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INSUFICIENCIA DE LAS INSTALACIONES DE RECEPCIÓN

Revisión del Manual general de la OMI sobre instalaciones portuarias de recepción

Nota de la Secretaría

RESUMEN	
Sinopsis:	En el Manual general de la OMI sobre instalaciones portuarias de recepción se facilitan orientaciones sobre la provisión de instalaciones portuarias de recepción para los desechos y residuos generados en los buques. Habida cuenta de los considerables avances normativos y técnicos que han tenido lugar desde su última edición en 1999, el MEPC 61 pidió que se revisara el Manual en el marco del PICT. El proyecto de Manual revisado figura en el anexo 2* del presente documento, para su aprobación por el Comité y posterior publicación.
Principios estratégicos:	Ninguna disposición conexa
Medidas de alto nivel:	Ninguna disposición conexa
Resultados previstos:	Ninguna disposición conexa
Medidas que han de adoptarse:	Véase el párrafo 6.
Documentos conexos:	MEPC 61/24 y FSI 18/5 (anexo 2).

Introducción

1 El Manual general de la OMI sobre instalaciones portuarias de recepción facilita orientaciones sobre la provisión, incluida la instalación y el funcionamiento, de instalaciones portuarias de recepción para los desechos y residuos generados en los buques, que constituye una parte importante de la implantación eficaz del Convenio MARPOL. El texto del Manual fue aprobado por primera vez por el MEPC 35 en marzo de 1994 y su capítulo 11 fue actualizado por el MEPC 42 en noviembre de 1998. El MEPC 35 acordó además que se imprimiera y distribuyera el Manual como una publicación de la OMI, cuya última edición data de 1999.

* En inglés solamente.

2 Habida cuenta de los considerables avances normativos y técnicos que han tenido lugar desde su última edición, incluida la entrada en vigor en 2003 y 2005 de los Anexos IV y VI del Convenio MARPOL, respectivamente, y la revisión completa de los Anexos II y V del Convenio MARPOL, el MEPC 61 acordó que era urgentemente necesario actualizar el Manual. Atendiendo a la petición formulada por el MEPC 61, la revisión del Manual se incluyó como punto prioritario en el Programa mundial del PICT correspondiente al bienio 2012-2013. A este respecto, se contrató a dos consultores para llevar a cabo una revisión completa del Manual basándose en las orientaciones elaboradas por el Grupo de trabajo por correspondencia para abordar el problema de las deficiencias de las instalaciones portuarias de recepción (FSI 18/5, anexo 2) y teniendo en cuenta todo avance normativo internacional relacionado con la provisión de instalaciones portuarias de recepción adecuadas, todo avance tecnológico y las actuales políticas nacionales de gestión de desechos.

3 El proyecto de texto de Manual revisado figura en los anexos 2 y 3[*] del presente documento. Habida cuenta de la magnitud de la revisión y para facilitar su consulta, no se han indicado los cambios introducidos en el proyecto de texto presentado. En el anexo 1, en cambio, se facilita una lista de las principales enmiendas. El proyecto de texto será corregido, revisado y formateado por la Secretaría antes de su publicación.

4 Teniendo en cuenta las consideraciones del Grupo de correspondencia pertinente del Subcomité FSI (FSI 18/5, anexo 2) sobre si las secciones 8.1.2 a 8.1.5 deberían ser más precisas, en el anexo 3 del presente documento se recoge un proyecto de texto alternativo y más breve para tales secciones. Se invita al Comité a que decida qué versión debería incluirse en el Manual final.

5 En consonancia con otras publicaciones recientes o previstas de la OMI, tales como "MARPOL – Cómo llevarlo a la práctica" o la publicación prevista "Gestión del agua de lastre – Cómo llevarla a la práctica", se propone armonizar el título de dicho Manual con estas publicaciones de modo que pase a ser "Instalaciones portuarias de recepción – Manual de instrucciones".

Medidas cuya adopción se pide al Comité

6 Se pide al Comité que tenga a bien:

.1 acceder a cambiar el título de la publicación de modo que pase a ser "Instalaciones portuarias de recepción – Manual de instrucciones" (párrafo 5);

.2 decidir qué versión de las secciones 8.1.2 a 8.1.5 debe utilizarse (párrafo 4); y

.3 examinar y aprobar el proyecto completo del Manual revisado que figura en el anexo 2, con miras a su posterior publicación.

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[*] En inglés solamente.

ANEXO 1

RESEÑA DE LAS ENMIENDAS PRINCIPALES

Prólogo

Se incluyó un prólogo que contiene elementos procedentes de la antigua sección 1.3 del capítulo 1 (Antecedentes). A su vez, se han suprimido tales elementos de la sección 1.3.

Capítulo 1 – Introducción

– Se ha actualizado teniendo en cuenta las enmiendas al Convenio MARPOL (por ejemplo, la inclusión del Anexo VI) y otras corrientes de desechos procedentes de los buques, tales como las que se mencionan en el Convenio internacional para el control y la gestión del agua de lastre y los sedimentos de los buques, 2004 (Convenio sobre la gestión del agua de lastre o Convenio BWM) y el Convenio internacional sobre el control de los sistemas antiincrustantes perjudiciales en los buques, 2001 (Convenio sobre los sistemas antiincrustantes o Convenio AFS); y

– se ha enmendado la visión general de la estructura del Manual para armonizarla con la ligera reestructuración de algunos capítulos (fundamentalmente los capítulos 5, 6 y 14).

Capítulo 2 – Marco jurídico

– Se ha actualizado la legislación con las modificaciones introducidas más recientemente en el Convenio MARPOL, teniendo presentes las zonas especiales y las ECA;

– se ha incluido información más detallada acerca del Convenio de Basilea sobre el control de los movimientos transfronterizos de los desechos peligrosos y su eliminación (Convenio de Basilea), el Convenio sobre la gestión del agua de lastre y el Convenio sobre los sistemas antiincrustantes;

– se ha actualizado el texto teniendo en cuenta la labor realizada en las reuniones del MEPC y en los Grupos de trabajo y de trabajo por correspondencia pertinentes, desde la última actualización del Manual en 1999; y

– se han reseñado todas las circulares y directrices pertinentes relacionadas con las instalaciones portuarias de recepción, incluidas las modificaciones subsiguientes de las definiciones e interpretaciones de términos tales como: adecuadas, demoras indebidas, GISIS, acuerdos regionales y zonas especiales.

Capítulo 3 – Elaboración de una estrategia de gestión de desechos para los desechos procedentes de los buques

– Se han aclarado los cambios generales de la estrategia de gestión de desechos con respecto a enfoques y opiniones generales (por ejemplo, la jerarquía en la gestión de desechos, el principio "cradle to cradle" (de cuna a cuna) y la gestión de materiales);

- se han incluido por todo el capítulo todos los cambios resultantes de las actualizaciones normativas del Convenio MARPOL, el Convenio BWM y el Convenio AFS, y las normas pertinentes de la ISO;

- se ha incluido un subcapítulo sobre la elaboración de un plan de gestión portuaria de desechos como parte de la estrategia de gestión de desechos; y

- se han introducido cambios de redacción y se han reestructurado los párrafos.

Capítulo 4 – Implantación nacional

- Se han introducido cambios de redacción; y

- se ha introducido un ejemplo de implantación de la legislación (conforme a la petición formulada por el FSI) y un programa de certificación voluntaria.

Capítulo 5 – Planificación para las instalaciones de recepción

- Se han introducido cambios de redacción;

- se ha introducido un cambio en la estructura del Manual mediante la inclusión del antiguo capítulo 6 sobre "Emplazamiento de las instalaciones portuarias de recepción" en el nuevo subcapítulo 5.2.6. Esto se debe fundamentalmente a que la elección del emplazamiento debería ser parte de la etapa de planificación/estudio, en lugar de un elemento independiente, que sólo se tiene en cuenta tras la fase de planificación;

- se ha modificado la estructura del antiguo capítulo 6: en lugar de dividir el capítulo por tipo de corriente de desechos, ahora se divide por tipo de instalación (móvil o fija). Para cada tipo de instalación, se hace una distinción entre corrientes de desechos líquidos y sólidos. Esta estructura se basa en un enfoque más práctico ya que, por ejemplo, una instalación fija puede recoger más de una corriente de desechos al mismo tiempo. Además, se evita una posible repetición;

- se ha suprimido la sección sobre instalaciones de tratamiento, tal como se había examinado en la antigua sección 6.3, puesto que la cuestión, abordada en tal grado de detalle, queda enmarcada en el capítulo 8 (equipo alternativo para recoger, almacenar y tratar los desechos generados por los buques);

- se ha puesto de relieve que, durante la planificación de una instalación portuaria de recepción y antes de que pueda comenzar la fase de construcción, es importante que se hayan aprobado los permisos y licencias necesarios; y

- se ha incluido un plan operativo de la instalación de recepción en el gráfico 4, conforme a la petición formulada por el Subcomité FSI.

Capítulo 6 – Planificación de la gestión de los desechos portuarios

- Habida cuenta de la importancia de la elaboración de un plan de gestión de desechos adaptado a las necesidades y las características del puerto en cuestión, se ha redactado un capítulo nuevo para abordar dicha cuestión.

Capítulo 7 – Tipos y cantidades de desechos generados por los buques

– Se ha actualizado teniendo en cuenta todas las modificaciones normativas introducidas en el Convenio MARPOL, el Convenio BWM y el Convenio AFS;

– se han introducido cambios de redacción; y

– se menciona el impreso de notificación previa como medio para compilar datos pertinentes, que sustituye al antiguo apéndice 1 del presente capítulo (semejante, pero desfasado).

Capítulo 8 – Equipo alternativo para recoger, almacenar y tratar los desechos generados por los buques

– Se han actualizado y perfeccionado ciertas técnicas, teniendo presentes nuevos residuos regidos por el Convenio MARPOL y otras corrientes de desechos procedentes de los buques desde la última revisión;

– se han introducido cambios de redacción;

– en respuesta a una observación formulada por el Subcomité FSI (que figura en el anexo 2 del documento FSI 18/5) sobre si esta sección podría ser más precisa, se ha redactado un texto alternativo más breve (anexo 2 del presente documento), y se ha actualizado asimismo la sección 8A existente (nueva sección 8.1). Se invita al Comité a que decida qué versión debería incluirse en el texto final del Manual;

– se ha suprimido el uso de lagunas como método de tratamiento ya que no debería alentarse la utilización de esta técnica cuando existan alternativas satisfactorias; y

– se ha incluido una sección sobre protección portuaria.

Capítulo 9 – Reciclaje de desechos generados por los buques

– Se han incluido opciones de reciclaje para los desechos regidos por los Anexos IV y VI del Convenio MARPOL y otros desechos relacionados con los buques tales como el agua de lastre y los sistemas antiincrustantes, y actualizaciones normativas para los desechos regidos por los Anexos I, II y V del Convenio MARPOL;

– se han suprimido las referencias a los procesos de mezclado, puesto que el mezclado de desechos oleosos en combustibles para usos marinos está prohibido en muchos casos;

– se ha actualizado el diagrama de flujo sobre desechos oleosos; y

– se han incluido referencias a la economía circular y la utilización de desechos como materias primas.

Capítulo 10 – Opciones para la eliminación final

– Se han vuelto a numerar los gráficos y los diagramas de procesos, que se han incluido en las secciones correspondientes;

– se han incluido opciones para la eliminación con respecto a los Anexos IV y VI del Convenio MARPOL, el agua de lastre y los desechos de sistemas antiincrustantes; y

– se han actualizado o suprimido técnicas de eliminación (por ejemplo, labranza en lo que respecta a los desechos regidos por el Anexo I del Convenio MARPOL).

Capítulo 11 – Establecimiento y explotación de las instalaciones de recepción (incluidos los mecanismos de financiación)

– Se han actualizado las características de cada sistema de recuperación de costos en consonancia con prácticas modernas y actuales;

– se han incluido referencias a la norma ISO 21070 sobre la gestión de las basuras a bordo (por ejemplo, con respecto a la segregación de la basura);

– se han incluido cuestiones relacionadas con la posible recuperación de los costos en lo que respecta a los desechos regidos por el Anexo VI del Convenio MARPOL y otros desechos relacionados con los buques (agua de lastre y sistemas antiincrustantes); y

– se han actualizado las referencias y direcciones de organizaciones financiadoras internacionales.

Capítulo 12 – Coordinación entre las prescripciones aplicables al puerto y las aplicables al buque

– Se ha incluido la referencia a la Guía de la OMI de buenas prácticas para los proveedores y usuarios de las instalaciones portuarias de recepción (MEPC.1/Circ.834); y

– se ha incluido una explicación más detallada de la notificación de supuestas deficiencias de las instalaciones de recepción.

Capítulo 13 – Opciones para el cumplimiento y el control

– Se han incluido referencias a la Guía de buenas prácticas de la OMI, actualizada (MEPC.1/Circ.834);

– se han explicado en más detalle las funciones de los órganos encargados del cumplimiento, tales como la supervisión por el Estado rector del puerto, y se ha introducido un nuevo diagrama de procesos (figura 33 – Posible plan de inspecciones como parte de la supervisión por el Estado rector del puerto contemplada en el Convenio MARPOL); y

– se ha introducido a redes internacionales y locales de cumplimiento.

Capítulo 14 – Situaciones específicas

– Se han incluido los desechos regidos por el Anexo VI del Convenio MARPOL (referencia específica a sustancias que agotan la capa de ozono); y

– se ha incluido una nueva sección sobre acuerdos regionales para los pequeños Estados insulares en desarrollo (PEID).

Capítulo 15 – Lista de comprobaciones

– Se han introducido cambios de redacción.

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ANNEX 2

DRAFT REVISED TEXT OF THE COMPREHENSIVE MANUAL ON PORT RECEPTION FACILITIES ("PORT RECEPTION FACILITIES - HOW TO DO IT")

PORT RECEPTION FACILITIES - HOW TO DO IT

London 2014

First published in 1995

by the INTERNATIONAL MARITIME ORGANIZATION

4 Albert Embankment, London SE1 7SR

Second edition 1999

Third edition 2014

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Foreword

The development of the first *Comprehensive Manual on Port Reception Facilities* was agreed at the 32nd session of the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) in March 1992. A Working Group on Port Reception Facilities was established to draft a comprehensive manual on the provision of adequate port reception facilities, and the Manual was approved by the 35th session of MEPC in March 1994, and published in 1995.

In 1999 a new chapter 11 on the establishment and operation of port reception facilities was included, as well as some editorial changes made to the other chapters. These amendments were approved by the MEPC at its 42nd session in November 1998.

The 2014 edition does not only contain updates on the regulatory framework and several waste management methods, it also broadens the scope of the original manual. The revised Manual is no longer limited to guidance regarding the provision of port reception facilities for MARPOL residues (Annexes I to VI), it also provides practical guidance relating to the management of other ship-generated waste streams such as ballast water sediments and waste from the application or removal of anti-fouling systems controlled in Annex 1 of the AFS Convention. Also, the title has been changed to *Port Reception Facilities – How to do it.*

The Manual still provides practical information to Governments and competent (port) authorities, in particular those in developing countries, as well as the shipping industry, agencies and waste contractors seeking assistance when implementing MARPOL. It also provides guidance on how to tackle possible inadequacies, as, in order to fully comply with MARPOL, a party State has to ensure the provision of adequate port reception facilities meeting the needs of ships entering their ports, without causing undue delay to the ships.

Although once landed ashore ship-generated waste does no longer fall within the scope of MARPOL, this Manual also explicitly elaborates on the further downstream management of the waste. Hence, an adequate port reception facility must allow for the ultimate disposal of ship-generated waste in an environmentally sound manner.[1]

[1] IMO resolution MEPC.83(44) - *Guidelines for Ensuring the Adequacy of Port Waste Reception Facilities.*

CHAPTER 1 - Introduction

1.1 User guide

This Manual provides guidance on the provision of reception facilities for ship-generated waste, as part of the implementation of the International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto, and as further amended by the Protocol of 1997 (MARPOL).

Widespread use of this Manual will help overcome problems related to the implementation of this portion of MARPOL.

MARPOL requires the government of each party to ensure the provision of adequate port reception facilities without causing undue delay. A port reception facility is anything which can receive shipboard residues and mixtures containing oil, noxious liquids, sewage, garbage, ozone-depleting substances or residues from exhaust cleaning systems. Type and size of the facility depend on the needs of the ships visiting a port. Where a simple garbage bin and a barrel for waste oil may suffice in a small port, another will need large storage tanks for the reception of residues and mixtures containing oil or noxious liquids.

Using the Manual will allow the provision of the necessary reception facilities separately or as part of a wider waste management strategy. Where there is such a waste management strategy in operation, port reception facilities for ship-generated waste can be integrated with the normal port or local waste management processes. This will often be at relatively low cost. Any new facilities can also be integrated with other shipping-related processes designed to safeguard human health and the environment, such as quarantine arrangements.

For parties to MARPOL, failure to establish adequate facilities is a breach of international obligations and will increase the risk of illegal discharges from ships. Where they can, ship operators will favour ports with good services at reasonable cost.

When MARPOL was developed and adopted, the general view was that its Annexes would cover all types of ship-generated substances which were considered harmful to the marine environment. In subsequent years, however, it has become clear that other types of ship-related residues need to be regulated as well. Therefore, also the management of the following waste streams will be discussed in this Manual:

- Ballast water sediments: the *International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004* (the Ballast Water Management Convention or BWMC) requires that party States ensure the provision of adequate reception facilities for the reception of sediments in ports and terminals where cleaning or repair of ballast tanks occurs (Article 5). Such reception facilities shall operate without causing undue delay to ships and shall provide for the safe disposal of such sediments. While the BWMC only requires port reception facilities for sediments, the guidelines to the BWMC also refer to the provision of reception facilities for ballast water (*Guidelines for Ballast Water Reception Facilities (G5)* (resolution MEPC.153(55)); and

- Wastes generated by the application or removal of anti-fouling systems controlled in Annex 1 of the *International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001* (AFS Convention): party States have to take appropriate measures to require that these waste streams are collected, handled, treated and disposed of in a safe and environmentally sound manner.

Since the above-mentioned waste streams are only generated during specific moments in the lifetime of a ship (e.g. during maintenance, repairs or conversion operations) and are not necessarily to be discharged in every port of call, the need for the provision of port reception facilities for these types of waste clearly differs from those for MARPOL residues. For these specific waste streams, the focus in this Manual will therefore be on their storage and treatment, and not on the provision of the port reception facilities.

1.2 Organization of the Manual

The Manual has been prepared bearing in mind that action will be required at different government and port operation levels, and the roles of each may be very different.

The Manual also recognizes that in some parts of the world there will be bilateral or multilateral arrangements which relate to the provision of port reception facilities and waste management.

Readers who need to have a complete overview of MARPOL and of their responsibility for the provision of reception facilities, may wish to proceed chapter by chapter through the Manual.

A section describing specific situations is included in chapter 14. It deals with the unique problems associated with provision of port reception facilities for small ships or in cases where regional arrangements are in place. Government and regional officials will find guidance on their MARPOL obligations and how they relate to national, regional or local waste management strategies in chapters 2, 3, 4 and 11. This will help them participate as necessary in developing programmes for implementing adequate waste reception and treatment arrangements for ports within their jurisdictions.

Chapters 5 to 12 will be useful to agencies responsible for planning the establishment of port reception facilities and integrating them into a broad waste management strategy. Managers and operators of ports will find practical guidance in chapters 5 to 9 for establishing facilities in the port areas under their control. These chapters set out major options, and provide a basis for pursuing more detailed technical advice. Many managers and operators with responsibilities for waste treatment and cost recovery will be assisted by chapters 10 and 11.

