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SHIPS AND THE MARINE ENVIRONMENT

by

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INTRODUCTION

Ships interact with the environment in which they operate in many ways. From the earliest times of man's attempts to traverse the world's oceans, ships have unintentionally transported organisms from one part of the globe to another and have caused the deliberate and accidental release of substances into the environment. Shipping casualties provide the most visual manifestation of the interaction between ships and the marine environment, especially if they result in the death of crew or passengers, or in the release of hazardous cargo or fuel. The most spectacular examples of the latter that attract the attention of politicians, the world's media and the public at large are those that involve laden oil tankers, especially if they result in the release of thousands of tonnes of oil.

The main focus of this paper is accidental oil spills but brief attention is also given to a number of the other environmental concerns related to shipping that are currently receiving widespread attention. These include the introduction of invasive species through ballast water; ship recycling; DNA tagging; and alternatives to TBT based anti-fouling paints.

ACCIDENTAL OIL SPILLS

Major tanker spills are now exceptionally rare events as a result of the successful prevention programmes initiated by industry and governments, particularly through the International Maritime Organization (see figure over page). However, world-wide statistics are no consolation to those whose coastlines and livelihoods are affected by the consequences of major accidents such as the ERIKA off the west coast of France in December 1999. Smaller spills, including those involving heavy bunker fuel from non-tankers, can also have serious consequences, especially if they affect sensitive coastal resources, including facilities used to cultivate fish, shellfish and other marine products.

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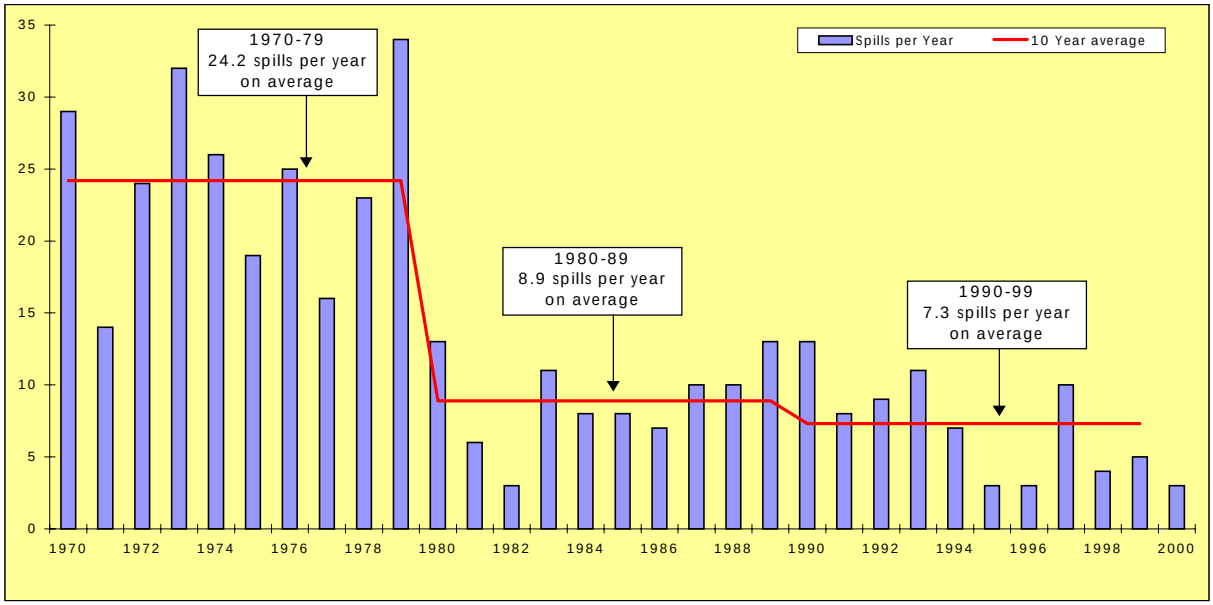
1. ITOPF is a non-profit making organisation funded by the world's shipowners. The organisation's priority technical service is responding to marine spills to give advice on effective cleanup techniques and the mitigation of damage. Staff are also involved in assessing the impact of spills on economic resources and the environment, and advising on the technical merits of claims for compensation. ITOPF staff are routinely assisted by other experts and local surveyors and always seek to work closely with government agencies and potential claimants. Since 1977 ITOPF staff have attended more than 450 spills in over 80 countries.

Further information can be found on ITOPF's Web site at **http://www.itopf.com** and in the ITOPF Handbook 2001/2002, copies of which will be available at the Conference.



