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SUMMARY OF REPORTS ON NINE STUDIES ON VARIOUS POSSIBLE APPROACHES TO THE PROBLEM OF MARINE POLLUTION PREVENTION AND ABATEMENT

INTRODUCTION

Pursuant to the decision of the IMCO Assembly concerning the convening of the 1973 Marine Pollution Conference, the work for the preparation of a draft Convention for the Prevention of Pollution from Ships was undertaken by the Maritime Safety Committee and its technical Sub-Committees.

As an initial step for the preparation of a draft Convention, the Sub-Committee on Marine Pollution, at its tenth session (6-10 September 1971) decided to assess the design, operational and economic implications of each possible approach to the problem and the degree of pollution abatement which each approach might be expected to achieve.

The Sub-Committee assigned special working groups comprising "lead" and associated countries and organizations in consultative status with IMCO to carry out the following nine studies:

STUDY I	-	SEGREGATED BALLAST TANKER
STUDY II	-	DUAL PURPOSE TANKS WITH MEANS TO ISOLATE OIL OR NOXIOUS MATERIALS FROM WATER
STUDY III	-	RETENTION OF OIL ON BOARD
STUDY IV	-	CLEAN TANKS FOR BALLAST PRIOR TO VESSEL SAILING
STUDY V	-	RETAINING DIRTY BALLAST ON BOARD FOR IN-PORT DISPOSAL

STUDY VI	-	THE ENVIRONMENTAL AND FINANCIAL CONSEQUENCES OF OIL POLLUTION FROM SHIPS
STUDY VII	-	COLLECTION AND DISPOSAL OF SHIP-GENERATED DRY GARBAGE
STUDY VIII	-	SHIP-GENERATED SEWAGE TREATMENT AND HOLDING SYSTEMS
STUDY IX	-	POLLUTION CAUSED BY THE DISCHARGE OF NOXIOUS SUBSTANCES OTHER THAN OIL THROUGH NORMAL OPERATIONAL PROCEDURE OF SHIPS ENGAGED IN BULK TRANSPORT

During the preparatory work for the Conference a number of documents including progress reports on studies and other information relevant to the studies have been submitted to the Sub-Committee on Marine Pollution and these documents are listed in the Appendix. These have constitued a significant contribution to the development of the draft text of an International Convention for the Prevention of Pollution from Ships, 1973.

The summary of the nine studies as prepared by the "lead" countries is attaches to this document. The conclusions derived from each study are essentially those of the lead country concerned and may not necessarily represent the general consensus of the Sub-Committee.

The copies of the final reports on all nine studies will be made available during the Conference and distributed one copy per delegation.

STUDY I

SEGREGATED BALLAST TANKERS

Lead country: United States
Associated countries: Norway and Sweden

In preparation for the International Conference on Marine Pollution, 1973, the United States undertook a study of segregated ballast tankers. The objectives of the study were:

1. To determine practical arrangements for a family of tankers with segregated ballast capabilities.

2. To evaluate the effect of design modifications on oil pollution abatement by developing estimated capital costs and operating costs; assessing the practical factors involved; the degree of effectiveness in pollution abatement; and a cost effective analysis.

The study was conducted in two parts. The first part investigated segregated ballast configurations for very large crude carriers. Twelve designs were considered; eight versions of a 250,000 DWT tanker; two versions of a 120,000 DWT tanker; and two versions of a 500,000 DWT tanker. The second part investigated segregated ballast configurations for smaller (handy sizes) tankers for the carriage of clean or dirty products or crude oil. The term dirty products is used for those ships designed for the carriage of either crude oil or dirty refined products. Nine designs of a 21,000 DWT tanker were considered; six for the carriage of dirty products and three for the carriage of clean products. Five designs of a 75,000 DWT tanker were also considered; three for the carriage of crude oil and two for the carriage of dirty products.

The study has been completed and the report of each part submitted to the Sub-Committees on Marine Pollution and Ship Design and Equipment. Each report contains a summary table and synopsis which comments on the results. Concerning these results, it may be observed that:

1. All segregated ballast designs produce an increase in ship price and in required freight rate (RFR). The percentage increase in ship price for a given design option gives a reasonably close indication of the percentage increase in RFR.

2. The ship price and values of RFR are sensitive to the level of segregated ballast capacity, and they increase as more complex ship arrangements are introduced.

3. The degree of effectiveness for operational pollution abatement is improved by the use of segregated ballast. The improvement noted for the smaller tankers in clean and dirty product service are not as great as those in crude oil service because of the greater amount of tank washing in product service.

4. The degree of effectiveness for accidental pollution abatement indicates none of the designs produce a high degree of effectiveness against both stranding and collision.

For the three basic hull configurations investigated it may be noted that:

1. The RFRs for double hull tankers (bottom and side) are relatively independant of (a) deadweight; (b) the range of ballast level ($0.45\Delta_{FL}$ to $0.60\Delta_{FL}$), and (c) cargo variations. The RFR increase is in a band of 15.5 to 20.5 percent. The cost effectiveness tends to become slightly better as deadweight decreases.

2. The RFRs for staggered wing tanks versions are relatively insensitive to deadweight, but are sensitive to [illegible] ballast level. The RFR increase is in a band of 3 to 10 percent. The cost effectiveness tends to increase with lesser levels of segregated ballast and decrease with high levels.