Whilst the need for reception facilities in a port is essential for ship-generated waste, the facilities needed for the proper collection of ballast water sediments and wastes from the application or removal of anti-fouling systems are clearly of a different type, as the focus there will be on the storage and treatment. The collection, management and final disposal of MARPOL-residues will be discussed in chapters 7 to 10.

The structure of the Manual is presented in figure 1 below.

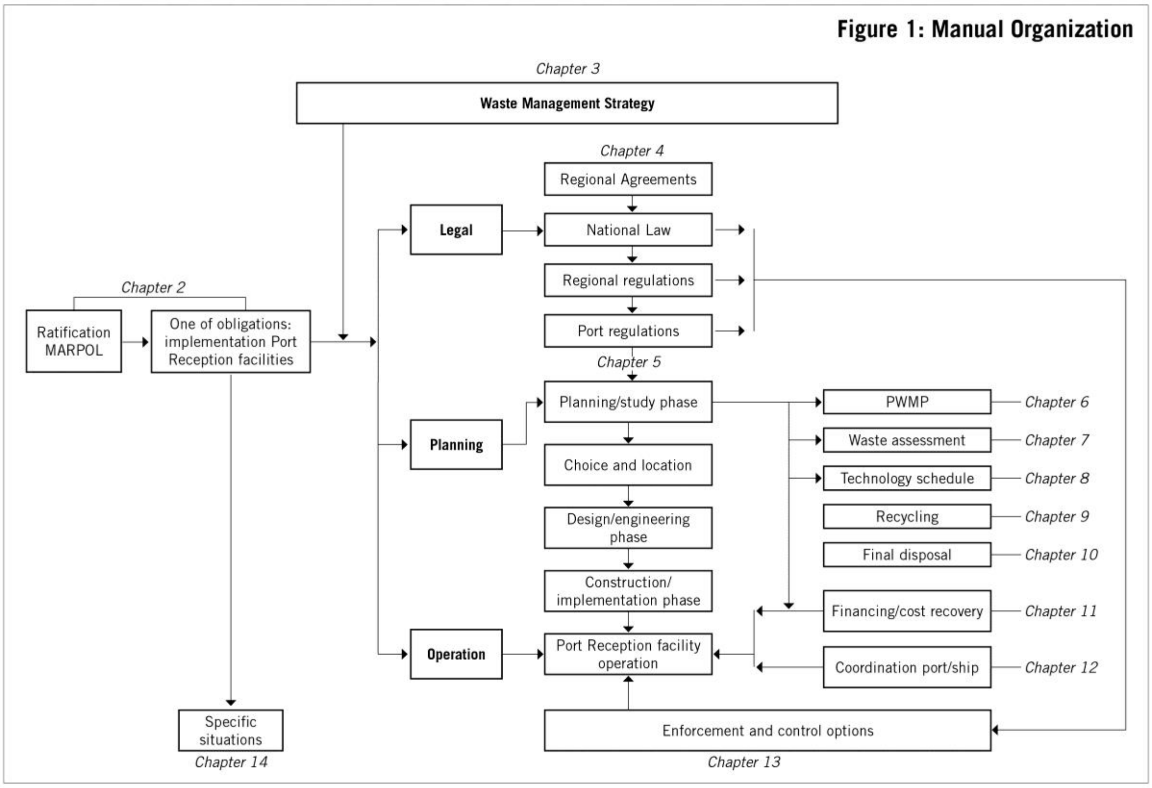

Figure 1 - Manual organization

CHAPTER 2 - Legal Background

2.1 Major elements of the present policy framework at international level

2.1.1 MARPOL Convention

In the 1950s and late 1960s, the international community developed international institutions and legal instruments to cope with the mounting volumes of wastes discharged into coastal waters or disposed of offshore. Now, a number of global and regional institutions and instruments exist, both within and outside the UN system, for the protection and preservation of the marine environment.

The first international convention to control oil pollution from ships was the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 (OILPOL 54). Despite several important amendments (1962 and 1969), the OILPOL Convention had some serious shortcomings that effectively defeated its purpose. OILPOL 54 requires Contracting Parties to take all appropriate steps to promote the provision of adequate reception facilities. However, the provision of port reception facilities was left to the discretion of port States and was, therefore, not a requisite condition for compliance with OILPOL 54. This is regarded as one of the main reasons why the installation of reception facilities did not progress satisfactorily.

In order to achieve the complete elimination of intentional pollution of the marine environment by oil and other harmful substances as well as the minimization of accidental discharge of such substances, the International Conference on Marine Pollution developed the International Convention for the Prevention of Pollution from Ships, 1973, to replace OILPOL 54. The Convention was further modified by the Protocol of 1978. The most commonly used short title for the *International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto* was MARPOL 73/78. The Convention has subsequently also been modified by the Protocol of 1997, whereby a sixth Annex was added. The Convention and its six Annexes as a whole are today generally referred to as MARPOL (the *International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, and as further amended by the Protocol of 1997)*. The Articles and Protocols provide the general framework, whereas the Annexes contain detailed and stringent regulations for the prevention of pollution.

Any reference in this Manual to MARPOL means the Convention, its Protocols and its Annexes which contain regulations for:

- the prevention of pollution by oil (Annex I);
- the control of pollution by noxious liquid substances in bulk (Annex II);
- the prevention of pollution by harmful substances carried by sea in packaged form (Annex III);
- the prevention of pollution by sewage from ships (Annex IV);

- the prevention of pollution by garbage from ships (Annex V); and
- prevention of air pollution from ships (Annex VI).

Annexes I and II are mandatory, and States ratifying or acceding to MARPOL must give effect to the provisions of these two Annexes. Accession to the other Annexes is optional, and States may decide if and when they are ready to do so.[2] To date (July 2014), all Annexes have entered into force[3].

The ability to fully comply with the discharge requirements of Annexes I, II, IV, V and VI of MARPOL is dependent upon the availability of adequate port reception facilities. Annex III does not require the provision of port reception facilities.

To remedy the shortcomings of OILPOL 54, MARPOL uses stronger and more positive wording on the provision of port reception facilities. Each Party undertakes to ensure the provision of adequate facilities at ports and terminals to meet the needs of ships using them, without causing undue delay. It also specifies the categories of ports and terminals which require reception facilities together with their capacities.

To reduce and eliminate pollution from ships, the provision of adequate port reception facilities is an indispensable requisite. Parties to MARPOL have the right of a port State to take action to ensure that ships comply with MARPOL requirements. Port State authorities can inspect such ships to verify documentation and determine if the ship has discharged or is likely to discharge harmful substances in violation of the regulations.

Enforcement of pollution control regulations is not an easy task and its success depends on the concerted efforts of all Parties involved. Therefore, the Convention requires that Parties cooperate in the detection of violations and the enforcement of the provisions of the Convention, using all appropriate and practicable measures of detection and environmental monitoring, adequate procedures for reporting and accumulation of evidence.

The main elements of MARPOL are summarized in table 1.

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[2] Article 14(1) of MARPOL reads: "A State may at the time of signing, ratifying, accepting, approving or acceding to the present Convention declare that it does not accept any one or all of Annexes III, IV and V (hereinafter referred to as "Optional Annexes") of the present Convention. Subject to the above, Parties to the Convention shall be bound by any Annex in its entirety.

[3] Annex I: 2 October 1983;
Annex II: 6 April 1987;
Annex III: 1 July 1992;
Annex IV: 27 September 2003;
Annex V: 31 December 1988 (and revised from 1 January 2013); and
Annex VI: 19 May 2005.

Five of the six Annexes to MARPOL have regulations requiring the provision of adequate port reception facilities for:

Annex I	Oil: in loading ports, ship repair yards, bunkering ports (regulation 38);
Annex II	Noxious Liquid Substances (NLS) in bulk: in ports and terminals an adequate reception needs to be present for cargo residues resulting from compliance with Annex II and in ship repair ports where repair to NLS-tankers can take place (regulation 18);
Annex IV	Sewage: ports and terminals in all areas and in special areas in particular when ports and terminals are used by passenger ships (regulations 12 and 13);
Annex V	Garbage (including cargo associated waste and cargo residues not covered by other Annexes): all ports handling ships in national and international trade (regulation 8); and
Annex VI	Ozone-depleting substances together with equipment and materials (such as insulation foams) containing the same: in ports, terminals, repair ports and ship recycling facilities; residues from exhaust gas cleaning systems as these are developed and enter into service: in ports, terminals, repair ports (regulation 17).

Discharge into the sea of oil, chemicals, sewage and garbage resulting from the normal operation of ships is strictly limited and/or prohibited.

Most stringent discharge limits are applicable in Special Areas. The following areas have been designated as Special Areas for one or more Annexes:

Mediterranean Sea,	Black Sea,	Baltic Sea,
North Sea,	Red Sea,	the Gulfs area,
Gulf of Aden,	Wider Caribbean,	Antarctic area,
North West European waters,	Oman Area,	Southern South Africa waters.

Stricter requirements regarding sulphur content in bunker fuel in Emission Control Areas (ECAs) might have an effect on waste production, e.g. MARPOL Annex I and Annex VI residues, in these areas:

Baltic Sea (SO_x), North Sea (SO_x), North American (SOx, NO_x and PM) and United States Caribbean Sea ECA (SO_x, NO_x and PM)[4].

Setting strict ship construction and equipment standards which minimize to a practicable extent the release of oil and chemicals in case of an accident.

Provision for mandatory ship inspections and surveys to ensure compliance with international standards.

Reporting without delay incidents involving oil, noxious liquid substances in bulk and harmful substances in a packaged form.

[4] Date of entry into force: 1 January 2013; in effect from 1 January 2014.

Cooperation between Governments in the detection of violations and enforcement of the rules. Take account of changes in technology and international seaborne trade through rapid "tacit amendment" procedures. Promotion of technical cooperation.

Table 1 – Main elements of MARPOL

2.1.2 UNEP, UNCLOS and Basel Convention

The need for concerted efforts was also recognized and reaffirmed in various regional seas conventions drafted under the auspices of the United Nations Environment Programme (UNEP). These conventions generally declare that the States Parties shall take all appropriate measures conforming to international law to prevent, abate, combat and control pollution caused by ships and ensure effective implementation of applicable international rules for the different types of pollution[5].

It is generally accepted that when taking measures to prevent or control (marine) pollution, these measures should not lead to merely transferring wastes and pollution from sea to land. This has been stated in Article 195 of the UN Convention on the Law of the Sea (UNCLOS):

"In taking measures to prevent, reduce and control pollution of the marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another."

Other articles of UNCLOS also refer to prevention of pollution[6]. Although MARPOL requires the provision of port reception facilities, this does not mean that a Party's responsibility ends with the provision of adequate facilities to receive ship's waste; within the requirements of the global framework there is also a responsibility to ensure the proper treatment and disposal of these wastes, along with other land-generated wastes. This requires an appropriate policy for waste management (as will be explained further in chapter 3).

It is also relevant to refer to the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (Basel Convention). This Convention was adopted on 22 March 1989 and entered into force on 5 May 1992, the ninetieth day after the date of deposit of the twentieth instrument of ratification, acceptance, formal confirmation, approval or accession by a country to the Convention.

The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as "hazardous wastes", based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" – household waste and incinerator ash.

Besides the restriction of transboundary movements of hazardous wastes, the Basel Convention also focuses on the reduction of hazardous waste generation and the promotion

5 For examples of Regional Seas Conventions: http://www.unep.org/regionalseas.

6 Article 194 of UNCLOS encourages States to harmonize their policies, and Article 211 of UNCLOS requires that States shall adopt laws and regulations for the prevention, reduction and control of pollution of the marine environment for flag vessels which at least have the same effect as that of generally accepted international rules and standards through the competent international organization or general diplomatic conference.

of environmentally sound management of hazardous wastes, wherever the place of disposal. In order to determine in what way provisions of the Basel Convention might apply, or not, to waste generated on board ships, a legal analysis was prepared by the Secretariat of the Basel Convention.

In general, this legal analysis states that the provisions regarding the transboundary movements of hazardous wastes do not apply to waste originating from the normal operation of a ship, when on board the vessel. Once they are offloaded, it is clear that the principles regarding the environmentally sound management do apply to these waste streams[7].

Through successive decisions, Parties to the Basel Convention have also underlined the importance of close cooperation between the Basel Convention and the International Maritime Organization, in order to tackle common problems as efficient as possible by a holistic approach.

Along with the Basel Convention, guidelines were developed regarding the management of certain waste streams, such as household and oily waste. These guidelines can be downloaded through the Basel Convention's website (www.basel.int).

2.1.3 Ballast Water Management and Anti-Fouling Systems Convention

The Ballast Water Management Convention (BWMC) requires that party States, in ports and terminals designated by those party States where cleaning or repair of ballast tanks occurs, ensure the provision of adequate reception facilities for the collection of the sediments, taking into account the *Guidelines for ballast water reception facilities* (G5) (resolution MEPC.153(55)) developed by the IMO. Where the obligation in the BWMC only refers to the provision of reception facilities for sediments, the guidelines take into account provisions for reception facilities for ballast water.

Furthermore the Anti-Fouling Systems Convention stipulates (AFS Convention) that party States shall take appropriate measures within their territory to require that wastes from the application or removal of anti-fouling systems, controlled in Annex 1 of the AFS Convention, are collected, handled, treated and disposed of in a safe and environmentally sound manner to protect human health and the environment.

Since these facilities are located at ship repair or recycling yards, the focus throughout this Manual will be mainly on the environmentally sound storage and treatment of these waste streams rather than on the provision of reception facilities in a port.

2.2 Role of IMO and MEPC

The International Maritime Organization (IMO) is the only specialized agency of the United Nations wholly dedicated to maritime affairs. Over the years it has developed a co-ordinated scientifically and technically oriented strategy for the protection of the marine environment from pollution generated by the shipping industry. Recognizing that in the environmental field activities of IMO were becoming increasingly involved with related activities of other UN bodies and organizations was an important reason for the establishment of the Marine Environment Protection Committee (MEPC). MEPC is a permanent Committee to execute and coordinate all activities of the Organization relating to the prevention and control of pollution of the marine environment from ships. It is the main expert body of IMO, composed of experts nominated by Governments, industry, environmental organizations and other organizations interested in the protection of the marine environment.

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7 For a complete and in-depth study of the legal analysis: http://www.basel.int/Implementation/LegalMatters/Ships/tabid/2405/Default.aspx.

With respect to the provision of port reception facilities, MEPC has always stressed that Governments in assessing the adequacy of port reception facilities should also consider the technological problems associated with the treatment of the wastes received and the ultimate disposal of garbage and of the residue and effluent from the reception and treatment facilities.

Therefore, States should be encouraged to take responsible action within their national environmental programmes and to consider such disposal and effluent standards along with other shore-generated wastes.

To facilitate this process, the short term work programme adopted at the first MEPC meeting (1974) included inter alia the development of new techniques and methods for cleaning, recycling and disposing of harmful substances and the promotion of support for those States which request technical assistance.

Since then, the subject of port reception facilities has been on the agenda of virtually all meetings of the MEPC. In that time, various working and correspondence groups have been established and much progress has been achieved, as several guidelines and circulars have been navigated through and adopted by the Committee. The most important and comprehensive documents, besides this Manual, worthwhile mentioning are the following:

- MEPC.1/Circ.834: *Consolidated Guidance for Port Reception Facility Providers and Users*, which is intended to be a practical users' guide for ships' crews who seek to deliver MARPOL residues/wastes ashore and for port reception facility providers who seek to provide timely and efficient port reception services to ships, containing an updated advanced notification form, the waste delivery receipt and a revised format for reporting alleged inadequacies;

- Resolution MEPC.83(44): *Guidelines for ensuring the adequacy of port waste reception facilities*, containing in its appendix a sample assessment procedure for ports;

- Resolution MEPC.219(63): *2012 Guidelines for the implementation of MARPOL Annex V*, providing assistance for port and terminal operators in assessing the need for, and providing, adequate reception facilities for ship-generated garbage; and

- Resolution MEPC.199(62): *2011 Guidelines for reception facilities under MARPOL Annex VI,* providing assistance for port and terminal operators in assessing the need for and providing adequate reception facilities for ozone-depleting substances (ODS) and exhaust gas cleaning residues.

Within the IMO, it is mainly the Sub-Committee on Implementation of IMO Instruments (III) (formerly known as the Flag State Implementation Sub-Committee (FSI)) that in the recent years reported frequently to the MEPC on the issue of tackling the inadequacies of port reception facilities. The MEPC, at its 55th session in October 2006, approved an Action Plan to tackle the alleged inadequacy of port reception facilities developed by FSI.

The Plan contains work items aimed at improving the provision and use of adequate port reception facilities, including work items relating to reporting requirements; provision of information on port reception facilities; identification of any technical problems encountered during the transfer of waste between ship and shore and the standardization of garbage segregation requirements and containment identification; review of the type and amount of wastes generated on board and the type and capacity of port reception facilities and development of the *Guide to Good Practice on Port Reception Facilities*. Moreover, it also contained the work item on the revision of this Manual.

2.3 What are adequate facilities?

In order to fully comprehend the issue and proceed through this Manual, it is very important to fully comprehend the terminology used. Therefore, these terms, which are frequently used, are explained in the following sub-chapters.

With respect to the provision of adequate port reception facilities, the obligations of contracting parties have been defined by MEPC. As the contracting parties acquire more experience with the implementation of the regulations, these definitions will evolve.

2.3.1 Adequacy

The IMO has agreed[8] that:

"To achieve adequacy the port should have regard to the operational needs of users and provide reception facilities for the types and quantities of wastes from ships normally visiting the port."

Notwithstanding the above, adequate facilities can be defined as those which:

- mariners use;
- fully meet the need of ships regularly using them;
- do not provide mariners with a disincentive to use them; and
- contribute to the improvement of the marine environment.

Furthermore the provided facilities must allow for the ultimate disposal of ships' waste to take place in an environmentally appropriate way.

As a minimum, the capacity of reception facilities at cargo unloading, loading, and repair ports and terminals should be capable of receiving those residues and mixtures which are handled within that port and which must be discharged to reception facilities. All ports including marinas and fishing ports, regardless of size, will need to provide adequate facilities to receive garbage and waste oil from engines, etc. Larger ports, with more and various types of ships calling, will need to provide more extensive reception capacity (e.g. for cargo residues, bilge water, quarantine waste, etc.).

The receiving capability should be at least appropriate in time and availability to respond to the continuing needs of ships using the port. Arrangements needed to facilitate the discharge of residues, mixtures and all types of waste without causing undue delay to ships, such as prior notification of substances and quantities expected for discharge, piping or equipment required for discharge etc. are made between the ship and the reception facility.

Governments should ensure that the formalities for the use of reception facilities, particularly customs, health and environmental formalities should be as simple and expeditious as possible in order to avoid undue delay of the ship.

Governments should also ensure that the costs for receiving and processing wastes should be covered in such a way that fees, if charged, would not provide a disincentive for the use of the port reception facilities (for compliance incentive systems see chapter 11).

[8] Resolution MEPC.83(44) – *Guidelines for ensuring the adequacy of port waste reception facilities.*

2.3.2 Undue delay

The master or the owner of a ship or his authorized representative should notify the appropriate authority in good time, but generally not less than 24 hours before discharge is expected to take place. Any special or unusual wastes should also be reported at this time.

The request to use the reception facility should contain all relevant information with respect to substances and quantities expected for discharge, expected time of arrival (ETA) and expected time of discharge, berth, etc. The time of transfer should be mutually agreed upon and transfer of waste should take place during the cargo-handling working hours of the port unless the ship's normal call at the port is not at a time within this period.

The Standard Format of the Advance Notification Form for Waste Delivery to Port Reception Facilities (MEPC.1/Circ.834) can be used to enhance the waste delivery by notifying the providers of port reception facilities of the intention to use the facilities.