Tanker Spills over 700 tonnes, 1970-2000 (Source: ITOPF Oil Spill Database)

Dramatic pictures of oil contaminated beaches and wildlife all too often cause politicians, the media and public to demand increased regulatory activity, even though oil spills cause far less long-term environmental and economic damage than many other less visible pollutants and human activities such as coastal development and commercial fishing. The feelings of outrage generated by oil spills are exacerbated by the limitations of existing oil spill combating techniques. The reality is that once the oil has been spilled, the best that can be achieved is damage limitation through mounting the most effective response that technology and the circumstances of the incident will allow. The only real solution, therefore, is preventing such events happening in the first place.

Response to Spills

Whilst the world is much better prepared and equipped to deal with major marine oil spills than it was thirty years ago, it remains the case that we are not able to overcome some of the fundamental technical problems associated with combating such events. What is more regrettable is the fact that most significant oil spills are not dealt with as effectively as current technology should allow. This is frequently because those responsible for managing the response operations take insufficient account of the extensive technical knowledge and experience that is available, especially in terms of the lessons that have been learnt from previous spills around the world.

When oil is spilled onto the surface of the sea it spreads very rapidly. This is one of the fundamental factors that limits the effectiveness of all at-sea response techniques. The type of oil is also critical, with heavy crudes and heavy fuel oils frequently posing the greatest problems because of their high viscosity. This means that they do not readily dissipate or degrade naturally. They are therefore highly persistent in the marine environment and so can travel great distances from the original spill location, causing widespread contamination of coastal resources.

Knowledge of the type of oil and predictions of its probable movement, behaviour and fate are vital in order to select the most appropriate response strategy.

At-sea Response - Two main options are available for combating oil on the surface of the sea: containment and recovery, and chemical dispersion. Both have severe limitations in a major spill, especially if the weather is bad. In the case of dispersants it is also important to appreciate that they are not effective on all types of oil and that inappropriate use can lead to additional damage being caused.

Protecting Sensitive Resources - The protective booming of sensitive coastal resources, such as fish and shellfish cultivation facilities, can be highly successful so long as intended deployment strategies are planned in advance of a spill and fully tested.

Shoreline Cleanup - Shoreline cleanup is usually a 'low-tech' business with most reliance being placed on locally available non-specialised equipment and manpower. However, it needs to be carried out in accordance with a clear strategy that takes account of the characteristics of the particular oil, the level of contamination and the relative environmental, economic and amenity sensitivities of different locations. Inappropriate cleanup actions can lead to additional damage being caused.

Termination of Cleanup - All cleanup activities should be constantly evaluated to ensure that they remain appropriate as circumstances change. As soon as any operation has been shown to be ineffective, likely to cause unacceptable additional damage to environmental or economic resources, or the costs begin to greatly exceed diminishing benefits it should be stopped.

Management of Spill Response

The technical aspects of dealing with an oil spill, as well as the prompt availability of well-maintained and appropriate equipment with trained operators are clearly important. However, the effectiveness of the response to a major spill will ultimately depend on the quality of the contingency plan, and the organisation and control of the various aspects of the cleanup operation.

There are good reasons why governments have traditionally assumed responsibility for organising the response to ship-source spills. Not the least of these is that such incidents often involve vessels in innocent passage ("passing ships") whose owners do not have an operational capability in the affected country and who could therefore not be relied upon to respond promptly when the need arises. The responsibility for protecting a country's interests also ultimately must rest with government authorities since they alone have that mandate and are in a position to determine priorities for protection and cleanup in the particular circumstances. The international compensation Conventions (i.e. 1992 Civil Liability Convention and 1992 Fund Convention) were largely created to encourage such authorities to assume the responsibility for responding to spills of persistent oil from tankers by providing a straightforward system whereby the costs of 'reasonable' measures would be promptly reimbursed.

It is ITOPF's opinion that government-organised response to ship-source spills is worth preserving and that the trend in some parts of the world to emulate the USA and require shipowners to organise the response to their own spills should be resisted. This is not, of course, to suggest that a shipowner who suffers a spill should not offer positive support and assistance to the affected government. Indeed, this is one of the main purposes of ITOPF's involvement in spills on behalf of its tanker-owner Members and shipowner Associates.

Contingency Planning

There is a greater likelihood that prompt and effective response decisions will be made if considerable effort has been devoted in advance of any spill to the preparation of comprehensive, realistic and integrated contingency plans for different levels of risk. Unfortunately, many contingency plans frequently fail to adequately address a wide range of key issues, including:

- the identification of sensitive environmental and economic resources,
- priorities for protection and clean-up,
- agreed response strategies for different sea and shoreline areas at different times of the year and for different types of oil,
- temporary storage sites and final disposal options,
- and command and control.