3. The RFRs for the double bottom versions are insensitive to deadweight, but increase with ballast level. The RFR increase is in a band of 6 to 12 percent. The cost effectiveness is relatively insensitive to deadweight and is superior to the other two basic configurations.

This study does not present any conclusions nor recommendations with respect to the results. It does, however, provide a data base from which an overall assessment can be drawn for the evaluation of tanker design criteria in conjunction with the other studies conducted in preparation for the Conference. It was beyond the scope of this study to attempt such an evaluation.

STUDY II

DUAL PURPOSE TANKS WITH MEANS TO ISOLATE OIL OR NOXIOUS MATERIALS FROM WATER

Lead country: United States

This feasibility study concentrates on impermeable membranes within tanks to isolate oil (or other cargoes) from seawater ballast. Investigation has been primarily at the 250,000 DWT size with complementary work on a 50,000 DWT tanker. The IMCO oil outflow criteria have been used along with classification society rules for scantlings. It has been demonstrated that, when combined with the weight critical nature of tanker which can produce segregated ballast, only 4 and 2 tanks need be fitted with membranes, respectively in the 250,000 and 50,000 DWT cases studied. However, it appears tanks need to be smooth inside to reduce friction on the membrane. As a consequence the cargo ballast tanks should have double bottoms and would probably be centre tanks. Additionally, this scheme would have an influence on other features such as ballasting arrangements, structural design, and filling and emptying procedures. Several different membranes geometries and attachment methods seem worthy of investigation.

Model tests at 1/20 scale were performed with the tank (vessel hull) stationary to examine filling and emptying. Several schemes were tried to reduce wrinkling of the membrane. The best of these seemed to be low pressure gas on the opposite side of membrane from the filling liquid. Such low pressures can be achieved by ordinary inert gas systems aboard tankers. The same model was used in tests simulating ship motion. These tests indicated an inert gas pressure could be used to hold the membrane in place on the tank top and thus reduce abrasion.

Structural studies and weight estimates were made to optimize tank arrangement and achieve smooth surfaces. Both new construction and conversion were dealt with.

Numerous membrane materials were considered and a tentative selection was made of nylon fabric with nitrile on both sides. This would be compatible with sea water and most oils.

Economic analysis indicates that a membrane system, when combined with the IMCO recommended B/15 double bottom, can increase RFR as little as 5 percent if the inert gas system is assumed already installed for safety reasons. Other assumptions increase the RFR with conversion of existing tankers being the most costly.

The study does indicate feasibility and economic competitiveness in some areas. Although numerous potential and real difficulties have been identified it seems premature to discontinue study and development of the concept at this time. The originally conceived feasibility study is, however, completed.

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STUDY III

RETENTION OF OIL ON BOARD

Lead country: United Kingdom
Associated countries: France, Japan and Soviet Union

This study analyses the "load-on-top" system as practised on various sizes of oil tanker and the special problems of operating it on short-haul and OBO carriers. It concludes that with minor exceptions, "load-on-top" can, on an average ballast voyage, keep the instantaneous rate of oil discharge and the total amount discharged well within the 1969 amendment limits. The greatest weakness is that the system as now practised relies too much on the human element.

Equipment and systems available and foreseen for improving "load-on-top" and reducing reliance on the human element are considered. The study concludes that, for tankers, significant improvements could be achieved, at an estimated maximum cost of £155 m for the existing world fleet, by universal adoption with suitable safeguards of recirculatory tank washing; installation of devices to monitor and/or control overboard discharges and of oily water separators for the approach to the oil/water interface in ballast and slop tanks. For existing non-tankers, at an estimated maximum cost of about £160 m, recommended measures are designing pipe arrangement to pass all bilge contents through a separator; providing holding tanks for use in port; developing an oil content meter capable of stopping discharge at a given oil content.

The study concludes that the improvements proposed should give a progressive reduction in LOT tanker discharges towards a theoretical minimum of 12,000 tons a year based on present movement of crude oil by sea.

This study suggests, as possible action for IMCO, endorsement of the proposed improvements to "load-on-top"; encouragement of recirculatory tank washing with safeguards; encouraging development of accurate oil content meters capable of cutting off unacceptable discharges; encouraging development of

high capacity oily water separators for ballast and slop tanks; further study of the special problems of short-haul and OBO carriers; and investigations of safe methods of burning oil residues in ships' boilers.

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STUDY IV

CLEAN TANKS FOR BALLAST PRIOR TO VESSEL SAILING

Lead country: France

Associated countries/Organizations: Germany, Federal Rep.of, Netherlands, Oil Companies International Marine Forum (OCIMF)

1. The Study IV report begins by giving a number of basic figures, also valid for other types of solutions: the crude oil traffic in 1975 and 1980 (number of ships of different classes and number of voyages), ballasting and cleaning requirements (duration of operations, amount of water and oil involved, and hence pollution per voyage and per year).

Present operating methods thus produce a total pollution estimated at 60,000 tons for 1975 and 90,000 tons for 1980, this assessment being made on the assumption that all tankers use the "load-on-top" procedure, and use it correctly.

2. Two main procedures are contemplated whereby the ship would only sail from the discharging port with clean ballast.

Procedure A consists of undertaking washing of tanks intended for ballast only after discharging operations have been completed, while procedure B provides that, in order to save time, washing should be begun while discharging is still taking place.

Procedure A requires that the washing operations should be carried out under inert gas; Procedure B also requires this, but in addition calls for the installation of a new stripping network.