Undue delay may arise when the time spent in port for the disposal of residues, mixtures or wastes goes beyond the normal turn-around time of the ship in that port, unless the delay is caused by fault of the ship, its master, its owner or his authorized representatives, safety requirements or the normal port procedures.

2.3.3 GISIS: Information on port reception facilities and alleged inadequacies

Governments shall supply to the Organization information on reception facilities available in ports, in accordance with article 11(d) of MARPOL. The received information is available on IMO's Global Integrated Shipping Information System (GISIS) web site[9]. The Port Reception Facilities Database (PRFD) went live to the public on 1 March 2006, as a module of GISIS. The PRF module is available to the general public, and provides data on facilities for the reception of all categories of ship-generated MARPOL waste in ports worldwide. Data on reception facilities can only be uploaded by the respective Member States via a log-in and password, while the public is allowed free access, following a simple registration, to all the information on a view-only basis[10].

In addition to this database, the PRF module on GISIS also contains information on cases of alleged inadequacies as well as on the procedure for reporting these alleged inadequacies. Reports of alleged inadequacies shall be submitted to IMO without delay using the *Revised consolidated format for reporting alleged inadequacies of port reception facilities*, which can be found in MEPC.1/Circ.834. Flag States are requested to distribute the revised format to ships and urge masters to use this format to report alleged inadequacies of port reception facilities to the Administration of the flag State and, if possible, to the authorities of the port State; to notify IMO, for transmission to the Parties concerned, of any case where facilities are alleged to be inadequate; and to inform the port State of the alleged inadequacies. Port States should ensure the provision of proper arrangements to consider and respond appropriately and effectively to reports of inadequacies, informing IMO and the reporting flag State of the outcome of their investigation.

2.3.4 Reception, treatment and ultimate disposal

Following the waste delivery, the representative of the port reception facility should provide a waste delivery receipt to the master of the ship. This form can then be retained on board of

9 http://gisis.imo.org/Public/Default.aspx.

10 Information on password administration for Member States has been made available in Circular letter No.2892 of 24 June 2008 (Access to IMO web services, including GISIS and IMODOCS) and in Circular letter No.2683 of 30 November 2005 (Global Integrated Shipping Information System (GISIS) – port reception facilities database).

the vessel along with the mandatory oil record book, cargo record book and garbage record book. The waste delivery receipt may be used by the master afterwards as a proof for the waste delivery, e.g. when asked for by the inspection authorities. A standard form for the waste delivery receipt can be found in MEPC.1/Circ.834.

Governments, in assessing the adequacy of reception facilities should also consider the technological problems associated with the treatment of wastes received from ships and the ultimate disposal of garbage and the residues and effluents from the reception facility.

Although the establishment of waste management standards and effluent standards is not within the scope of MARPOL, States are strongly advised to take responsible action within their national programmes to consider such standards along with land-generated wastes.

Guidance and information on different treatment and disposal methods for several waste streams may be found in technical guidelines developed under the auspices of the Secretariat of the Basel Convention[11].

The technology of the separation, treatment and disposal process is a significant factor in determining the adequacy in general, as it is a primary means of producing an effluent of required purity and for ensuring that the ultimate disposal of residues, mixtures and all types of waste is environmentally safe.

2.3.5 Adequacy at a regional level

The definitions given in the previous paragraph all refer to adequacy at a port level. Each contracting party has a duty to ensure that the ports and terminals under its jurisdiction comply with the port reception facility requirements of the Convention. At a regional level the term "adequacy" may also apply to cooperation among contracting parties, in the case of Small Islands Developing States (SIDS), as well as among ports within a country.

However, port waste management planning in a regional arrangement can only provide a sustainable solution when undertaken in a way that vessels do not have an incentive to discharge the ship-generated waste at sea.

In March 2012, the MEPC adopted, through resolutions MEPC.216(63) and MEPC.217(63), amendments to MARPOL in such a way that SIDS may, when they satisfy the requirements, participate in regional arrangements for the provision of port reception facilities for MARPOL Annex I, II, IV, V and VI residues. These amendments entered into force on 1 August 2013. To assist the party States in these specific geographic regions with the implementation of these new regulations, guidelines were prepared regarding the development of a regional reception facilities plan (RRFP), see resolution MEPC.221(63).

In chapter 14 of this Manual, special situations such as regional arrangements are further described.

Certain regional initiatives, such as the development of regional waste reception and handling plans embedded in the implementation of the European Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues, cannot be considered as regional arrangements in the MARPOL-context. The European directive is a set of requirements all EU Member States have to implement, and there are no special bilateral agreements between these Member States regarding the provision of port reception facilities. All Member States have to ensure the provision of adequate port reception facilities in their ports, which receive sea-going vessels. When an inter-port

11 http://www.basel.int/.

strategy is in place (see sub-chapter 3.6 of this Manual) the reception facilities may serve different ports, even when located in different countries, e.g. a waste contractor who has several barges/trucks for waste collection may operate in different ports at the same time, according to the operational needs.

It can be noted that in the IMO *2011 Guidelines for reception facilities under MARPOL Annex VI*[12] the concept of regional arrangements (without limitation to SIDS) is encouraged as an alternative to ensure adequate PRF.

When there are no regional arrangements in place and ships can dispose of their wastes only in a few ports in a region, this will either mean that these ports carry the burden for the whole region (i.e. receiving wastes that should have been disposed of in other ports) or (even more likely) that ships are more inclined to dispose of their wastes illegally. If the area is designated as a Special Area, a lack of adequate reception facilities has even greater implications.

2.3.6 Special Areas

When a particular sea area is designated as a Special Area for one or more Annexes of MARPOL, the disposal of ship-generated wastes and residues at sea is even more restricted than outside Special Areas. This means that ports within a Special Area have a special responsibility to ensure the provision of adequate reception facilities in all ports that receive such wastes/residues. The Special Area status cannot come into effect until there are sufficient numbers of reception facilities available in that area.

For a Special Area to come into effect, a concerted effort is required by all Governments of States bordering such an area to ensure that their ports provide adequate reception facilities.

The Government of each Party to the Convention with a coastline which borders a Special Area, shall notify the IMO of the measures taken in this respect. For practical reasons it may be advisable to set up a coordination unit in the region to monitor the situation and to advise IMO, on a collective basis, when the countries concerned are prepared. Upon receipt of sufficient notifications the IMO shall establish a date from which the Special Area shall take effect. Notification will be given 12 months in advance.

Today, the following Special Areas under MARPOL with stricter discharge requirements exist[13]:

Special Areas	**Amendments adopted to the MARPOL Annex**	**Entry into force of the amendments**	**More stringent measures in effect from**
MARPOL Annex I: Oil			
Mediterranean Sea	2 Nov 1973	2 Oct 1983	2 Oct 1983
Baltic Sea	2 Nov 1973	2 Oct 1983	2 Oct 1983
Black Sea	2 Nov 1973	2 Oct 1983	2 Oct 1983
Red Sea	2 Nov 1973	2 Oct 1983	*
"Gulfs" area	2 Nov 1973	2 Oct 1983	1 Aug 2008 (resolution MEPC.168(56))
Gulf of Aden	1 Dec 1987 (resolution MEPC.29(25))	1 Apr 1989	*

12 Adopted on 15 July 2011 by resolution MEPC.199(62).
13 MEPC.1/Circ.778/Rev.1, annex 1.

Special Areas	Amendments adopted to the MARPOL Annex	Entry into force of the amendments	More stringent measures in effect from
MARPOL Annex I: Oil (cont'd)			
Antarctic area	16 Nov 1990 (resolution MEPC.42(30))	17 Mar 1992	17 Mar 1992
North West European waters	25 Sept 1997 (resolution MEPC.75(40))	1 Feb 1999	1 Aug 1999 (resolution MEPC.77(41))
Oman area of the Arabian Sea	15 Oct 2004 (resolution MEPC.117(52))	1 Jan 2007	*
Southern South African waters	13 Oct 2006 (resolution MEPC.154(55))	1 Mar 2008	1 Aug 2008 (resolution MEPC.167(56))
MARPOL Annex II: Noxious Liquid Substances			
Antarctic area	30 Oct 1992 (resolution MEPC.57(33))	1 Jul 1994	1 Jul 1994
MARPOL Annex IV: Sewage			
Baltic Sea	15 July 2011 (resolution MEPC.200(62))	1 January 2013	**
MARPOL Annex V: Garbage			
Mediterranean Sea	2 Nov 1973	31 Dec 1988	1 May 2009 (resolution MEPC.172(57))
Baltic Sea	2 Nov 1973	31 Dec 1988	1 Oct 1989 (resolution MEPC.31(26))
Black Sea	2 Nov 1973	31 Dec 1988	*
Red Sea	2 Nov 1973	31 Dec 1988	*
"Gulfs" area	2 Nov 1973	31 Dec 1988	1 Aug 2008 (resolution MEPC.168(56))
North Sea	17 Oct 1989 (resolution MEPC.36(28))	18 Feb 1991	18 Feb 1991 (resolution MEPC.37(28))
Antarctic area (south of latitude 60 degrees south)	16 Nov 1990 (resolution MEPC.42(30))	17 Mar 1992	17 Mar 1992
Wider Caribbean region including the Gulf of Mexico and the Caribbean Sea	4 July 1991 (resolution MEPC.48(31))	4 Apr 1993	1 May 2011 (resolution MEPC.191(60))
MARPOL Annex VI: Air pollution (Emission Control Areas)			
Baltic Sea (SO_x)	26 Sept 1997	19 May 2005	19 May 2006

Special Areas	Amendments adopted to the MARPOL Annex	Entry into force of the amendments	More stringent measures in effect from
MARPOL Annex VI: Air pollution (Emission Control Areas) (cont'd)			
North Sea (SO_x)	22 Jul 2005 (resolution MEPC.132(53))	22 Nov 2006	22 Nov 2007
North American (SO_x, and NO_x and PM)	26 Mar 2010 (resolution MEPC.190(60))	1 Aug 2011	1 Aug 2012
United States Caribbean Sea (SO_x, NO_x and PM)	15 Jul 2011 (resolution MEPC.202(62))	1 Jan 2013	1 Jan 2014

* The Special Area requirements for these areas have not taken effect because of lack of notifications from MARPOL Parties whose coastlines border the relevant Special Areas on the existence of adequate reception facilities (regulations 38.6 of MARPOL Annex I and 5(4) of MARPOL Annex V).

** The new special area requirements, which will enter into force on 1 January 2013, will only take effect upon receipt of sufficient notifications on the existence of adequate reception facilities from Parties to MARPOL Annex IV whose coastlines border the relevant special area (regulation 13.2 of the revised MARPOL Annex IV, which was adopted by resolution MEPC.200(62)).

Table 2 – Special Areas under MARPOL

2.4 Technical cooperation

Article 17 of MARPOL addresses the promotion of technical co-operation. The Parties to MARPOL shall promote, in consultation with IMO and other international bodies, with assistance and coordination by the Executive Director of the United Nations Environment Programme, support for those Parties which request technical assistance for:

.1 the training of scientific and technical personnel;

.2 the supply of necessary equipment and facilities for reception and monitoring;

.3 the facilitation of other measures and arrangements to prevent or mitigate pollution of the marine environment by ships; and

.4 the encouragement of research;

preferably within the countries concerned, so furthering the aims and purposes of the MARPOL Convention.

It has been recognized that many developing countries have difficulty in implementing the standards and conventions which have been and are being developed by IMO, and support may be required to build up institutional, legal and technical capacity. Each substantive IMO committee has been requested to formulate a technical cooperation sub-programme within its field of competence. Following this request, MEPC formulates and adopts a technical cooperation sub-programme, in which the proposed activities are described. These activities fall broadly within the following categories:

- advisory services to address specific problems on request of developing countries and for organization and implementation of activities;
- training (seminars, workshops, individual fellowships);
- research (preparation of special studies);
- materials (facilitating the provision of materials for marine pollution prevention, and production and dissemination of training aids, etc.); and
- information (production and dissemination of publicity material on the sub-programme and regional action plans).

To tackle alleged inadequacies of port reception facilities, MEPC 55 approved an Action Plan in October 2006. The Plan was developed by IMO's FSI Sub-Committee on the basis of input from the Industry "Port Reception Facilities Forum" and contained 13 work items grouped in the following six categories:

.1 reporting (1 work item);

.2 information on port reception facilities (3 work items);

.3 equipment technology (2 work items);

.4 types and amount of wastes (3 work items);

.5 regulatory matters (2 work items for FSI and 1 for MEPC); and

.6 technical cooperation and assistance (1 item).

FSI's correspondence group, under category 6, endorsed the development of assistance and training programmes for developing countries regarding for provision and management of port reception facilities as a priority theme for IMO's ITCP biennium 2012-2013.

CHAPTER 3 - Developing a waste management strategy for ship-generated waste

3.1 Objectives of a waste management strategy

Many ports have provided some sort of services for ships to dispose of their wastes, whether formalized or not, adequate or not. However, it is obvious that ship-generated wastes are part of a port's total waste stream. Similarly, all wastes received and generated in a port are part of the waste stream of a country. As MARPOL only addresses the provision of port reception facilities for ships, the waste handling practices in the port and in a country are beyond the scope of the Convention.

Nevertheless, there are a number of reasons why the issue of ship-generated waste should not be isolated from the waste handling practices in a port and in a country. Ship-generated wastes become a part of the total waste stream of a port, once received on shore. Both ship-generated wastes and land-generated wastes in the port should be handled in an environmentally sound way. Otherwise, actions taken to prevent pollution may merely transfer the problem from the sea to the land or vice versa. For example, if ship-generated waste is dumped onshore, soil or groundwater contamination and risk to human health may be the result. An example of land-based wastes that may result in water pollution are operational oil spills at terminals, which will have adverse effects unless the spilt oil is properly collected and disposed of.

A second reason is that, although the proper management of wastes is expensive, the costs for remedial actions are extremely high and the threat of adverse health and ecological effects is never completely removed. An integrated approach to waste handling that incorporates the entire life cycle of waste (from the moment of generation until its final disposal) may save considerable future expenses (cradle-to-grave approach).

A third important argument is that ship-generated wastes as well as land-generated wastes may contain valuable materials, which could be reused as a resource material for other industrial activities. Discarding these wastes therefore is an inefficient use of resources, and recycling options should be explored (cradle-to-cradle approach).

Furthermore, waste minimization is an important object of a waste management strategy. Unnecessary waste production burdens on waste transport, treatment and disposal facilities and should be avoided.

In general, a waste management strategy should take into account the following waste management hierarchy:

.1 prevention/avoidance;

.2 reduction;

.3 product recycling (re-use);

.4 material recycling;

.5 recovery for use as fuel;

.6 disposal by incineration; and

.7 disposal to landfill.

Development of a waste management strategy is a powerful tool to establish a coherent system of waste handling practices and facilities to address the above concerns. Basically, a waste management strategy is a systematic approach, which outlines how, and by whom, waste is managed. It outlines the practical actions, such as collection, transport, storage, treatment and disposal, and the legislative and administrative controls which ensure that these actions are carried out[14]. A waste management strategy incorporates handling of both ship-generated wastes and cargo residues, which are received in a port, and land-generated waste, either from domestic or industrial origin.

Handling of waste can be addressed at various administrative levels. This is illustrated in figure 2.

Obviously, a waste management strategy should lead to an operating waste handling system, and therefore it should result in legislation, organizations, procedures and facilities that actually solve the problem.

Also the ISO developed standards relating to the management of ship-generated waste:

- ISO 16304: arrangement and management of port waste reception facilities; and
- ISO 21070: management and handling of shipboard garbage.

These standards can be used, on a voluntary basis, to verify the waste management procedures in place.

Section 3.2 addresses briefly the types of waste subject to the MARPOL regulations that could be incorporated into a waste management strategy. Section 3.3 and 3.4 of this chapter concentrate on the development of a waste management strategy in general, whereas sections 3.5 through 3.7 address waste handling options in ports.

[14] http://www.unep.org/tools/default.asp?ct=waste.

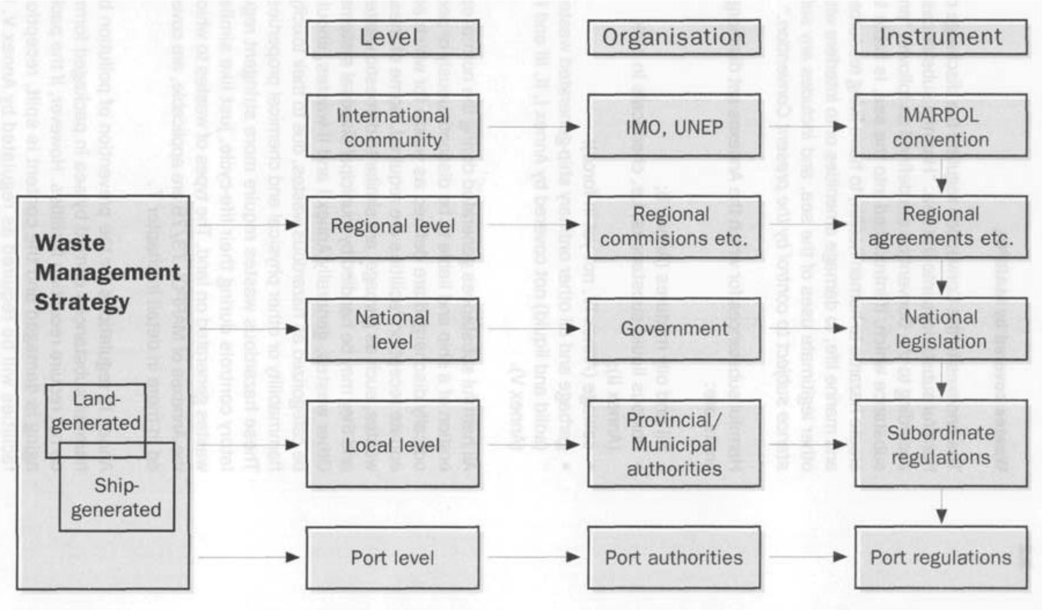


Figure 2 – Waste management at different administrative levels

3.2 Waste streams originating from shipping

3.2.1 Wastes covered by MARPOL

The Annexes to the MARPOL Convention regulate the discharge of harmful substances into the environment. "Harmful substances" according to the Convention are defined as follows: "any substance which, if introduced into the sea, is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea, and includes any substance subject to control by the present Convention."

The Annexes of MARPOL have provisions for the discharge of the following residues:

Annex I	Oil and oily mixtures;
Annex II	Noxious Liquid Substances (NLS) in bulk: i.e. chemicals in bulk;
Annex IV	Sewage;
Annex V	Garbage;
Annex VI	Ozone-depleting substances together with equipment and materials (such as insulation foams) containing the same; and residues from exhaust gas cleaning systems.

All harmful substances generated during the normal operation of a ship and liable to be discharged are defined as waste for which adequate reception facilities are required. Some of these wastes, such as garbage, are similar to domestic wastes and they may be handled by municipal disposal systems. Other wastes, generally Annex I and II wastes, should be categorized as hazardous wastes, due to their toxicity, flammability or other physical and chemical properties. These hazardous wastes require more stringent regulatory controls during their life-cycle, just like similar wastes generated on land. The types of wastes to which the Annexes of MARPOL are applicable, are covered in more detail in chapter 7.

Annex III regulations for the prevention of pollution by harmful substances carried by sea in packaged forms do not require port reception facilities. However, if the packaging is damaged and the content is spilt, reception facilities will be required as regulated by Annex V. It should be noted that these residues and broken packaging containing such residues would need adequate precautions to prevent pollution.

Annex VI sets the requirements for the limitation of air emission from ships. These emissions include ozone-depleting substances, nitrogen oxides (NO_x), sulphur oxides (SO_x), volatile organic compounds (VOCs) and emissions from shipboard incineration. This Annex requires the delivery to port reception facilities of ozone-depleting substances (when removed from ships) and exhaust gas cleaning residues (see regulation 17 of MARPOL Annex VI).

