states is restricted to monitoring and reporting ships' violations.

The major problem with the Flag State system has been the widespread use by shipowners of opened registries. Those opened registries have undermined MARPOL73/78's pollution control efforts in the sense that most of those countries do not have the resources to properly regulate their huge fleets. Furthermore, because of their dependence upon registry income, these states do not have the inclination to rigorously prevent and punish pollution from their multinational clients.

Because opened registries do not have the economic or political incentive to protect the oceans MARPOL 73/78 needs to break the flag state hegemony and give other states a stronger authority to inspect other countries' vessels as well as investigate violations under it' scope of application. Hence, it will be dangerous to let coastal states punish other states' vessels for, unscrupulous ones may use such environmental enforcement as a device to hassle and prosecute their ships for political reasons.

Given that MARPOL73/78 has chosen to give full power to flag states, it should at least try to establish basic standards for those flag states' enforcement. As it is right now, the convention allows each state to decide how best to satisfy its requirements. An example is that under their duty to inspect and certify tankers, what constitutes a passing grade varies from one Flag State to another. Similarly, while every state is required to investigate discharge violations and punish ships if there is sufficient evidence, what constitutes "sufficient evidence" depends upon each state.

MARPOL73/78 needs a strengthened implementation in many parts of the world. And this requires technical developments and installations such as reception facilities, which are substantial investments.

Improvements at government level

Since the environment issue has that characteristic of making the interests and objectives of nations overlap, it would be a good idea to really work in cooperation with each other. Achievement of ocean policy objectives today requires international cooperation.

Governments and regional organizations should be effective in order to identify approaches and prioritize actions to deal with marine environment problems in general and land-based pollution in particular since that side is up to left to the individual country to deal with.

The policy for the reduction of land-based sources of marine pollution from coastal cities may be reoriented by a significant investment in water supply and management infrastructure (mainly for developing countries) and an improvement in the environmental performance of industry. For the last point, the idea is that government can for instance decide to reward businesses publicly for good environmental behavior and shame others for bad behavior. One of the United States Environmental Protection Agency's most effective environmental management tools has been the Toxic Release Inventory (TRI), a 1986 regulation which requires certain industrial sectors to publicly report environmental releases and transfers of chemicals.

The decentralization of authority to local communities can also help in the reduction of land-based source pollution. Indeed, people and industries that are obliged to live with and in the pollution are more likely to be quicker to take action. Also, even the threat of receiving a black label by consumers may serve to increase many companies' investment in environmental management. By decentralizing their authority, governments should also develop the capacities of coastal cities to understand and act on local environmental problems through measures of information, education and bargaining power. That decentralization measure should include an increased centrally collected shares of revenue to the municipalities, as well as issue their own taxes.

To the maritime administrations

Even though it is well known that maritime administrations are the last priority of governments, make sure to get yourselves heard by your respective governments. Human life has no price and the marine environment is vital for today and future generations, therefore, make sure that your ships comply with requirements of your legislation and the international laws as well. There is no need to ratify conventions if you can not make them enforced. Your Maritime Education Training (MET) institutes comply with the relevant requirements if you want to have the best seafarers. To the opened registry administrations, do not allow others to qualify your flag as "flag of convenience". In order to rehoist your flag, do not hesitate to the money to earn from those activities and improve your performance.

To the shipowners

Money is without any doubt very important nowadays, but remember that you can run your business without taking into account a main element like the sea. Therefore, make sure that your vessels are adequately constructed, equipped without cheating with your flag state or your classification society. Be aware that your seafarers are human beings like you and consequently need to be treated as such (good working and living conditions, fair wages etc).

To the seafarers

Human life has no price, so, make sure to treat yours with due care and respect, meaning that you should not behave inconsiderably. In that case, always ask when you do not know for it is better asking than putting the whole crew's live at risk. Life on your ship will certainly be too boring if you know how to share how to behave with your superiors and your colleagues as well.

No one can deny that oil spills from tankers have negative impacts on the marine environment, mainly because of the important volume spilled at once and sometimes in confined areas. However, one can assert that nowadays, oil tankers are not more pollutant than other sources that have been treated in the previous chapters. Also, new developments have proved that a polluted environment can be restored within a year or two.

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