3. Procedure A increases the immobilization of ships by between 50 per cent and 65 per cent according to their size, and thus requires additional berths in discharging ports. Its annual cost would be $190 million in 1975, and $280 million in 1980. Its cost per gross ton transported would be 11 cents, and the cost of prevention would be 3,200 dollars per ton.

Procedure B is more economical, but involves a more complex operation, which would perhaps not be feasible on all ships. Its annual cost would be $130 million in 1975 and $165 million in 1980. Its cost per gross ton transported would be 7 to 8 cents, and the cost of prevention would be 2,200 dollars per ton.

4. In conclusion, Study IV reveals certain problems:

- it would appear to be nearly impossible to implement effective control procedures;
- the problem of washing cargo tanks remains unsolved;
- in order to avoid discharging 60,000 tons of oil into the sea, it will be necessary to agree to the discharge after treatment of 3,000 tons of oil (5 per cent) in discharging ports.

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STUDY V

RETAINING DIRTY BALLAST ON BOARD FOR IN-PORT DISPOSAL

Lead country: Israel

Associated countries/Organizations: United States, Italy, Oil Companies International Marine Forum (OCIMF)

Study V refers only to oily waste generated by the crude oil traffic which consists of more than 80% of the oil carried at sea. The Ashkalon Terminal was used as a prototype for worldwide application.

One of the outstanding problems is the heavy pollution of the Mediterranean, which carries about 40% of the world crude oil and in particular the short haul character of a great part of this trade to which the present load-on-top procedure is not applicable.

Study V takes into consideration both the worldwide traffic and the Mediterranean situation, the last deeply surveyed by Italy and France in order to propose a solution effective for this area.

Insofar as the worldwide traffic is concerned, it has been calculated that in 1980, according to the '69 Amendments to the Convention, the maximum permitted amount of oil discharged into the sea reaches about 160,000 tons per year, while the on-shore reception and treatment system at 10 p.p.m. reduced the amount of oil discharged into the sea to about 8,000 tons per year, based on a figure of 800,000,000 tons of ballast carried annually.

The total investment cost for 1980, in this case, has been evaluated in Israeli study (MP XIII/2(a)/6) as 520 x 10^6 dollars (including buoy, submarine pipeline, storage tanks and treatment facilities) and the annual overall cost worldwide is 176 x 10^6 dollars (including operating cost of plant, ship delay time, additional berthage, the compensation for loss in transfer, capacity and amortization cost), with a unit cost per ton of crude oil handled at loading terminals of 0.073 dollars per ton neglecting the income

arising from reclaimed oil. A considerably high figure based on a different assumption has been submitted by OCIMF.

The on-shore reception and treatment of oily ballast water provides an effective means for substantially reducing the amount of oil discharged into the sea.

It is applicable to major loading ports and to existing tankers. Moreover in the Mediterranean where the problem of oil pollution prevention is of major significance, this system is particularly suitable.

Referring to the Mediterranean crude oil loading terminals not yet equipped with such facilities, the maximum investment cost for 1971 is estimated at 80 x 10^6 dollars, and increasing to 120 x 10^6 dollars in 1980.

Maximum overall cost of these facilities is estimated as 7 cents per ton of crude oil loaded. There are some indications that this figure can be significantly reduced by studying in greater depth the economic aspects associated with the system. It may be noted that the recovered oil may be sold as a low grade fuel.

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STUDY VI

THE ENVIRONMENTAL AND FINANCIAL CONSEQUENCES OF OIL POLLUTION FROM SHIPS

Lead country: United Kingdom

Associated countries: Norway and United States

Introduction

This note gives a brief summary of the main findings of the Study. There are three main sections dealing with:

a) the magnitude of oil discharges and likely future trends,

b) the biological effects of oil pollution, and

c) the economic consequences.

Most of the information was available from published sources but valuable assistance was obtained from the completed questionnaires circulated to IMCO Member Governments.

Discharges of Oil into the Oceans

1. This section attempts to estimate the amounts of crude oil and primary refined products currently entering world oceans from all major sources. Future trends incorporating alternative assumptions are projected.

2. The total quantity of petroleum hydrocarbons reaching the sea lies in the range of 2-5M tons p.a., divided roughly equally between marine and non marine* sources. Two-thirds of the marine discharges (say 1M tons p.a.) arise from tank washing and deballasting operations on tankers, and most of the remainder comes about equally from tanker accidents and ship bilge discharges. Discharges from L.O.T. operations contribute only 0.1M tons p.a. Three-quarters of all discharges occur in coastal areas.

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* In the sections of the report dealing with the biological consequences of oil pollution, the terms "marine" and "maritime" have different and precise meanings. Throughout the report the term "marine" has been used to describe operations occurring in or on the sea.

3. Only a fraction of the initial quantities of discharges from land-based origins may eventually reach the sea undegraded. The largest quantity comes from gaseous emissions of volatile oil products, which could amount to 25M tons p.a. Very little is known about the quantity of fall-out entering the sea, and this has not been included in the 2-5M tons total. Gaseous emissions apart, the bulk of the non-marine discharges reaching the sea probably comes from discarded lubricants.