3.2.2. Other ship related wastes and residues

Reference to adequate port reception facilities and/or the environmentally sound management of waste and/or residues originating from ships is not only made in MARPOL, but also in other conventions and guidelines such as the Ballast Water Management Convention and the Anti-Fouling Systems Convention. Therefore, the collection, treatment and disposal of the following waste streams and residues are also discussed in chapters 7 to 10 of this Manual:

- ballast water, containing harmful aquatic organisms and pathogens;
- ballast water sediments; and
- wastes originating from the application of anti-fouling systems.

3.3 Elements of a waste management strategy

A waste management strategy comprises a number of elements, which can be grouped under three main headings:

- administrative and legal matters;
- technology; and
- infrastructure and support services.

In table 3, a number of elements are listed.

Experience in many countries has shown that effective waste management relies on a combination of measures rather than a single technical or regulatory initiative. The strategy should preferably aim at simultaneous rather than sequential action on the following fronts (which are not listed in order of importance):

3.3.1 Administrative and legal matters

- development of legislation to set acceptable standards for waste reception, storage, treatment and disposal facilities, and requiring monitoring and reporting of all waste operations;

- development of a licensing system for all facilities dealing with the collection, transport and/or management of ship-generated waste, in particular when it involves hazardous wastes such as Annex I and Annex II residues; and

- development of procedures to enforce the legislation, to monitor the wastes handling processes and the service provided to the ships.

3.3.2 Technology

- establishment of safe and efficient reception, storage, treatment and disposal facilities and safe and environmentally sound management of existing facilities; and

- using technology that properly reflects modern waste management processing techniques.

3.3.3 Infrastructure and support services

- co-operation and support of all stakeholders involved such as governmental organizations, port authorities and the industry; and

- establishment of safe and efficient reception, storage, treatment and disposal facilities and safe management of existing facilities taking into account the infrastructure and support services in the port and beyond. The treatment and disposal facilities may or may not be located within the port area.

Administrative and Legal	Technology	Infrastructure and Support Services
Standards • environment • waste Discharge limits Disposal licenses Cradle-to-grave system of notification Liability for damage Compensation for damage Recordkeeping and reporting	Cleaner production Recovery and Recycling Treatment plants Incinerators Landfills Site clean-up Monitoring Specialized transport Oil recovery equipment Consultancy services Chemical and/or oil Emergency services Technical information	Sewers Public information Storage facilities Waste collection Transport services Disposal sites Laboratories and analytical equipment Waste exchange Operator training facilities

Table 3 – Waste management strategy elements

Gradual but simultaneous improvements in all elements of the strategy have been found to be more effective than a single major leap forward. There are many practical reasons for this, including the need for a great deal of learning and understanding of new procedures. Resource limitations are a practical reason for proceeding at a determined and measured pace. The need to adjust to the pace of local change also argues strongly for a sequence of steps to develop controls within an overall management framework, rather than immediate implementation of everything within a comprehensive framework.

3.4 Practical measures to take first

While having recognized the value of simultaneous action on a number of issues (listed in the previous section), it is still useful to identify some actions, which should be taken preferably at an early stage of the development of the waste management strategy.

The State Government plays a central role in initiating the development of the waste management strategy. This section focuses on the initiatives on a national level. In larger countries, state or regional or provincial governments have varying degrees of authorities delegated by the national Government. In smaller countries, however, all authority may rest with the national government. In the latter, case, the tasks described in chapter 5 may also have to be assumed by the national authority.

3.4.1 Some guiding principles

.1 It is better to do something than to investigate and study for too long

Action cannot be taken if absolutely no information is available. However, it should be kept in mind that no matter how well the initial survey is executed, an *accurate* picture of the quantities and types of wastes will only be achieved once there are operating facilities.

.2 It is necessary to provide prior funding if actions are to take place

The sums of money need not to be necessarily large, but they have to be strategically applied so as to obtain the best results. The initial expenditure should perhaps be to identify and publicize the problem so as to build support in principle for some type of action. The second stage involves spending money on training staff and on studying the options for action.

Alternatively, an incentive based fee system may be developed in order to create a business opportunity for private waste management companies, so that these companies will invest private money in the waste handling infrastructure and technology.

.3 Communication and education gives the guidance needed

Effective waste management requires a concerted effort. Gaining support from all stakeholders involved (port authority, local community, industry, government) is a key factor. Proper communication of plans, roles and needs is of vital importance. Therefore, it is recommended that discussions with the industry, governmental organizations which will be involved, public education etc. commence as early as possible.

3.4.2 Useful first steps

A number of practical steps taken as a whole can achieve an early improvement in the waste collection and disposal situation, at a relatively modest effort and cost. These steps will also lay the foundations for a more systematic approach to waste management in the long term. It is emphasized that these steps should be pursued in parallel rather than in any particular sequence.

.1 Designate the responsible agency, at the national and/or regional level, for initiating and co-ordinating the establishment of a waste management strategy

If a waste management strategy on a national level does not exist, it will be necessary to make a government agency responsible for developing the strategy. This may require establishment of a new agency, which should be properly staffed and funded in order to execute its tasks and responsibilities. The first task of this agency would be to prepare a plan, which outlines in general terms the procedure to be followed for the development of a waste management strategy, a time schedule, stakeholders involved, initial budgets and actions.

.2 Learn as much as possible about the waste situation

Before solutions can be devised and the actual development of a waste management strategy can commence, one must have a good idea of the nature and extend of the problems. Therefore, an assessment report is needed, in which the environmental problems are identified and quantified at an early stage.

Preferably, the report should draw some conclusions about short and medium term environmental risks. Useful elements to learn about include:

- current waste handling facilities and practices in general and in the port;
- results of preliminary environmental quality monitoring, e.g., oil and litter on the beaches or at sea; and
- an inventory of the types of waste, their hazardousness and an estimate of the waste quantities likely to be generated, e.g. based on the advanced waste notifications from ships. A complementary approach is to compile a rough inventory of chemicals used, manufactured or imported.

The above information could be most usefully compiled as a series of short reports for easy reference.

.3 Obtain independent, outside advice regarding both the problems and treatment options

Independent review and advice by experienced outside practitioners can assist the government and local port authorities in coming to a decision about what initiatives are needed. Particularly valuable is "horizontal co-operation", whereby personnel from one developing country assist those from another. In view of the difficulty of transferring experience in the early stages of a country's learning cycle, it is initially preferable to have a series of short-term consultations on specific well-defined topics, rather than a single massive study. Outside advice will not always be necessary. Small ports and marinas may well be able to do their own assessments but should be given advice if there is a need for it.

.4 Consider temporary measures for waste collection and disposal

Temporary measures can be a useful tool for waste handling practices in the short term. They involve technical measures, such as use of temporary landfills and collection and storage of waste. Temporary measures for regulatory and administrative arrangements are less common and also less desirable as they are not always easy to terminate once their usefulness has passed.

Temporary solutions should be designed to assist in early measurements of waste streams and to discover what types and amounts of wastes are generated by the different categories of ships and industry. Once known, it will be easier to accommodate their needs and to reveal violations of the discharge and disposal standards. A better knowledge of the size and nature of the waste stream allows a more accurate prediction of the types and size of future facilities. Temporary facilities are also a useful way for management and operational staff to gain experience in waste handling, with public relations, industry liaison and ship-shore co-ordination.

Temporary measures can lead to short-term improvements. However, if these measures do not meet all requirements and standards applicable to permanent solutions, it must be avoided that these measures gradually become permanent. They should be seen as an initial step only.

Although this applies to all types of waste, it is in particular valid for Annex I and Annex II wastes, because of their hazardous properties. Suggested guidelines for ensuring that temporary measures play a useful role, but do not come to dominate the programme, are:

- keep temporary solutions as short as possible with a firm deadline;
- plan for later treatment or recovery of (stored or land-filled) wastes by keeping them segregated if possible, and maintaining a record of their location;
- in respect to landfills, ensure that there are effective limitations for future use of the site. Assign responsibility and resources for care of landfill sites until such time as their permanent security can be guaranteed; and
- whenever possible, temporary operational controls should be designed in such a way that they anticipate more permanent solutions. For example, proper record-keeping of waste quantities and operating conditions is useful for gaining experience.

.5 Commence a programme of staff training

A comprehensive training process is important in building up expertise and contacts. Education and technical training is required to ensure that sufficient staff are being trained in skills relevant to meet current needs and projected demands.

A particularly important factor is the ability to guide and supervise consultants, both foreign and local. Excessive reliance on donations of "expert" studies or equipment, both of which may turn out to be inappropriate for local conditions, should be avoided.

.6 Parallel to activities in the port implement or improve enforcement schemes

In the absence of proper enforcement it is likely that wastes will be disposed of to water courses or to dumping sites that are not properly managed. To ensure that wastes are environmentally soundly managed it is necessary to develop and implement proper inspection scheme. Actual enforcement of regulations by the authorities in charge, together with the availability of legal disposal facilities, will contribute to environmentally sound waste handling and disposal.

3.4.3 Port Waste Management Plan

When the first steps are taken and some information and expertise is gained the competent authority or port should start developing a port waste management plan, in close consultation with all stakeholders. The *Guidelines for Ensuring the Adequacy of Port Waste*

Reception Facilities (resolution MEPC.83(44)) offer a good starting point to evaluate the needs and gaps in a port or region. A port waste management plan should at least contain the following information:

.1 an overview of applicable legislation (international, national, regional and/or local);

.2 a description of the types and quantities of ship-generated waste;

.3 a needs assessment for port reception facilities, taking into account the needs of ships normally visiting the port;

.4 a description of type and capacity of port reception facilities (planning, choice of location);

.5 a description of the procedure for reception and collection of ship-generated wastes;

.6 equipment alternatives to collect, store, treat and dispose ship-generated wastes;

.7 establishment and operation of reception facilities (including funding mechanisms);

.8 options for enforcement and control;

.9 description of the monitoring system;

.10 the competent authority and person or persons responsible for the implementation of the plan; and

.11 procedures for on-going consultations with relevant stakeholders such as ship agents, port reception facilities and port users in general; and.12 procedures for reporting alleged inadequacies.

More information on port waste management planning can be found in chapter 6.

3.5 Responsibility for establishing port reception facilities

Although in many cases the responsibility to provide port reception facilities is delegated by the Party State to the port authorities, it remains the responsibility of the government to implement MARPOL once it has been ratified. Subsequently, the actual provision of port reception facilities can be carried out by private companies (for which this may provide a business opportunity) or by a public enterprise (under governmental responsibility).

Some potential advantages and weaknesses of both systems are discussed as follows.

3.5.1 Private sector

The advantage of employing private companies is that existing companies may provide the most cost-effective way to obtain trained personnel, develop infrastructure for waste reception, storage and treatment, and knowledge. Where reception or treatment facilities exist, they could be brought into a licensing system, which binds them to compliance with the standards and regulations set by the appropriate authorities.

There may be companies with mobile collection facilities interested in offering port reception facilities along with their other services (e.g. bunker stations or collection of waste from land based industry). Transport companies with no permanent installation for treatment, processing or disposal of waste can be considered for provision of mobile facilities provided that they are obliged by virtue of a permit or contract to deliver the collected waste products in their lighters or road tankers to an approved storage, treatment or disposal facility.

One particular point of attention of such privately operated reception facilities can be that it may lead to an unhealthy form of price competition, handicapping those facilities using high technology processes (e.g. tipping at an improperly managed landfill or dumping at sea versus incineration or chemical treatment). On the other hand, private port reception facilities competing with each other can also lead to higher service levels (swift collection of waste 24/7), use of state-of-the-art technology, and competitive price setting.

A comprehensive licensing system, identifying equal acceptance, treatment and disposal standards for those facilities dealing with a designated type of waste helps to overcome this problem. A licensing system can also provide a sound basis to control and enforce the performance of treatment facilities, such as compliance with discharge standards, application of proper equipment, etc. (see also chapter 4).

Another possibility can be found by trying to prevent too much overcapacity (i.e. controlling the number of licensees) and strict assignment of certain wastes to certain treatment and disposal techniques; by the enforcement of strict emission standards; by the statutory use of certain facilities; or by controlling prices (possibly through a distribution scheme).

It is very important that port reception facilities licensed to receive certain types and amounts of wastes should also have a duty to accept these wastes, otherwise companies may be tempted to select and accept the wastes which are most profitable. For instance, waste streams with a high content of oil are more profitable than waste streams with a high content of water.

3.5.2 Public enterprise

The establishment of a comprehensive waste treatment and disposal scheme on a free-market basis may prove difficult or impossible without direct government involvement.

A waste management system controlled and operated by a government has certain advantages as well as disadvantages. An advantage of public responsibility is that it should lead to the rapid build-up of a comprehensive waste handling system, provided sufficient funds and/or incentive based delivery schemes are made available and the standards adopted are relevant to the principles of public policy. A disadvantage is that control and enforcement of the rules is also exercised by the government operating the facilities.

3.6 Development of an inter-port strategy

Basically, an inter-port strategy implies that wastes can be received in all ports, which are subsequently transported to a central treatment plant. Such a strategy can be more cost-effective than the provision of treatment facilities in every port.

An inter-port strategy may be applicable at two levels:

- at a regional level, where ports in neighbouring countries co-operate; and
- at a local level, where ports in one country co-operate.

Factors which may lead to an inter-port strategy, in which ports make a concerted action to provide reception and treatment facilities, include the quantities of waste received, costs, land requirements for disposal facilities, and/or types of treatment and disposal required. For example, the quantities of hazardous wastes usually tend to be relatively small whereas the level of expertise and treating costs to deal with the wastes are relatively high. Thus, the provision of a treatment facility (e.g. an incinerator) in each port may not be cost-effective or practical, but a central facility serving more than one port, and including the treatment of land based waste, could prove viable. Another example is the reception of ship-generated oily waste, which can be transported to a central treatment plant for further processing together with oily wastes from land-based origin. Some features of an inter-port strategy are:

- ports would need storage facilities for all types of wastes;
- in case of a regional strategy, international agreements would need to be prepared, whereas in case of a local strategy (only) internal regulations are required. The latter is probably easier to realize. An issue that will require attention in the case of a regional strategy is the implications of transboundary movement of waste;
- agreement would be needed on who would transport the waste, and a monitoring scheme would be required; and
- means of transport (e.g. trucks, railway or ships) would have to be commissioned and licensed.

In particular if ports are located in very remote areas, inter-port co-operation in the field of waste reception and treatment will be worthwhile to consider.

3.7 Possible options to integrate port reception and treatment facilities in a general waste management strategy

Although reception facilities must be made available in a port, once a country has ratified MARPOL, it does not necessarily follow that dedicated "stand alone" facilities must be provided by the government of a country.

In this paragraph, the (possible) role of entities other than the Government will be discussed, which could receive ship-generated waste. The responsibilities of these entities can be identified in national legislation (see chapter 4), and may vary among countries, since MARPOL does not state how and by whom wastes should be handled.

3.7.1 Possible facilities for MARPOL Annex I and Annex II residues

Given the chemical and physical characteristics and the hazardous nature of oily residues (Annex I) and cargo residues from certain types of noxious liquid substances, as defined in MARPOL Annex II, there may be possibilities for integrating the reception facilities for these residues. The following entities could be involved in Annex I and II waste reception and processing.

.1 Terminals for liquid bulk cargoes

Many Annex I and II wastes, such as residues or mixtures resulting from tank washings can be handled by the terminal or industry receiving the cargo. This particular option applies to dedicated terminals, which are used for loading or unloading cargo for a specific industry, e.g. a refinery or a chemical plant. Such a terminal may receive specific wastes only, which are closely related to the cargo loaded or unloaded.

Processing of wastes by these terminals - or the industry utilizing the terminal - may lead to substantial cost reductions, as they generally have appropriate equipment available. A further advantage is that waste management is likely to be more closely integrated into the management hierarchy of the company.

For example, the quantities of oily residues or tank washings on a per ship basis are generally not very large (see chapter 7), and reception and treatment of such wastes may be possible by the terminal or the industry without substantial modifications or extensions.

On the other hand, handling of dirty ballast may require large and therefore expensive tankage, and it will be difficult to receive these wastes without substantial modifications.

In the case of multi-purpose terminals, used by a variety of industries, there will be a much greater variety of wastes. Even so, the option of the industries processing wastes which are closely related to their production processes would be worthwhile exploring.

Although terminals may be a party to receiving and processing waste, it should be recognized that they generally are not suitably equipped to receive and process waste not directly related to cargo loaded or unloaded.

.2 Tank cleaning facilities

Companies providing tank cleaning facilities obviously have to receive these tank washings. Subsequent treatment of these wastes may take place at these facilities.

.3 Existing waste collection companies

The primary activity of these companies is collecting (and transporting) wastes, for instance domestic or industrial wastes from land-based sources. If a company is already involved in industrial waste handling, it may be a small step to provide reception facilities for ship-generated waste. Mobile collection equipment, such as barges and trucks, is very flexible and therefore useful in providing an efficient service to ships without causing undue delay.

A waste collector who does not own equipment for processing waste, must be made legally responsible for collecting and delivering the wastes to proper facilities where subsequent treatment takes place. In order to monitor the transport of wastes from source to final disposal, a system keeping track of wastes is necessary. This will be described in section 4.5.

.4 Waste treatment companies

The primary activity of these companies is treatment and possibly disposal of wastes. In order to make the operation of such a facility cost-effective, to receive a reasonable return on investments and to keep charges to the shipping industry under control, it is important not to create too much overcapacity by excessive licensing (see 4.4 and 4.5 for additional comments).

If the installation does not cover the entire treatment chain, it should be ensured that the untreatable wastes are transferred from the installation to another appointed and adequate facility.

In practice, it is possible that the activities of companies discussed in paragraph 2, 3 and 4 above may be combined to a certain extent in one company.

.5 Bunker stations

Bunker stations may be able to receive oily wastes, using existing equipment (e.g. bunker barges). In general, it is unlikely that the equipment will be appropriate to receive non-oily types of wastes, and ships should not expect to be able to deliver such wastes at bunker stations.

.6 Ship repair yards

Repair yards are confronted with wastes that ships have to dispose of before repair work can commence. Although reception of these wastes will occur, it does not necessarily follow that they will be able to treat those wastes. If these companies themselves cannot treat the wastes of the ships they repair it should be ensured that the wastes are transferred to a specialized company for proper treatment and/or disposal.

Contractual stipulations that the ship should arrive in port with clean ballast only, or that wastes must be reloaded for disposal elsewhere, are not in the spirit of the Convention.

The specific requirements of Annex I and II of MARPOL for e.g. loading ports and terminals are addressed in chapter 7.

3.7.2 Possible facilities for MARPOL Annex IV residues

Various options exist for treatment of sewage from ships. If the sewage generated in the port area is treated in a sewage treatment plant, it may be possible to discharge the ship-generated sewage directly into the port sewer system. This can be realized by connecting the ship directly to the sewer (by means of hoses, piping), or by utilizing tanker trucks to collect the sewage from ships and to transport it to the treatment plant.

This option may also be applicable if industry located in or near the port operates a biological waste water treatment plant. Depending on the capacity of the treatment plant and the amounts of sewage generated by ships in a port, it may be possible to treat ship-generated sewage without substantial extensions or modifications.

However, in many countries adequate treatment of domestic sewage is often lacking. In this case, a waste management strategy should facilitate an integrated approach to land-generated and ship-generated sewage. Combined treatment of ship-generated and land-generated sewage will be more cost effective than separate treatment.

3.7.3 Possible facilities for MARPOL Annex V residues

The scope of port reception facilities for garbage includes, apart from the provision of receptacles for garbage, a regular collection service and transport to a treatment and/or final disposal facility. Segregation of various types of garbage enhances recycling and, through diminishing the quantity that finally needs to be disposed of (incineration or landfill), lowers the cost of the service.