Damage Caused by Spills

Marine oil spills can cause serious damage to natural resources and to those whose livelihoods depend upon those resources. The nature and duration of the damage depends on a number of factors including, the type and amount of oil and its behaviour once spilled; weather conditions and season; the type and effectiveness of the clean-up response; and the characteristics of the affected area.

It is frequently difficult to establish the precise extent and likely duration of the effects of an oil spill and to distinguish changes caused by the spill from those caused by natural factors (e.g. climate) and human activities (e.g. commercial fishing, industrial pollution). However, scientific studies conducted around the world over the past 30 years have demonstrated that most oil spill effects are transient, that is of short duration. Even a major spill will not cause permanent environmental damage except in truly exceptional circumstances. This is because most marine plants and animals have evolved to be resilient to short-term adverse changes in their environment and to recover quickly when conditions improve. This is necessary if they are to withstand climatic changes, including devastating natural events such as El Niño, which routinely kill more marine birds and mammals than any oil spill.

Of the various possible short-term economic impacts of spills, most concern is generally expressed by those involved in tourism and in the catching or cultivation of fish, shellfish and other marine products. Typical fishery effects include contamination of fishing gear and cultivation equipment, and temporary tainting of the marine products themselves leading to marketing problems. Mortalities of adult fish and shellfish are very rare and long-term effects on stocks are unlikely to occur.

BALLAST WATER AS A VECTOR FOR INVASIVE SPECIES

The introduction of invasive aquatic species into new environments through, for example ships' ballast and the fouling of ships' hulls, has been identified as one of the four greatest threats to the world's oceans, second only to the physical alteration and destruction of marine habitats.

The use of water for stability when sailing partially laden or without cargo has long been a vector for the movement of exotic/non-indigenous species from one region of the world to another. The shipping industry is estimated to transfer approximately 10 to 12 billion tonnes of ballast water across the globe each year. Relatively recent changes in the speed of ships and the consequent reduction in voyage times, along with the increase in the size of ships and their ballast tanks, have combined to increase the probability of species survival, so overcoming the natural barriers in the world's oceans.

These surviving species can then be introduced into the local marine environment when the ship discharges its ballast water and associated tank sediment.

Effects of Invasive Species

The introduction of exotic/non-indigenous species does not in all cases cause damage to the receiving marine environment as the majority of the species that manage to survive the voyage are unable to establish viable communities in the new area. However when they do survive they can then out compete local species for food, habitat and other resources and may eventually replace the native species. This reduction in biodiversity has the potential to be permanent.

There can also be economic damage to marine resources and amenities, as shown in the USA. The introduction of the European zebra mussel *(Dreissena polymorpha)* into Great Lakes has caused significant fouling of intake pipes of hydroelectric power stations. The cost of control measures, for the USA as a whole since 1989, has been roughly estimated to be in the region of US$5 billion. In the Black Sea, the failure of commercial fisheries has been traced to reduction in native plankton stocks as a result of the introduction of the filter-feeding North American jellyfish *Mnemiopsis leidyi*.

Human health can also be at risk as it is feared some diseases, for example cholera, might be transported through ballast water. What is more probable is the occurrence of algae that have the potential to reproduce rapidly ("bloom") when conditions are favourable to cause "red-tides". These toxic dinoflagellates enter the human food chain through the consumption of shellfish such as oysters and mussels that have filtered the algae from the surrounding water. Health effects can be serious, including paralysis.

Technological Aspects and Legal Measures

At present there is no so-called "magic bullet" solution to this issue and there is unlikely to be one in the foreseeable future. The best available technology currently involves ballast water exchange and this will likely remain so for a number of years to come while

alternatives are developed. In the meantime the International Maritime Organization (IMO), through its Marine Environment Protection Committee (MEPC), is in the process of developing an international Convention that will help combat the problems associated with this issue on an uniform international basis. The Convention text is scheduled to be completed by 2002. At its core will be ballast water and sediment treatment options and standards.

There are two main aspects to the approach adopted regarding standards. Firstly, to select standards that would be applicable immediately whilst recognising their limitations, i.e. ballast water exchange with its uncertainties with respect to safety and effectiveness. In the longer term the objective would be to have a performance-based standard that would be achieved through IMO type-approved equipment. The standard applicable for ballast water treatment options would be based on a species kill rate as opposed to volumetric exchange of ballast water. Equipment and/or processes that meet this "species kill rate" standard would be type-approved.