4. In projecting future trends, the effect of various technological improvements must be set against the increasing quantities of oil likely to be produced, transported, refined, and consumed. It is estimated that with current L.O.T. efficiency and degree of adoption by the world tanker fleet, marine discharges could rise to 6M tons p.a. by the end of the century, of which up to 4M tons p.a. could arise from dirty ballast and tank washings from tankers. The contribution from L.O.T. operations to these figures would have risen to 0.4M tons p.a. If all tankers operated L.O.T. at maximum efficiency (as described in Study III report), marine discharges could be halved, with L.O.T. contributions at 0.04M tons p.a.

5. To limit the discharge of oil to 1/15000 of that transported by sea the whole world tanker fleet would need to operate L.O.T. and the procedure would need to be improved so as to halve the current average quantity of oil released. This would be assisted by a move towards larger tankers.

6. Tighter controls will probably be brought to bear increasingly on non-marine discharges, it is possible that by the end of the century the total discharges could be lower than at present.

7. Far greater amounts of hydrocarbons are released by natural processes such as the decay of animal and vegetable matter than the quantities of oil discharged from human operations. These could amount to many hundreds of millions of tons p.a., several millions of which arise in the sea directly.

8. In conclusion, this section of the study has shown how important operational discharges of oil are, as a contributor to discharges from maritime sources generally, and the consequences in terms of amounts discharged, of not adopting improved L.O.T. or equivalent measures.

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The Biological Effects of Oil Pollution

A review of the extensive literature on this topic was designed to identify the biological and ecological effects of (a) crude oil, (b) petroleum refinery products, (c) dispersants used in the clean-up operations following oil pollution incidents, and (d) materials like drilling fluids, on marine and maritime flora and fauna.

This review enabled us to conclude that the following factors have an important bearing on the effects of these substances:-

(a) crude oils, refinery products and the older types of dispersant with a high aromatic hydrocarbon content are inherently more toxic than those substances with low aromatic hydrocarbon content,

(b) the water soluble constituents (which are in general the most volatile components) of crude oils, refinery products, dispersants and drilling fluids are the components which are of most significance in determining their biological effects,

(c) pollution, either chronic or acute, in shallow and restricted waters presents a more serious hazard than similar forms of pollution in deeper and open waters,

(d) bad weather conditions prevailing at the time of an acute incident can result in the occurrence of emulsions of water in oil or oil in water, can result in a higher rate of solubility and thus higher local concentrations of oil in water. In extreme cases and in shallow waters this can result in impregnation of bottom sediments thus increasing its persistence,

(e) crude oils, refinery products when spilled in acute incidents, and dispersants undergo weathering processes which result in the rapid loss of the volatile and water soluble constituents. The extent of weathering depends upon factors like the elapse of time, intensity of sunlight, air and water temperature, sea currents, weather and wind conditions,

(f) the residues remaining after physical, chemical and biological degradation of crude oils and refinery products are tar lumps and the water soluble degradation products which are biologically insignificant.

We have come to the conclusion that, in general, laboratory experiments are a less reliable guide to the biological effects of oil pollution and associated related conditions, than are observations made in the field.

Field observations indicate that:-

(a) both chronic and acute oil pollution incidents, independently of the nature of the pollutant, do damage to bird life. Chronic oil pollution capable of producing an oil soaked spot from 1.5 cms diameter on the plumage of swimming and diving birds takes a steady toll of the world population. An acute oil pollution incident can result, in certain circumstances, in the death of up to 80% of a local bird population. The world population of the Jackass penguin is currently at risk of extinction. Local populations of auks and some species of duck are in decline locally and in danger of local extinction,

(b) the level of chronic oil pollution of the open ocean is so low as to be insignificant and the extremely localized effect of acute oil pollution incidents in this sphere is ecologically insignificant,

(c) the current level of chronic oil pollution, generally, in coastal waters, estuaries and harbours appears to have little ecological significance. In localized areas where severe chronic pollution occurs from land-based installations, damage of a local nature is done to littoral, sublittoral and salt marsh flora and fauna. Some fishery resources are affected by tainting,

(d) acute oil pollution incidents, particularly in shallow and confined waters in coastal or estuarine areas has caused minor localized damage to flora and fauna. In severe cases recovery to near normal conditions may take up to two years. In the case of some incidents the effects are undetectable,

(e) biodegradation of oil by bacteria, yeasts and fungi occurs at significant rates even at temperatures below freezing point. In coastal waters, where the supply of nutrients and temperature conditions are favourable, this is a potent force for the removal of oil from the environment,

(f) there is no evidence which points to the accumulation of the carcinogenic polycyclic aromatic hydrocarbons in higher animals or that such compounds can be passed up the food chain.

The Economic Consequences of Oil Pollution

In this section of the study it was found useful to divide the cost of oil pollution into two categories:

(1) Economic costs: deriving from the control and removal of oil spilled at sea and its clearance from the shore, effects on a) the tourist industry, b) demand for the sales of fish, c) birds consumed as food, as well as multiplied effects arising from these.

(2) Welfare reductions: which affect tourists, residents, water sportsmen, bird watchers and future generations of mankind.

The distinction between these two categories is that economic costs are those which involve increased expenditure or reduced income, whereas welfare reductions involve no actual monetary transaction but definite loss of satisfaction or utility.

From the limited data available the following conclusions were drawn.

(a) The only economic costs incurred are clean-up costs. From a survey of tourism we concluded that most people accept low-level chronic pollution as another uncertainty of a seaside holiday and there is no discernible effect on the income of the tourist industry. Insubstantial evidence exists connecting oil pollution with losses to the fishing industry and such losses of income are small relative to that of the industry.