Alternatives which may be considered for receiving and disposing garbage:

- collection and disposal by the port;
- collection by the port and disposal in municipal facilities;
- collection and disposal by municipal services; and
- collection by private companies and disposal at privately owned facilities.

The provision of reception facilities for ship-generated garbage cannot be separated from the community's ability to dispose of its own domestic garbage. The need to provide adequate port reception facilities for garbage may be a catalyst to the provision of safe, sanitary and economic disposal of solid wastes from land-based sources of waste as well.

Port authorities and authorities involved in solid waste handling should bear in mind that, while there are good reasons for wastes segregation, there are practical and physical limitations to the extent which ships can comply with such requirements. The problem of segregating wastes is even more pressing when there are widely different requirements in different ports in the same region. Solutions to this should be sought in consultation with all stakeholders concerned.

3.7.4 Possible facilities for MARPOL Annex VI residues

3.7.4.1 Ozone-depleting substances

The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion. The treaty entered into force on 1 January 1989.

Regulation 12 of MARPOL Annex VI describes the control of ozone-depleting substances for ships.

The following are the major sources of ozone-depleting substances (ODS):

- refrigeration equipment;
- air conditioning equipment; and
- fire extinguishing equipment.

Given the fact the type of equipment containing these ODS or halocarbons is similar on land and on board ships, the facilities for these Annex VI residues can be integrated with land-based collection and treatment facilities.

It is recommended that technicians servicing equipment containing ODS and halocarbon alternatives must be appropriately trained and follow acceptable servicing procedures. They must not fill leaking equipment and must use proper recovery/recycling equipment and methods to prevent the release of ODS and halocarbon alternatives into the environment.

Facilities for the recycling or disposal of unwanted ODS are limited. In most cases ODS that are not reusable in their current state must be sent to an appropriate facility for recycling, conversion or destruction. These facilities might not be located within the own territory, given the high degree of specialization and expertise needed. In this case, the sender should be aware of possible international requirements regarding the transboundary movement of this waste.

3.7.4.2 Residues from exhaust gas cleaning systems

As on-board exhaust gas cleaning systems, as a viable alternative for low sulphur fuels, are currently increasingly being installed, proper port reception facilities for residues will be needed. The storage, treatment and disposal of exhaust gas cleaning residues can be integrated with similar waste streams originating from land-based exhaust gas cleaning systems.

Given the high degree of specialization needed to treat this waste type, transboundary movement of the waste to a treatment and/or disposal plant might be necessary when there is no in-land expertise available.

3.7.5 Possible facilities for other wastes

Wastes originating from the application of anti-fouling systems, as well as ballast water sediments will be mainly generated at ship repair yards and/or ship recycling yards. These yards are confronted with wastes that ships have to dispose of before repair work can commence. This does not necessarily mean that they will be able to treat those wastes. If these companies themselves cannot treat the wastes of the ships they repair, it should be ensured that the wastes are transferred to a specialized company for proper treatment and/or disposal.

CHAPTER 4 - National implementation

4.1 Introduction

Administrative and legal matters are one of the main elements of integrated waste management. The preparation and implementation of legislation and regulations is one of the key tasks of Governments.

Considerations such as the constitution of the individual country concerned, whether it is a single unified State or a federation, and the distribution of administrative powers, have a strong influence both on the extent to which legislation on waste management is possible and the form in which legislation can be made, implemented and enforced. The economic situation of the country may be an equally limiting factor for the effectiveness of the legislation.

This chapter discusses general principles with regard to legal requirements for waste management. These principles are broadly applicable regardless of the above mentioned differences.

It is assumed, for the purpose of this discussion, that no comprehensive legislation on waste management exists in the country. For countries where relevant legislation is already developed, certain sections may be less relevant.

4.2 Legal requirements

4.2.1 General principles

Waste handling legislation can be addressed at different administrative levels, each with their respective regulations.

The Annexes to MARPOL prescribe that Parties undertake to ensure adequate reception facilities are provided, so that ships can deliver (specific categories of) waste in ports. MARPOL does not prescribe how wastes should be handled and treated, once they have been delivered to a port reception facility. Additional regulations at national level and/or lower level of authority are required to ensure environmentally sound processing and disposal of wastes.

National legislation should serve the following purposes with respect to MARPOL:

.1 it should connect MARPOL with regional agreements (if applicable), national law and local regulations, and give effect to the provisions of the Convention, including its Protocols, Annexes and Appendices;

.2 it should focus on how to implement and enforce MARPOL once the Convention has been ratified;

.3 it should give the appropriate authority the power to enforce the legislation that incorporates the requirements of the Convention and its Annexes; and

.4 it should set general policy and grant power to the appropriate authority to issue specific regulations.

In many countries, environmental and maritime affairs are not assigned to the same specific authority. If so, frequent consultation and close cooperation between the different competent authorities responsible for environmental and maritime affairs, is recommended.

As described earlier in chapter 3, the handling and treatment of ship-generated waste should not be isolated from wastes generated by land-based sources.

The basic principles of the waste management strategy should therefore be reflected in the legislation that will be developed in relation to MARPOL. Implementation of a waste management strategy itself may be regulated in separate legislation and is not necessarily a part of the legislation concerning implementation of MARPOL. However, it is important that the legislation directly related to implementation of MARPOL will be a part of a coherent framework of environmental legislation - of which certain parts may already exist in a country - which should also address areas other than ship-generated waste.

European Member States implemented the European Directive on port reception facilities for ship-generated waste and cargo residues 2000/59/EC. This Directive reaffirms the MARPOL obligations regarding the provisions of port reception facilities and, moreover, it strengthens and refines these MARPOL obligations. Stringent requirements regarding the mandatory discharge for ship generated waste for all vessels entering a Union port, the development of a cost recovery system, the mandatory use of an advanced waste notification and more became applicable throughout the EU by the entering into force of this Directive.

4.2.2 Reviewing existing legislation

If a country has legislation dealing with land-generated wastes, it should be reviewed prior to the development of complementary legislation on ship-generated wastes. This will contribute to development of a coherent legal structure and prevent proliferation of laws and regulations which are difficult to survey and enforce, show overlaps or gaps or are otherwise deficient or susceptible to conflicting interpretations.

The drafting of effective regulations is a difficult task. A multitude of waste sources and handling operations have to be covered, and yet the regulations have to be practical to enforce. New regulations on ship-generated waste have to fit into an existing framework of laws. A basic starting point, however, is that ship-generated wastes once received on shore should be treated the same as land-generated waste.

Many of these regulations have already developed their own classification and permit systems. In addition, regulations and classifications concerning hazardous waste need to pay regard to the Basel Convention where transboundary shipping of hazardous waste is considered. Areas potentially addressed by existing legislation might include those shown in table 4:

Pollution control (air, water and soil) Water laws Waste disposal Industrial chemicals control Pesticides control Pharmaceuticals Household poisons Occupational health and safety	Disaster and emergencies Transport Land planning Environmental impact assessment Sewerage and drainage General industry laws covering classification, approval, registration, inspection Specific industry laws addressing

Public health Biodiversity/exotic organisms	e.g. ports, petrochemicals etc.

Table 4 - Legislation areas potentially related to waste control

In covering their respective areas of application, the existing laws may result in some overlap or even inconsistencies (i.e. conflicts). In some cases, they may complement each other so as to provide more complete coverage. The nature of such interaction is determined by how each part of legislation is written.

4.2.3 Passing new legislation

When developing new legislation, either directly concerning MARPOL, or in the general field of waste handling and disposal, common elements can be identified, which are addressed in virtually all regulations concerning waste handling. These elements include, but are not limited to:

- the objectives of the legislation;
- a description of the responsibilities of all stakeholders involved, which may be waste generators, ship agents, operators and transporters, and governmental organizations;
- a definition of (hazardous) waste and the type(s) of wastes that are involved;
- control mechanisms, such as permits/licences for transporters, operators and facilities;
- monitoring and reporting of waste generation, delivery, transport, treatment and/or disposal;
- waste management planning;
- standards for discharges to water, air, land;
- standards for waste transport;
- bans on certain operations;
- clean-up responsibilities; and
- enforcement methods and possible penalties for non-compliance with requirements.

If standards are developed for reception facilities, the standards of MARPOL applicable to discharges of ships should be taken into account as a minimum, to avoid shifting pollution from the sea by ships to pollution by land-based installations (for example, as ships are required to discharge wastewater with maximum 15 ppm of oil, it is not desirable to allow 100 ppm for a reception facility).

It is recommended that provisions be included in the national legislation incorporating an easy amendment procedure. This will facilitate a prompt response to revisions of MARPOL through more detailed standards and subordinate regulations. Efforts should be undertaken to streamline national amendment procedures to ensure that MARPOL regulations become effective at a national level at the same time they take effect internationally. Legislation should be flexible enough to authorize the appropriate authority to implement any revisions to the Convention and its Annexes.

Governments may be of the opinion that MARPOL is self-executing, which is to say that its provisions constitute a body of immediate applicability. Administrative regulations required for the practical application could be dealt with separately by way of codes of conduct, guidelines or other appropriate mechanisms.

The Convention requires Parties to ensure the provision of adequate reception facilities to meet the need of ships without causing undue delay (for interpretations see chapter 2). The appropriate national authority should ensure that the terms are made operable and appropriate to the circumstances. The coordination between port and ship is an important aspect, which is addressed in chapter 12.

4.2.4 The legislative process

For each country, the legislative process will have its own characteristics and procedures. However, it is recommended to use local expertise of parties involved in, and affected by the waste management strategy, in proposing legislation. The participants in the legislative process may therefore include:

- the involved state and local government agencies;
- port authorities;
- ship-owners and agents;
- the oil industry and chemical industry as shippers/receivers;
- owners/operators of terminals;
- the waste management industry (if any);
- (independent) surveyors;
- environmentalists; and
- members of the local community.

Participation in the legislative process may be achieved by:

.1 Advance notice of proposed legislation

In this option, parties may participate in the legislative process by submitting written views, data, or arguments or any other relevant supplementary information on the proposed legislation. The comments received before expiry of the consultation period should be considered before final action is taken on the proposal. If there is sufficient interest, public meetings may be part of the consultation procedure. Once the regulations have been drafted, the same type of procedure may be repeated to receive input on this draft. Subsequently, the final drafting can take place.

.2 Formation of an advisory panel for developing a waste management strategy

To facilitate the process, the relevant concerned parties may be directly invited to participate in an advisory panel or to comment on the draft version of the regulations. Often such a committee is divided into two subgroups: one subgroup focuses on the technical aspects and the other on the contents of the regulations.

An advisory panel may not only be useful in the rule-making process, but can be very helpful in resolving problems arising from the implementation of the waste management procedures. However, such a process will not result in as widespread public involvement as the procedures suggested in paragraph 1 above.

4.2.5 How to make the terms "adequate" and "undue delay" operable

The Convention requires the provision of adequate reception facilities to meet the need of ships without causing undue delay. The appropriate national authority should ensure that the terms are made operable and appropriate to the circumstances.

This can be achieved by extending the powers existing under the law which promulgates the Convention into local legislation, so as to allow the regulatory authority to take into account requirements for reception facilities and issue directions when not satisfied.

This approach requires an obligation being placed on the addressee (i.e. the port authority and/or terminal operators) to provide the reception facilities considered adequate for the ships trading in that port. If a deficiency in the facilities is identified (by complaint from a ship-owner, master or any other means) the appropriate authority can issue directions to improve the facilities and/or the level of service or take other actions - e.g. civil or criminal proceedings - as required.

It would be helpful to develop a body of case-specific examples that can serve as guidance for others to comply with the provisions. Over time these examples will provide a valuable source of information, resulting from the actual application of the guidelines with respect to the phrases "adequate" or "undue delay"

In all cases where arrangements need to be made for disposal a well-coordinated prior notification procedure should be set up and the appropriate information should be distributed to seafarers and ships agents.

See also chapter 2, section 2.3 and chapter 12.

4.3 Control mechanisms

One of the basic legal requirements for the implementation of a reliable system of waste management is the establishment of comprehensive control mechanisms. These mechanisms are necessary to ensure that the technical and organizational methods defined are actually used and that illegal dumping or other practices are avoided.

Successful control of wastes will require that adequate waste tracking and monitoring systems are in place so that competent authorities can act rapidly to minimize the possibility for inappropriate handling of the wastes.

If an accident does occur, control means that the authorities have the means, both legal and financial, to respond quickly in order to reduce any dangers posed to human health and/or the environment.

Monitoring and tracking of wastes means that the location of such wastes is known at all times, i.e. from "cradle to grave", and that the wastes do, in fact, arrive at an appropriate facility for treatment, storage and/or disposal. This is generally done by establishing a paperwork system that documents the routing and composition of waste. However, there are cases where parts of this process have been automated using web-based technology, leading to reduced bureaucracy for the users and more transparency.

The primary means of enforcing a comprehensive waste management strategy, and hence the main enforcement duties of the regulatory authorities, will be:

- licensing of reception, storage, treatment and disposal facilities;
- routine and non-routine surveillance and monitoring of licensed operations, with powers of revocation;
- collection and analysis of properly completed documentation and other data from waste producers, storage depots, carriers and treatment or disposal facilities; and

- prosecution of illegal activities.

In section 4.4, licensing as a control mechanism will be discussed in more detail. In section 4.5, an ancillary paperwork system to keep track of (hazardous) wastes is addressed.

4.4 Licence

Licensing is the principal means by which authorities can exercise detailed regulatory control of reception, storage, treatment and disposal of wastes. Licensing is applicable to both land-generated and ship-generated wastes.

Licensing allows for easy compliance with standards and ensures proper handling and disposal. This reduces the risk of illegal disposal. Licensing of facilities should be subject to a prescribed standardized procedure. To be effective the following should be considered for inclusion in a licensing system:

- licence application;
- validity of the license;
- review of application by the authorities;
- verification of ability of the applicant; and
- issue of licence with conditions (discharge limits, reporting procedures, inspection procedures, etc.).

In some countries licensing applies to all equipment with which the wastes are collected, stored or treated. Other countries may choose a more performance-based approach. In such cases the licence should set clear performance standards; e.g. the licence holder is not allowed to discharge anything into the environment except for those emissions authorized by a permit.

Applying for a licence prior to starting waste handling operations should be made obligatory by legislation. The relevant regulations should also specify the conditions under which a licence can be granted, altered or withdrawn. Special consideration should be given to the financial and professional reliability of the licensee. The licensing scheme should fit into the overall management principles of the country concerned; this might mean that the licensing of one or more of the activities mentioned above can be dispensed with for the time being.

A licence should be subject to periodical renewal as well as amendment and/or revocation if the conditions set out in the licence are not met. There should be provision for modifying the licence to allow for technical and scientific developments. If appropriate, public participation in the decision-making process should be encouraged in order to avoid, as far as possible, local conflicts arising from a lack of information and participation.

According to the chosen system of control, the relevant provisions should be incorporated into the licence with sufficient specifications to ensure that the terms of the licence can be enforced.

4.4.1 Licensing collection and transport

In terms of control, collection and transport are a very important part of the waste handling cycle. Reduction of disposal costs (such as illegal disposal) can increase the profit of the waste collector. Thus, wherever there is a free choice of collectors, high standards should be placed on the qualifications and performance of such bodies. If the collection and transport of waste is licensed, the threat of losing the licence for malpractice will be a serious deterrent.

A licence should be granted only when strict standards are in place and when there is sufficient evidence that a reliable service can be guaranteed. Applicants for a licence should be required to prove their reliability and proficiency by permitting inspection of their technical equipment, verification of their financial situation, insurance coverage and trained personnel.

Licences should be issued only for the types of waste the applicant has sufficient technical means to handle. Different categories of waste require separate collection and transport systems. This will help to avoid unsuitable mixtures of waste and the widespread dispersal of hazardous waste in other wastes, and to improve the opportunities for re-use or recycling of certain types of waste.

A condition that transport only takes place when treatment (and ultimate disposal) has been arranged may be useful in establishing permanent business links between waste collectors, treatment facilities and ultimate disposers. Such a system, however, might not be easily established in cases where reliable applicants for a licence are not available or where it conflicts with the general policy of the country concerned. In these cases, collection and transport of waste by the treatment plant may be encouraged to keep the number of enterprises involved in waste handling to a cost-efficient minimum.

4.4.2 Licensing treatment land disposal

Treatment and disposal of waste should be permitted only in licensed facilities. The objective of licensing is to allow waste treatment and disposal to occur in an orderly, regulated fashion, consistent with environmental protection and the maintenance of public health. A licence should be required for all types of waste treatment and disposal facilities, such as storage sites, treatment and incineration plants and landfills. Licensing should also cover mobile facilities, such as those for dewatering, neutralization and detoxification. Mobile facilities can produce specific hazards through the improper disposal of treatment residues such as contaminated wastewater, but because of their mobility they are difficult to control.

Facilities should be licensed for the handling of specified groups of waste, but without being unnecessarily restrictive (a facility may very well be capable of handling all kinds of waste). The list of permitted wastes should form part of the licence. Exceptions should require the prior, written approval of the competent authority.

The information to be provided when applying for a licence can be categorized as follows.

Site characteristics

- location and size;
- capacity;
- accessibility (berths, roads, railways);
- possibility for expansion; and
- (hydro)geological conditions, in particular applicable for landfills.

Activities

- description of waste treatment processes and equipment;
- types, quantities and composition of wastes treated and disposed; and
- possible further treatment or disposal processes.

Environmental impact

- estimated emissions of contaminants to air (flue gases, vapours), water (composition and quantity of wastewater discharged) and soil (leachate migration and composition); and
- monitoring plan.

Protective measures

- description of protective measures that have been taken to reduce the emissions of pollutants to air, water and soil; and
- emergency response plan in case of hazard or accident.

If site selection is not subject to a general plan and is decided on a case-by-case basis, the applicant for a licence should be legally required to provide the information necessary to evaluate a site for selection. This is particularly important for landfills, but also applies to incinerators (compliance with air quality standards) and to physical, biological and chemical treatment plants (availability of wastewater treatment facilities and receiving watercourses).

4.5 "Cradle-to-grave" system of notification

For a sound treatment and disposal of hazardous waste, it is necessary to follow the waste from the moment of reception until final disposal or reuse of the material. Proof of disposal or reuse can be established by using a "cradle-to-grave" or "cradle-to-cradle" system of notification.

These so called "evidence" waybills should contain particulars regarding the type and quantity of the waste substances in question, the means of transport and details regarding the producer or generator, carrier and party attending to the disposal. In this manner the route taken by the waste material becomes evident step by step for the competent authorities and also for the companies involved: this document establishes a link (i.e. a paperwork tracking system) between the different activities.

Many countries have adopted some kind of tracking system to document the generation, transport, treatment and final disposal of hazardous waste. The paperwork accompanies the waste shipment and provides a record of waste movement from the waste producer through each intermediate management state to final treatment and disposal. The paperwork serves as a "chain of custody" document. Every time the waste shipment changes hands, the responsible persons sign the paperwork. Often the government regulatory agency must receive a copy of the paper-work at crucial stages in the transfer, to monitor the transfer.

The documents can be accompanied by chemical analyses results of the particular waste.

The waste collector issues a document before passing the waste to another party, listing the source, characteristics, destination and all the planned methods for intermediate collection, transport and storage operations, and for final disposal of the wastes. The document is signed by the shipmaster and the receiver, and a copy is made available to the shipmaster as proof of the legal discharge.

The document accompanies the waste to its destination which may be a waste treatment or disposal facility. The producer, the various intermediate operators and the operator of the final installation successively endorse the document on taking over the waste (see example in figure 3). Each keeps a copy endorsed by the following operator, and these copies are available for inspection by the inspection service for a specified period (e.g. three years).