Ship Recycling

The disposal of ships when they reach the end of their economic life is a crucial element in the continual renewal of the merchant fleet. Ship recycling yards therefore have a vital role in the lifecycle of a ship.

In recent years the process of recycling ships has had a higher profile. The main issues relate to the environmental and health concerns at the yards, which are mainly located in developing countries such as India, Pakistan, Bangladesh and China. A major factor in the siting of a yard is its proximity to a market for the recycled materials. The ship recycling process also blurs the line between land-based and marine-based pollution.

At present there are no internationally-recognised standards addressing this issue. However, the shipping industry has taken some practical steps to reduce some of the concerns, whilst recognising that it cannot unilaterally prescribe working conditions on the yards as this ultimately falls under the jurisdiction of the national authorities concerned. With this in mind a shipping industry working group, chaired by the International Chamber of Shipping (ICS) and including a wide range of shipping interests, has developed an Industry Code of Practice on Ship Recycling and a Hazardous Materials Checklist. This is generally regarded as a significant step forward on another complex issue that is also on IMO's agenda and will be addressed at the next meeting of the MEPC through a working group, building on the work of a correspondence group.

DNA Tagging

One of the factors that adversely influences the public's perception of shipping is the chronic pollution of shorelines, most especially amenity beaches, as a result of illegal discharges of oil contaminated ballast water, fuel oil sludge or the washing out of machinery space bilges. This is an issue that has exercised the IMO since its inception. One of the main problems has always been that unless a ship is caught in the actual act of carrying out one of these illegal activities, it is virtually impossible in many situations

to attribute an operational oil slick to the ship concerned. This generates considerable anger among the affected public and the government authorities who have to bear the costs of cleanup.

Consequently research has been carried out over many years to assess the suitability of introducing an effective "marker" into the oil to allow "fingerprinting" in the event of a spill so that the guilty party can be identified with certainty.

The introduction of a hydrocarbon biomarker or DNA tag as a method of fingerprinting the liquid has been assessed by the UK's Maritime and Coastguard Agency (MCA) with the conclusion that this approach could be effective. The results of this assessment have been presented to IMO's MEPC which has added the topic to the work programme of its Bulk Liquid and Gas (BLG) sub-committee. The report recommended that rather than tagging all cargoes it would be more practical to focus on oily residues and bunkers. This reflects the frequency of beached oil coming from bilge and bunker sludge sources as opposed to the cargo residues.

Whilst many practical and legal aspects undoubtedly require further consideration, this approach is regarded as feasible as it would only require modification of existing shipping and port administration procedures.

Anti Fouling Convention (TBT)

As a ship sails across the oceans the friction between the hull and the water causes "drag". This "drag" effect is increased by the growth of marine animals and plants that attach to a ship's hull in the same way that they do to rocks and other structures in the sea. This "fouling" not only increases the friction between the ship and the ocean (and in turn the fuel consumption and associated atmospheric emissions), but it is another way that invasive aquatic species are introduced into new environments.

One opportunity to remove the fouling is during a ship's dry-docking. However this only occurs between every two and five years. An alternative approach is to reduce the fouling during the operation of a ship by the application of special anti-fouling coatings to the ship's hull. These coatings inhibit the growth of unwanted organisms through the controlled release of biocides. The most common and effective chemical used to date in anti-fouling paints has been tributyl tin (TBT).

In the early 1980's research indicted that populations of shellfish in some European waters were under pressure for unknown reasons. These populations coincided with areas of heavy boating, mostly yachting. Further investigation revealed high levels of TBT in the populations concerned. As a result TBT has been widely banned from all small craft, since when the populations have recovered.

Since the discovery of these problems, the IMO has been developing the necessary regulations to address this issue in respect of commercial shipping, although the problem has shown itself to be more complicated than first thought. The MEPC has decided in principle that the new applications of TBT based coatings should be banned (probably by 1st January, 2003) and, at a later date (probably 1st January, 2008), all

existing coatings containing the material should be removed. However, this policy is hampered by the apparent lack of an equivalent substitute for TBT. In addition there are concerns that other materials might in time prove to be equally harmful to the marine environment; after all they have to have a biocidal action to work.

These and other issues, including entry into force criteria, will be considered by a Diplomatic Conference on the Anti-fouling Convention at the IMO this coming October.

Conculsions

This paper has sought briefly to highlight some of the many current environment concerns facing the shipping industry. Whilst not the most serious with regard to long term-damage to the marine environment, oil pollution resulting from both illegal discharges and accidental spills continues to be the focus of much attention and the issue that gives the oil transportation industry its bad reputation in the eyes of politicians and the public.