(b) The major clean-up costs are those associated with acute incidents, much less than ½ of this figure is associated with chronic pollution. These costs are already largely internalized to the oil industry because restitution from the source of acute pollution is usually sought. Based on U.K. data, global expenditures on chronic pollution clean-up are likely to be of the order of millions rather than tens of millions of pounds sterling per annum.

(c) Attempts to quantify welfare reductions for United Kingdom suggest a figure of about £0.75M p.a. as the maximum value of avoiding the loss of a bird reserve of particular interest to nature lovers. Because United Kingdom is a relatively wealthy country whose population uses and has easy access to the sea, and has a fondness for animals this is likely to over-estimate the position in other countries. It would therefore be unrealistic to scale up this figure to achieve a world figure. It seems unlikely that the world value would be much in excess of £10M p.a. This is the magnitude of costs which might be absorbed by the oil industry and against which the costs of improved control procedures might be set.

Qualifications

Quite early on in the study it became clear that there are many areas where information is either very scanty or non-existent.

The most serious obstacle to making valid predictions about economic effects of oil pollution is the lack of understanding of the factors affecting ecosystems and the overall effect on the ecosphere. No quantitative model exists which explains even approximately the continual fluctuations in the marine ecosphere. It is therefore impossible to identify the effects of increased oil pollution. It is likewise impossible to predict the future effect on marine life of increases in existing pollution levels. Where information is inconclusive the authors have attempted to be positive by drawing what appear to them to be reasonable inferences, based upon the available expert opinions.

It is worth stressing, however, that in such a field of great uncertainty any practical measures taken to combat oil pollution must be guided very much by commonsense, avoiding the extremes of complacent inaction on the one hand and alarmist hysteria on the other.

Finally it must be emphasised that whilst there is no evidence to support panic anti-pollution measures, the uncertainties are such that there are many fields where further information is desirable. This applies particularly to the following:-

(a) The nature, quantities, and locations of discharges.

(b) The physical, chemical, and biological effects of such discharges.

(c) The degradation of oil, both at sea, in the soil, and in the atmosphere.

(d) The true economic consequences of oil pollution.

IMCO may wish to encourage the work in progress in these fields and to stimulate further work in order to reduce the considerable ignorance which exists.

STUDY VII

COLLECTION AND DISPOSAL OF SHIP-GENERATED DRY GARBAGE

Lead country: Soviet Union
Associated country: Finland

The study is being carried out in accordance with Section VII, Appendix II, of the Sub-Committee's Report (OP X/9 of 24 September 1971).

The study envisages the following Sections (in brief):

(a) Preliminary study of the problem, preparation of questionnaires for Members of the Sub-Committee, preparation and agreement on proposals for priority measures and long-term programmes.

(b) Elaboration and agreement on restrictions and prohibitions on the discharge of garbage overboard for inclusion into the draft International Convention of 1973.

(c) Development of technical requirements and recommendations regarding the construction of ships and their equipment.

(d) Development of technical requirements for international standard garbage receptacles which are interchangeable.

(e) Development of technical requirements and recommendations for shore facilities to accept ships garbage.

(f) Development of methods of recording the disposal of garbage and checking that the requirements of the Convention are observed.

The first report on this problem was submitted to the twelfth session of the Sub-Committee in January 1972. This was followed by notes on further progress of the investigation which were presented to the thirteenth session of the Sub-Committee in June 1972 and a second report which was submitted to the fourteenth session of the Sub-Committee in November 1972.

These documents described the results of an investigation on garbage accumulation on ships of the USSR Marine, the composition of garbage, considerations on the effect of garbage on sea life, suggestions as to the limitation of garbage discharged from ships and the provision of ports and ships with special equipment for the collection, handling and treatment of garbage.

An analysis of existing methods of collection, storage, disposal and accumulation of ship-generated garbage has proved that it would be too early to give clear-cut recommendations as to the wide application of specific methods, materials or equipment. Practical experience has to be accumulated and generalized taking account of types of ships, conditions of trade, port conditions and other factors.

The following priority steps are planned:

- To provide the ports with return stocks of standard metal containers (urban type), which will be supplied to ships for the period during which they are lying in port and installed on the piers at the ship's side; means will also be provided to transport the containers to urban dumps.

- Special places should be provided on board of floating oil skimmers when under construction, for the reception of not less than 20 metal containers from ships.

- It is also planned to utilize soft containers in the form of plastic bags and to develop devices to facilitate their filling and sealing on board.

It appears that this method may prove to be most effective on existing ships in the near future.

- Furnaces should be installed on large new passenger ships for the incineration of garbage and compression arrangements to compact the garbage should be provided. An investigation of this equipment during operation will enable optimum arrangements to be provided for ships under construction and existing ships.

- The following methods deserve attention and practical testing:

  (a) garbage compression under high pressure and temperature with the application of additives to produce strong slabs for subsequent utilization.

(b) grinding of some types of garbage and victual waste followed by discharging it into the sea after an appropriate sanitary treatment.

- an investigation of various port incinerators has shown that for the time being this method cannot be recommended for widespread application, as such units require substantial space, numerous personnel and rather expensive equipment to prevent atmospheric pollution.

In many cases it appears that it will be advisable to transport garbage to municipal incinerators.

The fulfilment of this task could probably be facilitated by units designed for precompression of garbage to 1/5 or 1/6 of its original volume, but a practical examination of the technical and economic aspects of this method is required.