The inspection service is granted authority to require samples and analyses to be made available to verify a waste's composition. In case of a dispute, samples should be available for contra-expertise.

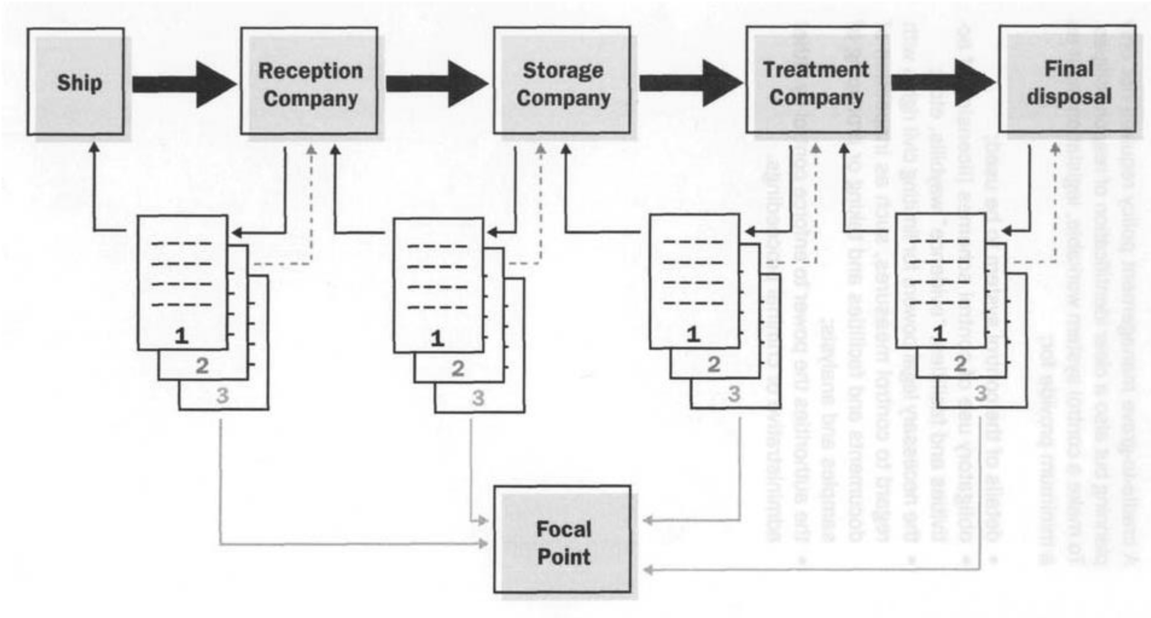


Figure 3 – Cradle-to-grave system of notification

A cradle-to-grave management policy requires not only planning but also a clear identification of responsibilities. To make a control system workable, legislation must as a minimum provide for:

- details of the control system to be used;
- obligatory use of control schemes (licensing of activities and facilities, "evidence" waybills, etc.);
- the necessary legal powers for limiting civil rights with regard to control measures, such as inspection of documents and facilities and taking or producing of samples and analysis; and
- the authorities the power to enforce control by either administrative or criminal proceedings.

4.6 Voluntary certification of port reception facilities

If no legislation is (yet) in place, using a voluntary auditing scheme can also assist in developing a comprehensive and solid strategy for the collection, treatment and disposal of ship-generated waste. The existing ISO standard ISO/DIS 16304 provides a method for addressing ship-generated waste and cargo residues from the moment it is delivered from the ship to the facility where it is managed ashore. It addresses the design of port reception facilities, their operation and management and can be used by new ports as well as existing ports in order to refine their systems.

CHAPTER 5 - Planning port reception facilities

5.1 Introduction

Ensuring the provision of port reception facilities requires good planning and design. Notwithstanding the fact that the description of the planning approach in this chapter is written with relatively large reception and treatment facilities in mind, it can also be used in a more general approach for the planning of reception facilities in smaller ports.

5.1.1 Provision of port reception facilities

For small ports extensive port reception facilities are usually not necessary, although large ships may also call at small ports. In this case the construction phase can usually start quite soon after the assessment of the expected waste quantities (see also Chapter 7), carried out in a study phase. In small ports it may also be feasible to install small treatment equipment, or to provide only facilities for reception of wastes and to transport the wastes to a central treatment plant (see also chapter 8).

In these relatively small projects a division of the project in the different phases, such as described in this chapter, will usually not be necessary. Some phases can be combined and especially the design/engineering phase is usually very short as the needed specifications for the procurement of equipment do not have to be very detailed.

5.1.2 Project approach

The implementation of port reception and treatment facilities can be divided into a number of phases, which a project in general follows. In chronological order these phases are:

- a study/planning phase, which ends in a recommendation on which course of action the port should follow, giving only broad treatment of each technical aspect;
- a design/engineering phase, which turns the chosen plan into detailed engineering designs;
- an evaluation/decision phase, after every of the previous phases, leading to a decision on how to continue in the next phase;
- a construction and implementation phase, including commissioning and start-up; and
- operation and maintenance of the reception facilities.

Each of these phases will be discussed in this chapter.

5.2 The planning/study phase

5.2.1 The feasibility study

In the planning/study phase a project plan has to be developed, which is usually done by a feasibility study. The project plan must be consistent with the waste management strategy (see chapter 3), as it is in fact one step in the implementation of this strategy. The size of a feasibility study depends on the specific situation and should result in a project plan, which will contain the following information:

- the necessity for reception facilities according to Annexes I, II, IV, V and VI of the MARPOL Convention;
- assessment of waste stream types and quantities to be handled by the reception facilities, including future trends (see also chapter 7);
- existing possibilities to receive and treat the wastes;
- selection of best technical option(s) for port reception (e.g. stationary or mobile) and treatment facilities;
- required additional measures for environmentally acceptable processing and treatment of the received wastes;
- description of spare capacity philosophy (it is important to provide for emergency storage capacity, that will enable the temporary reception of waste in case of a temporary plant malfunction);
- site selection study (the site should include sufficient spare land to allow for possible future extensions, avoiding sensitive environments);
- approximate investment and operating costs of the required reception and treatment facilities;
- which companies and authorities are or must be involved in the establishment and operation of the port reception facilities;
- a planning period for the design/engineering and construction phases; and
- an environmental impact assessment (EIA).

5.2.2 Data to be collected

The feasibility study will usually start with the collection of data, on the basis of which the preliminary design can be made. Essential to the design, is the assessment of types and quantities of wastes to be expected. This aspect is set out in further detail in chapter 7. The following data are essential for the study:

Port characteristics

- port layout;
- environmental data;

- berths and equipment;
- commodity flows;
- Information on companies or other organizations which could possibly receive and process certain wastes, such as:
  - garbage collection and treatment companies;
  - oil refineries;
  - terminals for petroleum products and other products;
  - chemical plants
  - ship repair and/or recycling yards;
  - tank cleaning companies.
- space requirements (also for possible extension);
- existing or available labour; and
- which laboratories could be used for testing samples of the wastes.

Ship characteristics

- present shipping traffic and ships' characteristics (including pleasure boats, commercial fishing vessels, and other non-commercial vessels);
- future trends in shipping traffic and ships' characteristics (including the categories mentioned in the previous point); and
- ship requirements for access to reception facilities including size limitations.

Waste characteristics

- types and quantities of wastes received at present and estimates of the waste streams that could be discharged in port (see also chapter 7); and
- types and amounts of waste generated in the port.

Port waste-handling characteristics

- existing facilities for the reception and treatment of wastes from ships (including location of facilities, access, security, visibility, signs, lighting, etc.); and
- existing facilities for the reception and treatment of wastes from local industrial activity.

Applicable laws, regulations and policies

- port and other regulations regarding the prevention and combating of port pollution and the receipt of wastes from ships (incl. existing fee systems, e.g. implemented in port dues); and
- waste management strategy which is applied in the country.

5.2.3 Skills needed by the planning team

In summary, the planning team will need to be provided with the skills and time needed to carry out each of the following analyses:

.1 Technical/operational

Engineering studies to determine the feasibility of each design, how the proposed facilities will be used and what the operating obstacles and benefits might be; and a performance analysis to determine the effect of different types of reception facilities based on the level of service provided to the port's customers;

.2 Financial-economic

A financial analysis to determine what the revenue will be at different traffic levels, applying different fee systems, fluctuating volumes of delivered waste and different tariffs, and whether such revenue will support the costs of the facilities and the servicing of any loans.

.3 Environmental and socio-cultural

An analysis to determine the impact of the different types of reception, collection and treatment facilities (including discharge of effluents and air emissions) on the environment. Moreover the provision of these facilities will usually involve discussion with the local population. The planning team should be able to deal with these discussions. Therefore, the planning team preferably consists of people with a different socio-cultural background, for instance foreign consultants (see also section 5.2.4). Furthermore, effort must be made to prevent errors resulting from communication problems.

5.2.4 Use of consultants

In many cases it is possible that the port planning team will not have sufficient knowledge or manpower, to execute the above listed tasks. In this case it would be advisable to hire outside specialists and to confine the task of the port planning team to project control (see also section 5.6), or even only general project supervision. When hiring outside assistance the following aspects are important:

.1 past work and previous planning studies, even if shelved and not acted upon, should be made available to the new team. The same applies to all relevant data, needed for the study;

.2 the outside team should be contracted to spend part of the study period at the port location;

.3 consultancy contracts should name the individuals to be employed on the contract and care should be taken to check the capability of the individuals named;

.4 a liaison officer should be named by the authority to provide a focal point of contact for the team, and this officer should be given a satisfactory level of authority for technical and administrative decisions; and

.5 in the contract with consultants care should be taken that consultants will deliver a full set of as-built drawings and specifications, once the facility has been built.

5.2.5 Assistance from IMO

IMO's Technical Co-operation Division (TCD) provides assistance to developing countries on many different areas within ship safety and prevention of pollution in the form of missions by consultants, fellowships, i.e. sending experts from administrations to developed countries for "on-the-job" training. The funds for such assistance are provided mainly by donor countries and organizations and IMO's Technical Co-operation Fund.

Governments requiring assistance from IMO on projects related to reception facilities should write to the Secretary-General of IMO and explain the problems they face.

5.2.6 Choice of port reception facilities, including location

An important element in the planning of the port reception facilities, especially in case of stationary reception facilities, is the selection of a suitable location for these facilities. A site selection should be part of a feasibility study in the planning/study phase. In this sub-chapter, important criteria for site selection are discussed, with respect to the different reception and pre-treatment options.

The final treatment and/or disposal facility will be based on-shore, but the collection equipment can either be mobile or shore-based at a central point.

In most cases a choice will have to be made between mobile and fixed reception facilities, although in large ports both can be applied. Mobile reception facilities have the advantage that the investment cost is less (especially in case of trucks), that they can be put in operation very quick, and that they can be operated in a more flexible way. The interference of movements on the quay/in the water with other operations, such as loading/unloading of cargo, and a restricted or prohibited access for mobile facilities on jetties, such as those where oil products, liquefied gases, bulk chemicals or packaged dangerous goods are handled, are possible disadvantages. Fixed facilities on the other hand have the advantage that their scope of collected wastes will be wider (as they can be designed and equipped in a way that all MARPOL wastes and residues can be collected), that they have a larger capacity for collection and storage, and that they can combine the collection, storage and treatment of different waste types. An important disadvantage is the higher investment cost for these facilities.

5.2.6.1 Mobile port reception facilities

5.2.6.1.1 Floating reception facilities

.1 Liquid MARPOL residues

Usually barges, either towed or self-propelled, provide the best option for floating collection facilities. Different alternatives are discussed in chapter 8. In any case no sub-standard oil tankers should be used to serve as reception facilities, and care should be taken that an adequate crew is on board. Barges used for collecting wastes have only limited draught requirements, so they will present little problem in terms of adequate water depths. However, sufficient calm weather berthing space for the unloading of the wastes which have been collected and suitable docking facilities must be made available. Berthing facilities which were built for other purposes can often be used by reception facility barges. In ports where berths have become obsolete due to increased ship size, the old berths may be converted to docking reception facilities for barges.

.2 Solid MARPOL residues

The collection of solid wastes such as Annex V wastes might or might not be combined with the collection of liquid residues such as Annex I, II and IV wastes. A disadvantage of a combined collection, however, is that on board a tanker barge there might not be enough free space to provide a segregated collection of the solid wastes (e.g. with several skips) in the case the ship wants to land segregated waste streams. In any case, when using floating facilities, garbage is off-loaded from ships directly to a barge craft. Care should be taken that nets or other means of coverage are used to prevent the garbage from blowing into the water. When garbage is collected by a barge or other water craft, the garbage is off-loaded to land at some point to be hauled to an incinerator or landfill. Some provision must be made for off-loading the garbage barge either in the port at which the garbage is collected, at the disposal site (if it is accessible to the barge), or at another port if the garbage is transported by water to another port.

5.2.6.1.2 Vehicles

.1 Liquid MARPOL residues

When land vehicles are used for waste reception, a high flexibility with respect to the place of waste reception can be achieved, sometimes combined with a shorter service waiting time as compared to barges. However, while vehicles share to a large extent the same advantages as floating reception facilities, there are certain aspects which need to be observed and taken into account:

- the loading capacity of vehicles is usually much smaller than the capacity of barges; and

- terrain and road surfacing should be suitable for safe and swift transport.

.2 Solid MARPOL residues

Trucks or other vehicles used to collect solid wastes such as garbage by off-loading directly from ships require clear and readily available access to the ships. This type of approach requires a good road system within the port and quays or jetties which are sturdy enough to support the vehicles. Good logistics will be required to co-ordinate the garbage collection. As with collection vessels, care should be taken from garbage blowing into the water during off-loading. In the case of segregated waste streams, it might also be necessary to order more than one vehicle to collect the different waste streams in order to prevent the residues getting mixed (e.g. hazardous with non-hazardous solid waste).

5.2.6.2 Fixed port reception facilities

The alternative for mobile collection is to have one or more central shore-based waste collection points in a port. For small ports this solution might be suitable, especially when the reception facility is located on a strategic place (e.g. at the main lock providing access to the port). For larger ports the main disadvantage is that a ship has to shift berth, if reception of the waste is located at a fixed place. Shifting berths is a difficult, time-consuming and expensive affair, which might lead to undue delay (see chapter 2). If reception facilities are located in the wrong place, delays, congestion and an increased risk of accidents and collisions will result.

For reception of oil-contaminated water and other liquid MARPOL waste the construction of pipelines to each berth might be a feasible option, especially if the reception is combined with a tank cleaning facility, e.g. at an oil terminal.

If receptacles are placed at a designated site for the collection of MARPOL residues, they can be placed in a compound or environmental shelter, which is used to physically and visually shield the containers, to discourage use by non-port users, and to prevent garbage from blowing away. Depending on the size of the port, stationary receptacles are placed in one central location or at multiple sites within the port area. The space required depends in part on the number and type of receptacles to be located together and the types and volumes of wastes to be collected at a single site. For example, some States have strict requirements regarding the collection and treatment of international catering waste, often referred to as quarantine waste. In these States, waste contractors have to provide separate bins in order to collect the waste concerned. Also the treatment and disposal methods for this waste are often the subject of specific requirements, and will be further discussed in chapters 7 to 10.

Appropriate sites for garbage receptacles include wharves adjacent to moorages, access points to docks, fuel stations and boat launching ramps.

5.2.6.3 Temporary storage and pre-treatment

If on-site pre-treatment and temporary storage are provided in the port, appropriate space must be available. On-site pre-treatment sometimes occurs at the collecting receptacle. Compacting dumpsters, for example, both collect and compact garbage in the same piece of equipment. Alternatively, garbage can be collected from various points within a port and taken to a central location for compacting or baling. Temporary storage areas should be accessible to vehicles used to haul garbage form collection sites and to haul garbage from storage to an incinerator or landfill. Storage areas must be accessible to collecting vehicles and should be protected from wind and other environmental elements and from for-aging animals, for public health, safety and aesthetic reasons.

But also liquid MARPOL residues can relatively easily be pre-treated on-site, in particular bilges and sludges. These oily-water emulsions have the physical characteristics to separate by itself in two fractions (oil on top, water below) during temporary storage when left unhandled for a while. Often the water fraction can be biologically treated before being discharged into the dock water. The oil can be loaded into a truck or barge again to undergo further treatment in a treatment plant. In chapter 8 to 10, different treatment and disposal techniques will be further described.

5.2.6.4 Siting requirements

To summarize, the following considerations are important when selecting a site, either as a fixed port reception facility and/or pre-treatment or temporary storage site:

- other port operation should not be hindered;
- the risk for wastes to enter the water should be minimized;
- the necessary equipment to clean up spills or prevent spills from contaminating the whole port area should be easily available at the facility;
- the site should be at a convenient place both for seafarers and for port personnel and vehicles;
- the site should have sufficient lighting to allow for and encourage waste collection 24 hours a day;
- waste reception areas need to be clearly marked and easily located, especially when waste streams are to be collected in a segregated way;

- reception areas must be secure to prevent abuse or misuse and to ensure the safety of seafarers and port personnel using them;
- the impact of the facilities on the surrounding community should be minimized, especially with respect to noise, odour and outer appearance; and
- the facilities must comply with national, local and other applicable legislation on garbage collection and processing.

5.2.7 Evaluation of the study phase

The planning/study phase should be followed by an evaluation, to help the body responsible for the implementation of port reception facilities on how to continue in the next phase. The decision will be based on a thorough evaluation of the project plan. The elements of such a project plan are listed in section 5.2.1. Also comparison with good practices in other ports can be extremely useful.

In general, the following key elements should be taken into account:

- the existing and expected volumes of waste to be delivered to one or more reception facilities in the port;
- the expected types of waste to be collected (MARPOL Annexes);
- existing waste treatment facilities in the port or its vicinity;
- the number of daily waste collecting operations;
- possible strategic locations for the reception facility; and
- financial and budgetary constraints.

On the basis of the estimated costs a financial evaluation of the project has to be made. In this respect it is important to realize the accuracy of the cost estimate. In general, the initial study phase can only produce a cost estimate with an accuracy of 25-35%.

The first aspect to be evaluated is: did the feasibility study achieve the desired result? As the planning/study phase will lead to a conceptual design, the planning team members should evaluate whether they agree with the proposed facilities and with the proposed project approach and time planning. In this phase it is still possible to make relatively large changes in the design of the facilities, as only 5-10% of the total engineering work has been carried out. However, as the project continues, the design will become more detailed and large changes in the design will increase the cost significantly.

If an advisory panel has been formed, as indicated in chapter 3, it should be involved in this evaluation. In later phases of the planning its involvement can be less, as its main task consists of discussing general aspects of the reception/treatment facility rather than discussion about engineering details.

5.3 Design/Engineering phase

The next phase in planning port reception facilities is the design/engineering phase. Usually this phase is divided in two parts:

- basic engineering (or front-end engineering); and

- detailed engineering (or production engineering).

As indicated, different terms exist for these phases, but in this manual the terms basic and detailed engineering will be used. Engineering contracts can be based on these separate design phases. There are several types of contracts for design/engineering work. They may be based on fixed prices or on spent engineering hours.

A special type of design and construction tender is the turnkey contract. The builder is expected to design and to construct a complex of facilities in full operational order. Turnkey contracts are often applied to work requiring specialized technologies, such as a treatment plant for oily and/or chemical residues.

The initial costs of turnkey contracts are higher than for other engineering contracts. However, the advantages of turnkey contracts may well outweigh the initial extra costs. Advantages of the turnkey contract are twofold:

- the first is considerable saving of time, as price calculations are made simultaneously with the preparation of specifications in a single operation; and

- secondly, the interested port administration may receive a larger variety of ideas and designs from highly experienced sources at a relatively small cost.

Thus in a turnkey contract all phases starting from basic or detailed engineering up to start-up are included and executed by one contractor. Another possibility is to have the different phases carried out by different contractors. Therefore both design/engineering phases will be discussed in this section.

The basic engineering phase serves as an intermediate point to obtain a more detailed design and a more accurate cost estimate than those generated in the feasibility study. All instrumentation and equipment is detailed and usually presented in piping and instrumentation drawings (P&IDs) and other documents and a general layout of the facility will be made. The cost estimate will have an accuracy of 10-20%, whereas the engineering hours will amount to 25-40% of the total engineering.

The basic engineering phase also has to be evaluated. This might lead to small design changes or a change in planning or financing. Also the role of the contractor can be evaluated. Usually after this phase the required funds have to be secured and a go/no go decision taken. If it is decided to continue with the project, the evaluation should also lead to a decision on the basis for the next phase of the project, the detailed engineering.

In the detailed engineering phase, the designs from the basic engineering documents are worked out to such a detail that the documents can be used for construction. The materials and equipment have to be procured and subcontractors (for instance for civil works) have to be hired. When procuring equipment, it is important to include operation and maintenance manuals and extensive technical information on the equipment in the requisitions, to be delivered by the manufacturer. These documents should preferably be in the native language of the country. The port planning team could handle this task, but the usual practice is to incorporate these activities into the engineering contract with the contractor.

On the basis of the detailed engineering documents, the facility can be built. The detailed engineering has to be evaluated and the decision to start construction has to be taken.

Well-qualified staff is needed by the port administration for the port planning team, to serve as a communication link between port and contractor. The use of consulting engineers as a contractor is usually needed for the design/engineering phase since this is a difficult and costly task which can only be successfully performed only by specialized firms.

Furthermore it is essential to evaluate the planning and design/engineering phase together. The results of such an evaluation can be very useful for future projects. The following aspects are important in this evaluation:

- Did the project produce the desired result?
- Was the project cost-effective?
- What were the shortcomings or bottlenecks; suggestions to prevent this happening in future projects.

5.4 Permits and/or licensing

Before construction work can actually start, it should be noted that, depending on the legislation applicable in the port State, it might be necessary to obtain the correct licences and/or permits from the competent authorities, either from an environmental point of view, construction/spatial planning, or both. This should therefore be checked well before the activities start, since in many cases it might take up some time (weeks or even months) before the permit or permission can be granted.

5.5 Construction and implementation phase

When all licensing is in place, construction work can usually start before the detailed engineering finishes. For instance certain civil activities (e.g. foundations) have to be executed before any equipment can be installed. It is extremely important to keep a good overview of the construction works, as it is very expensive to repair errors made during the construction stage.

Since most of the routine work of construction and implementation is usually entrusted to consulting engineers, the local port planning team has the opportunity to concentrate on keeping a global overview of the activities. Team members should follow the progress of work to ensure that the concepts and designs are transformed into reality as technical facilities.

As small changes in the design always occur during construction because of unforeseen situations, it is important to have the consulting firm deliver as-built drawings and operation and maintenance manuals of the treatment facility, preferably in the native language of the country.

When the facility is constructed, commissioning will follow. This is a last check of all equipment, piping, etcetera, to assure that everything is ready for start-up. After commissioning, the plant will be taken into operation, the so-called start-up phase. In this phase the facility is started and brought into the normal operation mode.

An example of a reception facility operating plan is given in figure 4 below.

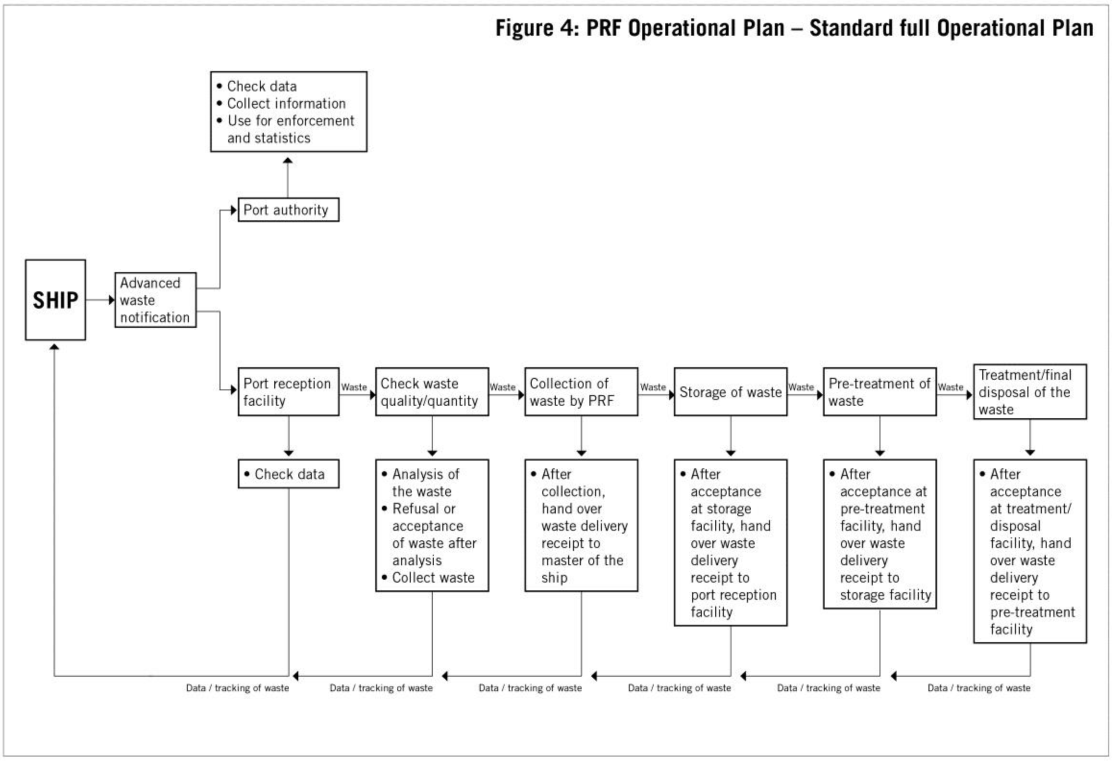


Figure 4 – PRF Operational plan

5.6 Project control

5.6.1 Introduction

Throughout all phases of the project it is important to monitor and evaluate the progress of the project. In most cases a project manager will be appointed to supervise the project and report to the port planning team. Figure 5 shows this type of project organization. In any case it is important to have one communication line only between port planning team and contractor, so that all communication will have to pass the project manager. If there are too many communication lines, the exchanged information is not streamlined and confusion about the design basis will arise. This will delay the project progress.

5.6.2 Supervision of the project

The information needed to control the project will depend on the level of control desired. It is not necessary, for the supervision of the planning project by the port planning team, to use methods of monitoring and control as detailed as those of the engineers who will have to design or construct the facilities. However, it is essential to stay informed about the progress of the project at all times.

A simple method of control is to identify successive goals, or "milestones", along a bar-chart, and to check progress towards each of these goals at regular progress meetings. Satisfactory "milestones" can be simply the completion of the stages described, each ending with an intermediate decision.

5.6.3 Work progress reports

Progress reports must be kept on a regular basis during the different project phases. The content of these reports will depend on the level of control. A chief engineer needs detailed technical reports to control the project progress. A project manager needs much less detailed reports, in which the emphasis will be on economical and planning aspects, rather than on detailed technical aspects (the same goes for the port planning team). Work progress reports are the basis for taking decisions and play an important role in the planning and control of the project, to signal delays in time allowing the opportunity to take appropriate corrective measures.

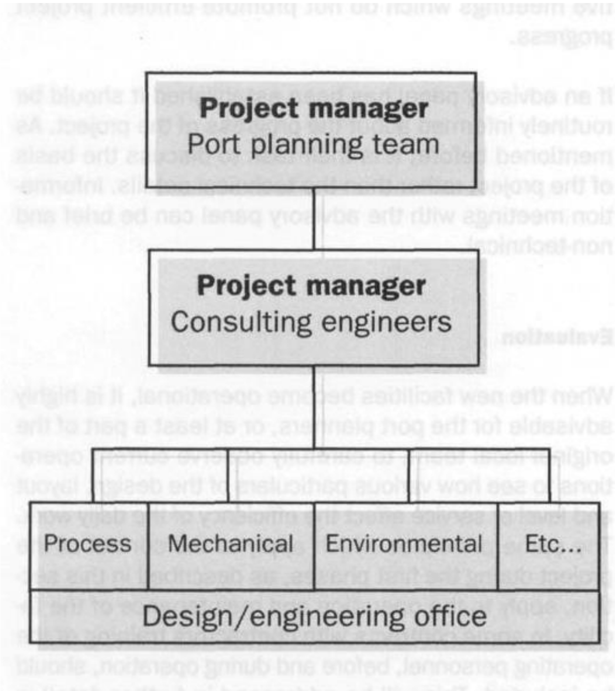


Figure 5 – Usual project organization

5.6.4 Progress meeting

Progress meetings serve the same purpose as progress reports. Again the subjects of the meeting depend on the control level in the project. It is advisable to hold progress meetings on a regular basis, in order to keep a firm control on the progress of the project. The frequency and duration of these meetings will be determined by the project itself.

Only people with a direct link to the subject of the meeting should participate. This may prevent long, ineffective meetings which do not promote efficient project progress.

If an advisory panel has been established it should be routinely informed about the progress of the project. As mentioned before, it is their task to discuss the basis of the project rather than the technical details. Information meetings with the advisory panel can be brief and non-technical.

5.6.5 Evaluation

When the new facilities become operational, it is highly advisable for the port planners, or at least a part of the original local team, to carefully observe current operations to see how various particulars of the design, layout and level of service affect the efficiency of the daily work. The same principles which apply to the control of the project during the first phases, as described in this section, apply to the operation and maintenance of the facility. In some contracts with contractors training of the operating personnel, before and during operation, should be included. This will be addressed in further detail in the next section.

5.7 Operation phase: improvements in performance and operation

During operation of the facilities, on-going measures have to be taken to ensure proper operation and to improve the operation of the facilities. These can be personnel, technical, administrative measures on measures to improve the infrastructure.

The following measures are advisable:

.1 Assigning a dedicated and capable operational manager;

.2 technical training programmes for superintendents and the labour force;

.3 the introduction of preventive maintenance programmes, with properly equipped and staffed workshops and an adequate supply of spares;

.4 constant monitoring of the plant operation and searching for methods to improve the plants performance;

.5 the monitoring should be registered in a logbook, to be used for maintenance purposes and for preventing future mistakes;

.6 improvement of the port infrastructure, directly linked with the operations of the reception facilities; and

.7 improvement of the discharge and disposal procedures, including the administrative procedures.

In order to improve the reception of wastes, possible complaints of ships experiencing undue delay can be very helpful in identifying bottle-necks and inefficiencies in the performance. There is more detail on this in chapter 12.

CHAPTER 6 - Port Waste Management Plans (PWMP)

6.1 Introduction

Adequate port reception facilities should meet the needs of users, from the largest merchant ship to the smallest recreational craft, and of the environment, without causing undue delay to the ships using them. The way how this level of adequacy is being achieved is relatively open, and States have a high degree of freedom to arrange the reception of waste in the most suitable manner.

However, it is generally acknowledged that adequacy of facilities can be improved by up-to-date port waste management plans (PWMP), established in consultation with all relevant stakeholders. Such a PWMP should preferably be a public and legally binding document, that not only can be used as a compendium of all applicable relevant requirements related to the collection, storage and treatment of ship-generated waste, but also as a guidance manual for port users and other stakeholders. The PWMP can also take into account requirements and goals of the national waste management strategy.

It is important that key information in the PWMP is made publicly available and disseminated to port users, as it will help ship owner and agents with their decisions related to the delivery of ship-generated waste. This can be done on the port's website and/or distributing literature (e.g. a brochure, flyer) to ships and their agents.

Detailed guidance for waste management planning is also included in the ISO Standard ISO 16304:2013 on "Arrangement and management of port waste reception facilities".

6.2 Development of a PWMP

A port waste management plan is a living document that provides an overview of all practices related to the collection of ship's waste, including a list of reception facilities, delivery procedures, waste treatment processes, an assessment of adequacy of reception facilities, an overview of communication and reporting procedures and a description of the fee system (when applicable).

Preferably, the PWMP should be developed by the port authority, in close consultation with all port users such as ship owners, ship agents, waste collectors, possible port-based treatment facilities, and relevant competent authorities such as port State control, environmental agencies and maritime authorities. However, in some cases it might be useful that also independently managed areas in the ports, such as fishing ports, oil terminals and chemical plants, draft their own plans and are responsible for managing their waste services as part of their operations.

When there is no in-house experience available to develop the PWMP, advice may be won from an external consultant (see also 5.2.4 and 5.2.5). Apart from technical knowledge and previous experience with port waste management planning in other ports, it is important that the consultant involved has or gains sufficient knowledge and/or affinity with the port concerned, its traffic and specific characteristics.

Ports within a region may also choose to develop a common PWMP and to apply a similar waste collection and cost recovery system. If the reception facilities also serve more than one port, care should be taken tough that these mobile reception facilities are able to serve the ships without undue delay in all ports involved. For that reason these ports need to be located within the borders of a party State, as otherwise the Prior Informed Consent (PIC) procedure under the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* would apply and, especially when transporting dangerous waste, cause delay.

6.2.1 Key elements

The PWMP should include all relevant information on, but not limited to, the following key elements:

- an overview of the relevant applicable legislation on waste management, including the responsibilities under national waste laws of the relevant stakeholders involved in the port;
- a list of existing port reception facilities, including location, type (fixed/mobile), capacity and the wastes they collect;
- an assessment of the need for additional port reception facilities, taking into account possible changes in traffic in the upcoming years;
- an overview of type and quantities of ship-generated waste received and handled;
- a description of the procedures for the reception and collection of ship-generated waste;
- a description of the charging system (when applicable);
- procedures for how to report and take action on alleged inadequacies of reception facilities;
- procedures on notification and reporting of ship-generated waste;
- procedures for consultations with local stakeholders; and
- enforcement measures.

When drafting a PWMP, and specifically when assessing the adequacy of existing reception facilities and analyzing the need for additional reception capacity, it is important that this assessment is done based on reliable and detailed information on waste types and quantities.

Data related to the need of ships to deliver waste in port and expected amounts of waste to be collected can be achieved through the use of the Advance Notice Form (ANF) developed by the IMO (MEPC.1/Circ. 834). Also, waste contractors already operating in the port area may be consulted upon in order to determine the expected amounts of waste.

The PWMP will take into account the specific characteristics of the port or terminal and its users. For smaller ports it might be appropriate to consider introducing a simplified procedure.

6.2.2 Consultation of stakeholders

When determining the appropriate levels of service for the collection, storage and treatment of ship-generated waste, it is important to consult port users to assess their needs with respect to the provision of reception facilities. Extensive consultation will also identify ways to improve practices.

The method of consultation can differ, and may depend on the size and type of the port, the way local stakeholders are organized through associations, and take into account the port's institutional framework. Consultation can be done in the form of meetings, or through an official consultation procedure where the draft plan is made public and every interested party can submit their comments within a certain timeframe.

To guard that the stakeholders' consultation process is ensured and transparent, it can be useful that the procedures for public consultation of PWMP are implemented in national and/or local environmental regulations.

6.3 Approval and monitoring process

In most States where an official approval process is in place, the authority approving and monitoring the PWMP is either the maritime authority or the environmental authority, at either national or regional level. Sometimes both of these authorities have a role, depending on type and size of ports.

The monitoring of the PWMP, to verify and ensure if the functioning of the system in practice is in accordance with the approved plan, is an important element in ensuring implementation. Competent authorities can develop inspection schemes to verify PWMP compliance.

Depending on the type and size of ports, evaluation and approval of the PWMP is usually done in separate stages and with different bodies involved in the process. In addition to the approval by the relevant authority, and in order to be ready for implementation, the plan usually also has to be adopted by the body governing or managing the port concerned.

In some States or when there is no real approval process in place, the responsibility to provide in an up-to-date PWMP may be delegated to or rest with the port authority.

CHAPTER 7 - Types and quantities of ship-generated wastes

7.1 Types and quantities of MARPOL Annex I residues

7.1.1 MARPOL requirements regarding oily wastes

In MARPOL the requirements for oily wastes are laid down in Annex I, "Regulations for the Prevention of Pollution by Oil."

In Annex I the term oil is defined as: "petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than petrochemicals which are subject to the provisions of Annex II of the present convention) and, without limiting the generality of the foregoing, includes the substances listed in appendix I to this Annex". This definition does not include vegetable and animal oil (which are subject to Annex II) nor does it include oily rags or used cooking oil (which are subject to Annex V). Oily mixtures, which are defined as "a mixture with any oil content", are also covered by Annex I.

All substances, for which the above definition of oil is valid, are subject to Annex I, and therefore the list in appendix I of MARPOL Annex I should not be seen as limiting.

In Annex I strict requirements are stated for the storage and discharge of oil by ships. Regulation 38 of Annex I requires the Parties to the Convention to ensure provision of reception facilities for oily mixtures in the following ports:

.1 all ports and terminals in which crude oil is loaded into oil tankers where such tankers have immediately prior to arrival completed a ballast voyage of not more than 72 hours or not more than 1,200 nautical miles;

.2 all ports and terminals in which oil other than crude oil in bulk is loaded at an average quantity of more than 1,000 tonnes per day;

.3 all ports having ship repair yards or tank cleaning facilities;

.4 all ports and terminals which handle ships provided with the oil residue (sludge) tanks(s) required by regulation 12 of Annex I;

.5 all ports in respect of oily bilge waters and other residues, which cannot be discharged in accordance with regulations 15 and 34 of Annex I; and

.6 all loading ports for bulk cargoes in respect of oil residues from combination carriers which cannot be discharged in accordance with regulation 34 of Annex I.

The stated requirements indicate that a wide variety of oil mixtures can be expected at port reception facilities. As mentioned on the advance notification form (MEPC.1/Circ.834, appendix 2), oily wastes can be divided in the following main groups:

- oily bilge water;
- oily residues (sludge);
- oily tank washings;
- dirty ballast water; and
- scale and sludge from tank cleaning.

Oily residues (sludge) are hereby defined[15] as residual waste oil products generated during the normal operation of a ship such as those resulting from the purification of fuel or lubricating oil for main or auxiliary machinery, separated waste oil from oil filtering equipment, waste oil collected in drip trays, and waste hydraulic and lubricating oils.

Of these main groups, sludge is by far the most oil containing oily-water emulsion.

A problem in the treatment of waste oils is that they are often contaminated with cleaning agents, which emulsify the oil. This makes treatment of the oil more difficult (see chapter 8). In order to determine the necessary capacity to achieve adequacy of port reception facilities for oily wastes, the amount and types of expected waste have to be quantified, with respect to the different groups that are mentioned above. The methodology for assessment of oily waste quantities is discussed in the next section.

7.1.2 Methodology for assessment of oily waste quantities

7.1.2.1 Data collection

In order to determine what kind of port reception facility is required for a specific port, it is necessary to have an estimate of both the type and the amount of oily wastes expected for the reception installation. The type (and characteristics) of the oily waste determine which treatment method should be applied. A first source of information is port statistics, if available. However, waste records are usually not incorporated in these statistics.

Therefore, information has to be collected by means of interviews, queries etc. One method for obtaining oily waste data is to interview all ships captains calling at the port to ascertain which oily wastes, and in what quantities, they would discharge to reception facilities, if these were available.

Of course these interviews are based on the assumption that the ships complied with the MARPOL requirements while "en route". The interviews should be carried out during a period with a representative amount of ship calls (at least several months), in order to obtain a good overview of the oily waste amounts to be expected for treatment. The longer the interviews are continued, the more accurately the data will represent the ports' oily waste situation. Managers of ship docks should also be questioned (especially docks for repair work on ships), to quantify the oily waste amounts resulting from their activities, which should be discharged to port reception facilities.