Based on the investigation of the problem already carried out and on the papers submitted by Finland, Japan and the USA, Regulations for the Collection and Disposal of Ship-Generated Garbage have been developed and included in the 2nd and 3rd drafts of Annex IV to the draft International Convention for the Prevention of Marine Pollution, 1973.

The proposed versions of Annex IV were discussed and reformulated during the XIV Session of the Sub-Committee on Marine Pollution, by a Working Group including representatives of Canada, the Federal Republic of Germany, the Netherlands, Norway, the United Kingdom and the United States of America, as well as a representative of the International Chamber of Shipping. This Working Group found it expedient to place the Regulations applying to collection and disposal of garbage generated on ships in a separate Annex V, and to leave in Annex IV only the Regulations concerning waste water. At the Preparatory Meeting (12 February - 2 March 1973) a final draft of Annex V was prepared on the basis of proposals submitted by a number of delegations.

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STUDY VIII

SHIP-GENERATED SEWAGE TREATMENT AND HOLDING SYSTEMS

Lead country: Canada

Associated countries: Sweden, United Kingdom, Germany and United States

Eleven basic methods of treating shipboard sewage have been evaluated and estimates made of capacity, costs and installation feasibility. Various sewage quality criteria and standards are also described. The study reveals the difficulty of estimating on a general basis the cost requirements of sewage treatment systems due to the large number of variables that can apply in the case of each ship. Some systems such as retention, recirculating, aerobic and macerator-chlorinator systems already have an extensive background of use with the recirculating system being generally the most effective when all variables are taken into account. The remaining systems show promise with the evaporative and vacuum transport types appearing more suitable for short term development.

The cost of installing any of these systems in an existing ship is considerably more than it would be for a new ship. In the case of large passenger ships and other ships with large complements, installation on existing ships would probably be economically prohibitive. The initial installed capital cost on a new large cargo vessel averages $55,000 with an annual operating cost up to $10,000 depending on the variables. For new large passenger vessels a capital installed cost varies from $250,000 to $1,000,000 with operating costs up to $70,000 per year, depending on the type of system installed.

To sum up, cargo ships could, without undue difficulty, be fitted with sewage treatment systems suitable for use in all waters, but the cost would be much higher for existing vessels. The feasibility of installation of such systems in large passenger ships depends upon the routeing, time in port and the required effluent standards. At the present stage of technical development, such conversions would be economically prohibitive for the vast majority of existing passenger ships.

STUDY IX

POLLUTION CAUSED BY THE DISCHARGE OF NOXIOUS SUBSTANCES OTHER THAN OIL THROUGH NORMAL OPERATIONAL PROCEDURE OF SHIPS ENGAGED IN BULK TRANSPORT

Lead country: Norway

Associated countries/Organizations: Germany, Federal Rep.of Netherlands, Sweden, United States and the International Chamber of Shipping (ICS)

This study is based on information received through a questionnaire, prepared by IMCO's Sub-Committee on Marine Pollution during its X. session and subsequent investigations, laboratory and full scale tests.

The figures and evaluations in the report of the study only refer to liquid noxious substances other than oil and are based on information received through the questionnaire and updated as far as practicable according to information received from the subsequent investigations, laboratory and full scale tests. The quantities do not represent world wide totals for all liquid noxious cargoes other than oil carried in bulk by sea. It is believed, however, that the information received provides a satisfactory basis for determining the substances remaining in the cargo tanks after discharge and the quantities and concentrations of such cargoes when discharged into the sea in the course of normal operations.

Information received to the questionnaire showed that there has been shipped, on a world basis, in 1970 approximately 16,500,000 tons of liquid substances other than oil and about 260 different types of cargo. The quantity of liquid substances other than oil discharged into the sea during normal tank cleaning operations during 1970 amounted to slightly less than 10,000 tons.

On the basis of the completed questionnaires an analysis of the geographical distribution indicates that the main discharges occur in the following areas:

North Sea	36,0%
North Atlantic West	18,7%
Caribbean Sea	16,9%
North Pacific Far East	11,7%

As an estimate based on a questionnaire it was also assumed that the remains of cargo in ships with double bottoms - where the lower part is free of profiles, and where drainage is good - will be 0.5 tons/tank for low viscosity products and 1 ton/tank for high viscosity substances. In ships without double bottom the figures were estimated to be 1 ton/tank and 1,5 tons/tank respectively for the two types of cargoes. (Average tank size 1,000 m^3.)

In order to give a realistic indication of the quantity of cargo remaining in the tanks after unloading, a practical test has been undertaken. This was done by placing the necessary chemical equipment on board a Norwegian chemical tanker. A chemist attended the cleaning operation and made an analysis of the tank washings. The practical tests show that the amount of remains in cargo tanks after transport of insoluble viscous substances seem to be of the same magnitude that was expected by the first rough estimate. Some substances which are viscous and water soluble such as glycerol and 50% caustic soda solution, will according to the calculations made, leave much less residue in the tanks than expected. The remains in the cargo tanks of low viscosity products including different chlorinated organic compounds and solvents, such as styrene, will before cleaning be very small, generally less than 20% of what was expected.

Investigations and full scale tests regarding operational practices on board chemical tankers when disposing of tank washings proved that two main methods are currently used:

- Discharge into the sea over the ship's side through the manifold.
- Discharge into the sea below the water line and led into the ship's wake.

Presuming that the wash-water contains 2% of the transported cargo, full scale tests proved that the initial concentration after discharge into the sea through the ship's manifold, could be as high as 100 ppm. When tank washings were discharged below the water line and into the ship's wake, the maximum initial concentration were in the order of 1 ppm. The average time for the concentrations to drop to half the maximum initial value, was about 74 minutes. It is therefore recommended that all tanks washings which will be permitted to discharge into the sea are let out below the water line and led into the ship's wake.

Taking into consideration the criteria established by the Joint Group of Experts on the Scientific Aspects on Marine Pollution (GESAMP) and the subsequent classification by IMCO of noxious liquid substances other than oil, the following recommendations are proposed in order to protect the marine environment from operational discharges from these substances:

- Tank washings containing category A substances, as defined in the Draft Convention, should be delivered to shore reception facilities at the discharging berth immediately after discharge. A standard precleaning procedure should be established for each substance classified in pollution category A.

- Tank washings containing category B and C substances, as defined in the Draft Convention, should be discharged into the ship's wake through a slop tank and by means of an equipment approved by the Administration, which will give a concentration in the ship's wake in the order of 1 ppm. The discharge must be made at a certain distance from the shore and below the ship's water line while the ship is under way at a certain speed. A precleaning procedure should be established for substances classified in pollution categories B and C. This precleaning procedure should be permitted carried out at sea.

The purpose of a precleaning procedure is, as far as practicable, to remove the liquid cargo remains in the tanks, pumps and lines after discharge. When establishing a standard precleaning procedure it has been found correct to recommend two separate types of operational requirements. One type concerning category A substances and the other type concerning category B and C substances.

In order to establish a precleaning procedure as described above, laboratory and full scale tests have been undertaken.

The test results prove that the discharge criteria set out in the Draft Convention can be met for category A substances as well as category B and C substances. A reservation is made, however, for category A substances pending advice from GESAMP regarding the insignificant concentration level. Further, they confirm that the amount of cleaning liquid which, for category A substances has been proposed taken ashore, is within reasonable limits to recommend reception and treatment facilities ashore. At present shore reception facilities are very few and restricted to certain areas.

Further, full scale tests proved that ships equipped with certain pump and pipe arrangements may have a substantial amount of substances left in the pipelines in spite of blowing the lines prior to performing the tests. This is a technical matter which can be solved by fitting the appropriate equipment for draining of pipelines. The problem should be referred to IMCO Sub-Committee on Ship Design and Equipment for further studies.

A preliminary study on compatibility of tank-washings when pumped into the same slop-tank indicate that no dangerous reactions will take place. A study on explosion and fire risks while performing restricted precleaning alongside will be undertaken by International Chamber of Shipping (ICS). This study is expected to be finalised in due time for the forthcoming IMCO Marine Pollution Conference.

Two important pollution measures should be taken into account when evaluating the degree of effectiveness regarding pollution abatement:

- The prohibition of discharge into the sea of the most objectionable source of pollutants resulting from operations by tankers i.e. tank washings etc. containing category A substances which causes harmful bio-accumulation in marine organisms and/or are toxic in concentrations less than 1 ppm.
- The improved manner of discharging tank-washings etc. containing substances classified in pollution category B and C. These tank-washings etc. will due to the proposed solutions be discharged into the sea in acceptable concentrations in accordance with the hazard criteria presented by GESAMP.

APPENDIX

LIST OF DOCUMENTS ISSUED IN CONNEXION WITH NINE STUDIES

I. Initial submissions

OP X/2/5	- USA	-	Proposal to study different aspects of marine pollution prevention
OP X/2/6	- USA	-	Outline for Study of segregated ballast tankers
OP X/2/8	- UK	-	Comments on USA proposal (OP X/2/5)
OP X/2/11	- USA	-	Outline for a study of flexible membranes in tankers
OP X/WP.3	-		Outlines of six studies
MP XI/2/3	- UK	-	Standardization of costing procedure among countries undertaking studies
MP XI/2/5	- USA	-	Summary progress report on studies undertaken

II. Issued documents on:

Study I - Segregated Ballast Tankers

Lead country - USA
Associated countries- Norway and Sweden

MP XII/2(a)/2	- USA	-	Summary progress report
MP XIII/2(a)	- USA	-	Progress report
MP XIII/2(a)/Add.1	- USA	-	Plans of the study
MP XIII/2(a)/Add.2	- USA	-	Increased transportation cost $ per gallon of crude oil
MP XIII/2(a)/2	- USA	-	Summary progress report on the study of segregated ballast for small product and crude oil tanker
MP XIV/3(b)	- USA	-	Summary progress report
PCMP/2/2	- USA	-	Report on part 2 of Study I
PCMP/2/2/Add.1	- USA	-	A brief overview of Study I
PCMP/2/3	- France	-	Remarks on Study I

Study II - Dual purpose tanks with means to isolate oil or noxious materials from water

Lead country	-	USA	
MP XII/2(a)/9	-	USA	- Preliminary report
MP XIII/2(a)/3	-	Sweden	- Comments on Study II
MP XIII/2(a)/10	-	USA	- Interim report
PCMP/2/6	-	USA	- Final Report on Study II

Study III - Retention of oil on board

Lead country	-	UK	
Associated countries	-	USSR, France and Japan	
MP XII/2(a)	-	UK	- Preliminary Report
MP XIII/2(a)/4	-	Sweden	- Comments on Study III
MP XIII/2(a)/5	-	UK	- Final report

Study IV - Clean tanks for ballast prior to vessel sailing

Lead country	-	France	
Associated countries/ Organization	-	FRG, Netherlands and the Oil Companies International Marine Forum (OCIMF)	
MP XII/2(a)/6	-	France	- Report on Study

Study V - Retaining dirty ballast on board for in-port disposal

Lead country	-	Israel	
Associated countries/ Organization	-	USA, Italy and OCIMF	
MP XII/2(a)/4	-	Israel	- Report on Study
MP XII/2(a)/4/Add.1	-	Italy	- Synthesis of the technical/economical study concerning the installation of plants for the reception and treatment of ballast near loading terminals in the Mediterranean
MP XIII/2(a)/1	-	OCIMF	- Outline appraisal of Study V
MP XIII/2(a)/6	-	Israel	- An abridged and final report
MP XIII/2(a)/8	-	France	- Long voyages and short voyages - Tentative global solution
MP XIII/2(a)/15	-	Italy	- The comprehensive study of shore reception facilities in the Mediterranean

MP/CONF/INF.2

Study VI - The environmental and financial consequences of oil pollution from ships

Lead country - UK
Associated countries - Norway and USA

MP XII/2(a)/3	-	UK -	Preliminary report with the attachment - "Oil in the Marine Environment" by P.G. Jeffery
MP XII/2(a)/5	-	USA -	Studies relating to fate and effect of oil discharge and oil spills
MP XIII/2(a)/11	-	France-	Comments on study (principles relating to the formulation of requirements of Annexes I, II and III)
MP XIV/3(b)/1	-	UK -	Progress report
PCMP/2	-	UK -	Final Report on Study VI
PCMP/2/Add.1	-	UK -	Final Report on Study VI/Appendices 1-4

Study VII - Collection and disposal of ship-generated dry garbage

Lead country - USSR
Associated country - Finland

MP XII/2(a)/1	-	USSR -	Preliminary report
MP XII/2(a)/1/Add.1	-	Iceland -	Additions to Study VII
MP XIII/2(a)/13	-	USA -	Initial report on study
MP XIII/2(a)/14	-	USSR -	Interim report
MP XIV/3(b)/3	-	USSR -	Progress report

Study VIII - Ship-generated sewage treatment and holding systems

Lead country - Canada
Associated countries - Sweden, UK, FRG and USA

MP XII/2(a)/8	-	Canada -	Preliminary report
MP XIII/2(a)/7	-	Canada -	Final report
PCMP/4/19	-	USA -	Sewage Treatment Equipment (Reports)

Study IX - Pollution caused by the discharge of Noxious substances other than oil through normal operational procedure of ships engaged in bulk transport

Lead country	-	Norway	
Associated countries/ Organization	-	FRG, the Netherlands, Sweden, USA, International Chamber of Shipping (ICS)	
MP XII/2(a)/7	-	Norway	- Preliminary report
MP XIII/2(a)/12	-	USA	- Initial report on the technical and economic feasibility of onshore treatment and chemical tanker washings
MP XIII/2(a)/16	-	Norway	- Progress report
MP XIII/2(a)/17	-	Norway	- Summary statement on Study IX
MP XIV/3(b)/2	-	Norway	- Progress report
PCMP/2/1	-	Norway	- Final Report on Study IX

III. Related material and documents

MP XII/6	-	USA	- Polluting spills in US waters - 1970
MP XII/6/1	-	USA	- Summary of the state of the art of oil slick identification
MP XII/6/2	-	France	- Research on prevention of accidental spills
MP XII/6/3	-	UK	- Research on the problem of identification spills
MP XII/6/4	-	Netherlands	- Report on the follow-up investigation in respect of the Shell Sand-sink trial
MP XII/6/5	-	USA	- Treatment and disposal of vessel sanitary wastes
MP XIII/2(a)/9	-	France	- Summary of study on accidental marine pollution by oil (3 Vols in French only)
MP XIII/7	-	France	- Study on products for combatting oil pollution (dispersants, absorbants and sinking agents)
MP XIII/WP.4	-	Summaries of Studies (Annex II to MP XIII/8)	
OP IX/4/5	-	Finland	- Analysis of casualties to tankers in the Baltic, Gulf of Finland and Gulf of Bothnia in 1960 - 1969
OP X/2/10	-	USA	- Tanker casualty analysis
MP XI/8/1	-	USA	- Tankers and Ecology

DE IX/3/2	- USA	- An analysis of oil outflows due to tanker accidents
PCMP/2/4	- Norway	- A progress report on a study on possible improvement in the operation of crude oil tankers
PCMP/2/5	- USA	- Effects of oil pollution in the marine Ecosystem
PCMP/2/8	- Japan	- A report on the development and present situation of an oil pollution prevention system by the Retention on Board method
PCMP/2/8/Add.1	- Japan	- A report on the Oil Content Monitoring Device
PCMP/2/8/Add.2	- Japan	- Reports on oily-water separating system and equipment for tankers
PCMP/2/9	- USA	- Interim Report on oil discharge characteristics of product oil tankers
PCMP/4/11	- Netherlands	- Information on transport practices and operational pollution relating to refined oil products
PCMP/4/15	- Netherlands	- Information on cleaning of tanks of chemical tankers
PCMP/4/33	- UK	- Report on tests of non-persistent oil in the marine environment