Instead of physically interviewing captains and other stakeholders, the competent authority may also consider to implement the use of the advanced notification form (see

[15] MARPOL Annex I, regulation 1.

MEPC.1/Circ.834, appendix 2). By making this reporting mandatory, the relevant authority, or a consultant assigned with the assessment, will be able to gain the necessary information from the notification forms.

This method will give an estimate, which can be used for determining the type and capacity of a port reception facility.

Before applying the method described above, an initial estimate of the oily waste situation in a port can be obtained by using certain estimation guidelines for oily wastes that can be expected in ports. However, these estimation methods are very rough and it has to be noted that they give only an "order-of-magnitude" estimate, which will not be accurate enough to design the port reception facilities. The data which is collected by means of the above mentioned method can therefore serve as a verification of these estimation methods.

The estimation methods for oily wastes are based on averaged amounts of wastes. These are (in per cent of tankers deadweight): for wash water 4-8%, for liquid oil residues 0.2-1% and for oily solids 0.01-0.1%. The amount of sludges for motor propelled ships is in the range of 2-3% of the daily fuel consumption, depending on the type of fuel that is used. When heavy fuel oil is used for instance the amount of sludges will be higher than when diesel fuel oil is used.

Ships over 400 gross tonnage are allowed to discharge their bilge water at sea through an approved oil-water separator with a maximum effluent oil content of 15 ppm, and will therefore usually only discharge bilge oil to port reception facilities. For ships under 400 gross tonnage and for ships which have not discharged their bilge water at sea, the average volumes of bilge water to be discharged will amount to 1-10 m^3.

A more accurate estimation may come from comparison amongst ports with similar traffic (in type and amount of ships and the frequency of calls). In this case also regional aspects, such as the presence of special areas or emission control areas, have to be taken into account.

On the basis of the collected waste amount data, the required capacity for an adequate port reception facility and a treatment facility for oily wastes has to be determined. It has to be emphasized that local data always provide a sounder basis for determining the reception capacity than the above general estimation guidelines.

7.1.2.2 Data interpretation and reception facility design

When data has been obtained from port statistics, notification forms and/or via interviews, the data have to be interpreted. On the basis of the types and quantities of oily waste streams, an adequate port reception facility and a pre-treatment facility can be designed.

It is worthwhile mentioning that in many ports worldwide the reception of liquid oily waste streams is in most cases combined with a pre-treatment facility (varying from a very basic de-watering unit to a more complex physical–chemical treatment plant in order to de-emulsify the oil/water mixture). This is not a necessity but simply proves to be most cost-efficient in most cases. Hence, the sooner the oil/water emulsion is dewatered and the higher the oil content of the stream, the higher the value of the waste stream becomes.

Important design criteria are:

- the initial reception capacity (the amount that can be received from a ship, without causing undue delay for the ship);
- the processing and storage capacity;
- the choice of treatment processes; and
- the recycling and disposal options for the effluents from the treatment facility.

The technology or combination of technologies that may be used for a specific port reception and subsequent treatment facility depends on a large number of factors, such as type of waste, desired effluent concentration, applicable legislative standards etc. The technologies and equipment options available for reception and pre-treatment of oily wastes will be discussed in chapter 8. The recycling options for oily wastes will be discussed in 9 and the final disposal options in chapter 10.

7.2 Types and quantities of MARPOL Annex II residues

7.2.1 MARPOL requirements for noxious liquid substances in bulk

The requirements for noxious liquid substances are laid down in MARPOL, Annex II, "Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk". The substances which are subject to Annex II are divided into four categories, as referred to in regulation 6 of Annex II. For each category requirements are defined. The categories are:

Category X:

Noxious liquid substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a major hazard to either marine resources or human health and, therefore, justify the prohibition of the discharge into the marine environment.

Category Y:

Noxious liquid substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a hazard to either marine resources or human health or cause harm to amenities or other legitimate uses of the sea and therefore justify a limitation on the quality and quantity of the discharge into the marine environment.

Category Z:

Noxious liquid substances which, if discharged into the sea from tank cleaning or deballasting operations, are deemed to present a minor hazard to either marine resources or human health and therefore justify less stringent restrictions on the quality and quantity of the discharge into the marine environment.

Other substances:

Substances indicated as Other Substances (OS) in the pollution category column of chapter 18 of the IBC Code[16] which have been evaluated and found to fall outside Category X, Y or Z because they are, at present, considered to present no harm to marine resources, human health, amenities or other legitimate uses of the sea when discharged into the sea from tank cleaning or deballasting operations. The discharge of bilge or ballast water or other residues or mixtures containing only substances referred to as "Other Substances" are not subject to any requirements of MARPOL Annex II.

Regulation 18 of Annex II states where port reception facilities for noxious liquid substances have to be provided:

.1 ports and terminals involved in ships' cargo handling shall have adequate facilities for the reception of residues and mixtures containing such residues of noxious liquid substances resulting from compliance with MARPOL Annex II, without undue delay for the ships involved; and

[16] International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code).

.2 ship repair ports undertaking repairs to NLS tankers shall provide facilities adequate for the reception of residues and mixtures containing noxious liquid substances for ships calling at that port.

Especially important for the application of Annex II is, that it states requirements for the discharge procedures of each category, including requirements for tank cleaning operations.

Before any prewash or discharge procedure is carried out in accordance with this regulation, the relevant tank shall be emptied to the maximum extent in accordance with the procedures prescribed in the ship's Procedures and Arrangements Manual.

Discharge requirements for substances assigned to category X, Y or Z require that:

- the ship is proceeding en route at a speed of at least 7 knots (self-propelled) or at least 4 knots (not self-propelled);
- discharge is below the waterline; and
- discharge is made at a distance of not less than 12 nm from the nearest land in a depth of water of not less than 25 metres.

Specific requirements for category X are:

- the tank must be prewashed before the ship leaves the port, and the resulting residues must be discharged to a reception facility until the concentration of the substance in the effluent to such facility is at or below 0.1% by weight;
- remaining tank washings must be discharged to the reception facility until the tank is empty; and
- any water subsequently introduced into the tank may be discharged into the sea in accordance with the general discharge standards described above.

Specific requirements for high-viscosity or solidifying substances in category Y:

- a prewash procedure as specified in appendix 6 of MARPOL Annex II must be applied;
- the residue/water mixture generated during the prewash must be discharged to a reception facility until the tank is empty; and
- any water subsequently introduced into the tank may be discharged into the sea in accordance with the general discharge standards described above.

Specific requirements for category Y and Z:

- if the unloading of a substance of category Y or Z is not carried out in accordance with the ship's Procedures and Arrangements Manual, a prewash has to be carried out before the ship leaves the port of unloading; and
- the resulting tank washings of the prewash must be discharged to a reception facility.

After the prewash a main wash may be carried out, for example, to prepare the tank commercially clean to receive another product. This is to avoid the risk of contamination of the new cargo by the residues of old cargo and, therefore, generally require more wash water than the prewash. This wash water could be discharged at sea in accordance with the provisions of Annex II; however, it often has to be discharged to the port reception facility for the purposes of backloading the new cargo at the same port. A reception facility is not allowed to refuse reception of these main washings if backloading has to be carried out.

In the Antarctic area, which is a Special Area for MARPOL Annex II, any discharge into the sea of noxious liquid substances or mixtures containing such substances is prohibited.

7.2.2 Methodology for assessment of waste quantities

As for MARPOL Annex I wastes, the potential type and quantities of Annex II wastes have to be estimated, in order to determine the capacity of an adequate reception and treatment facility. The methodology for assessment of waste quantities will be discussed in this section.

7.2.2.1 Data collection

In order to determine the size of port reception and/or treatment facilities required, it is necessary to have an estimate of the wastes to be discharged to the shore. A first source of information is port statistics, if available. However, waste records are usually not incorporated in these statistics.

One option is to let the receiving industries take care of their own waste, hereby following the legislation and standards as applicable to comparable land-based waste streams. However, when multi-purpose terminals receive chemical products, this may not be feasible.

In general, most chemicals ships have segregated ballast tanks. This means that the need for a ship to discharge ballast water contaminated with chemicals in ports, will occur rarely. The main contributor of MARPOL Annex II wastes to reception facilities is therefore wash water (or other washing liquids) resulting from tank cleaning activities. Annex II states specific requirements regarding the discharge procedure of noxious liquid substances. These requirements also extend to tank cleaning procedures, which are prescribed for each category.

In order to quantify the amounts of waste water, data has to be collected.

The most important source of information about the wash water amounts which are needed for the different chemicals will be by interviews or queries with tank cleaning firms, ship brokers, terminals, the producer and the consumer of the shipped chemicals. The P & A manuals of chemical carriers can also provide useful information. The use of consultants can be very helpful in these assessment studies.

Ship traffic data can give an overview of the amounts and types of chemicals handled in a port. Also the port plans for the future (possible expansion) should be taken into consideration.

When an interview is carried out for Annex I residues, also MARPOL Annex II residues might be included in the enquiry. An example of a questionnaire for these interviews can be based on the advanced notification form (MEPC.1/Circ.834). As for Annex I wastes, these interviews have to be carried out over a period of at least several months. Information also has to be retrieved from ship repair yards, to determine the amounts of Annex II wastes resulting during ship repair work.

The amount of wash water can be estimated on the basis of the correlations and requirements stated in Annex II. However, this is a rather theoretical and time consuming approach and data collected in the manner mentioned above will always provide a much sounder basis for waste assessment.

MARPOL prescribes a minimum quantity of water to be used in a prewash. This minimum water quantity is described in MARPOL Annex II, appendix VI "Prewash Procedures".

It has to be stressed that the mentioned method only gives the minimum quantity of water for prewash, and will only indicate an order-of-magnitude estimate of the minimum amount of wash water to be expected. For certain substances special washing procedures might be required and as a result wash water quantities can differ considerably from calculations with the mentioned method. Therefore, data retrieved from interviews and queries with companies which carry out tank cleaning activities, will give a more accurate overview of the amounts and types of waste to be expected for discharge to a port reception facility, and might serve as a verification if the minimum water quantity for prewash is observed.

7.2.2.2 Data interpretation and reception facility design

The data collected from port statistics, interviews and queries, which were described in the previous section, have to be interpreted. On the basis of the types and quantities of MARPOL Annex II wastes to be expected, a port reception facility has to be designed. Important design criteria are:

- the initial reception capacity (the amount that can be received from a ship, without causing undue delay for the ship);
- the processing capacity; and
- the choice of treatment processes.

The technology or combination of technologies that will be used for a specific reception and subsequent treatment facility depends on a large number of factors, such as type of waste, desired effluent concentration, etc. The different treatment technologies, which can be used in port reception facilities for treatment of Annex II wastes, will be discussed in the following chapters.

7.3. Types and quantities of MARPOL Annex IV residues

7.3.1. MARPOL requirements regarding sewage

Sewage, according to MARPOL, means:

- drainage and other wastes from any form of toilets and urinals;
- drainage from medical premises via wash basins, wash tubs and scuppers located in such premises;
- drainage from spaces containing living animals; or
- other waste waters when mixed with the drainages defined above.

Although not specifically defined by MARPOL, a distinction is often made between black water (fecal and urinal waste) and grey water (generated from activities such as laundry, dishwashing, and bathing). Grey water, however, is not covered by MARPOL Annex IV.

Sewage, which is often referred to as black water, shows a lot of similarities with grey water (in terms of waste type and composition), especially when looking at the waste handling techniques needed for the treatment and final disposal of the wastes. This will be further discussed in chapters 8 to 10.

The discharge of sewage into the sea is prohibited, except when the ship complies with the requirements of MARPOL Annex IV. Ships, to which these requirements apply, must be equipped with either a sewage treatment plant or a sewage comminuting and disinfecting system or a sewage holding tank (regulation 9). Ships who have in place an approved sewage treatment plant, or who are discharging comminuted and disinfected sewage using an approved system can discharge sewage at a distance of more than three nautical miles from the nearest land. Ships can only discharge not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land.

For passenger ships in the Baltic sea area, which has been designated as a Special Area for MARPOL Annex IV residues through resolution MEPC.200(62), the discharge of sewage from passenger ships within a special area shall be generally prohibited. An exception to the prohibition of discharge of sewage from passenger ships within a special area only applies when the ship has in operation an approved sewage treatment plant which shall be of a type approved by the Administration, taking into account the standards and test methods stipulated in the 2012 Guidelines.

All Party States have to ensure the provision of adequate port reception facilities at their ports and terminals for the reception of sewage, without causing undue delay to the ships using these.

On top, in special areas, each Party, the coastline of which borders a special area, has to ensure that:

- facilities for the reception of sewage are provided in ports and terminals which are in a special area and which are used by passenger ships;
- the facilities are adequate to meet the needs of those passenger ships; and
- the facilities are operated so as not to cause undue delay to those passenger ships.

7.3.2. Methodology for assessment of waste quantities

As black and grey water can, under certain conditions, be discharged legitimately into the marine environment, little is known about volumes to be expected when delivered ashore. It can, however, be expected that, if it would be delivered to a port reception facility, that the volumes will most likely be considerable.

Therefore, the potential quantities have to be estimated in order to determine the capacity of a reception and treatment facility for black (and grey) water. A first source of information is port statistics, if available. However, waste records are usually not incorporated in these statistics.

The most important and reliable source of information about the amount of black (and grey) water to be expected for collection, and therefore the need for reception facilities as a whole, will be interviews or queries with shipping companies, agents and ships' masters. The advance notification form (MEPC.1/Circ.834, appendix 2) can – again – be a guidance document for these interviews, or the use of it can be made mandatory by the competent authority. Information can also be retrieved from ship repair yards, to determine the amounts of black (and grey) water resulting from ship repair work.

When the port is not located in or nearby a special area, the delivery of sewage to a port reception facility will most likely occur rarely. For that reason it might be more efficient (cost-efficient as well as from an operational perspective) to store and treat the sewage along with land-based waste streams. In order to determine possible available storage capacity it will therefore also be useful to consult operational sewage treatment plants, as it can be expected that sewage (and grey water) from ships can be treated together with land-based sewage streams.

When the port reception facility is located in or near a special area, the expected amount should be assessed thoroughly in advance, as the volumes, especially from passenger ships, will be considerable. Special designated storage capacity and treatment plants are therefore advisable.

The data collected from port statistics, interviews and queries have to be interpreted. On the basis of the types and quantities of wastes to be expected, a port reception facility has to be designed. Important design criteria are:

- the location of a port (in a special area or not);
- the initial reception capacity (the amount that can be received from a ship, without causing undue delay for the ship);
- the processing capacity; and
- the choice of treatment processes.

The technology or combination of technologies that will be used for a specific reception and subsequent treatment facility depends on a large number of factors, such as type and amount of waste, desired effluent concentration, the presence or absence of land-based sewage treatment plants in the vicinity of the port, etc. The different treatment technologies that can be used in port reception facilities for treatment of black (and grey) water will be discussed in the following chapters.

7.4 Types and quantities of MARPOL Annex V residues

7.4.1 MARPOL requirements regarding garbage

7.4.1.1. General requirements

Regulation 1 of MARPOL Annex V defines garbage as all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes of MARPOL. Garbage does not include fresh fish and parts thereof generated as a result of fishing activities undertaken during the voyage, or as a result of aquaculture activities which involve the transport of fish including shellfish for placement in the aquaculture facility and the transport of harvested fish including shellfish from such facilities to shore for processing.

In general, the Annex V residues can be categorised into the following waste streams:

A) Plastics

Plastic means a solid material which contains as an essential ingredient one or more high molecular mass polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. For the purposes of this annex, "all plastics" means all garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products. Except as provided in regulation 7 (in emergency and non-routine), the discharge into the sea of all plastics is prohibited.

B) Food wastes

Food wastes means any spoiled or unspoiled food substances and includes fruits, vegetables, dairy products, poultry, meat products and food scraps generated aboard ship.

In some States food waste may require special waste handling and treatment techniques (e.g. quarantine waste, which in some States needs to be incinerated).

C) Domestic wastes

Domestic wastes means all types of wastes not covered by other Annexes of MARPOL that are generated in the accommodation spaces on board the ship. It does not include grey water.

D) Cooking oil

Cooking oil means any type of edible oil or animal fat used or intended to be used for the preparation or cooking of food, but does not include the food itself that is prepared using these oils.

E) Incinerator ashes

Incinerator ashes means ash and clinkers resulting from shipboard incinerators used for the incineration of garbage.

F) Operational wastes

Operational wastes means all solid wastes (including slurries) not covered by other Annexes that are collected on board during normal maintenance or operations of a ship, or used for cargo stowage and handling. This also includes cleaning agents and additives contained in cargo hold and external wash water. It does not include grey water, bilge water or other similar discharges essential to the operation of a ship, taking into account the guidelines developed by the Organization. Other similar discharges essential to the operation of a ship include, but are not limited to the following:

- boiler/economizer blowdown;
- boat engine wet exhaust;
- chain locker effluent;
- controllable pitch propeller and thruster hydraulic fluid and other oil to sea interfaces (e.g. thruster bearings, stabilizers, rudder bearings, etc.);
- distillation/reverse osmosis brine;
- elevator pit effluent;
- firemain systems water;
- freshwater layup;
- gas turbine washwater;
- motor gasoline and compensating discharge;
- machinery wastewater;
- pool, spa water and recreational waters;
- sonar dome discharge; and
- welldeck discharges.

G) Cargo residues

Cargo residues means the remnants of any cargo which are not covered by other MARPOL Annexes and which remain on the deck or in holds following loading or unloading, including loading and unloading excess and spillage, whether in wet or dry condition or entrained in wash water, but does not include cargo dust remaining on the deck after sweeping or dust on the external surfaces of the ship.

H) Animal carcass(es)

Animal carcasses means the bodies of any animals that are carried on board as cargo and that die or are euthanized during the voyage. This does not include fresh fish or parts thereof.

I) Fishing gear

Fishing gear means any physical device or part thereof or combination of items that may be placed on or in the water or on the sea-bed with the intended purpose of capturing, or controlling for subsequent capture or harvesting, marine or fresh water organisms.

General discharge prohibition

Regulation 3 of MARPOL Annex V contains a general prohibition to discharge garbage in to the sea, except as provided otherwise in regulation 4 to 7 of MARPOL Annex V.

Figure 6 below gives a simplified overview of the discharge requirements for MARPOL Annex V residues (resolution MEPC.201(62)). More detailed guidance can also be found in the *2012 Guidelines for the Implementation of MARPOL Annex V* (resolution MEPC.219(63)).

Regulation 8 of Annex V requires the provision of reception facilities in ports. All ports have to provide facilities. In addition, it is recommended that ships use port reception facilities as the primary means of discharge for all garbage.

<table>
<tr><th>Type of garbage</th><th>Ships outside special areas</th><th>Ships within special areas</th><th>Offshore platforms and all ships within 500 m of such platforms</th></tr>
<tr><td>Food waste comminuted or ground</td><td>Discharge permitted
≥3 nm from the nearest land and en route</td><td>Discharge permitted
≥12 nm from the nearest land and en route</td><td>Discharge permitted
≥12 nm from the nearest land</td></tr>
<tr><td>Food waste not comminuted or ground</td><td>Discharge permitted
≥12 nm from the nearest land and en route</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
<tr><td>Cargo residues[1] not contained in wash water</td><td rowspan="2">Discharge permitted
≥12 nm from the nearest land and en route</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
<tr><td>Cargo residues[1] contained in wash water</td><td>Discharge only permitted in specific circumstances[2]
and ≥12 nm from the nearest land and en route</td><td>Discharge prohibited</td></tr>
<tr><td>Cleaning agents and additives[1] contained in cargo hold wash water</td><td rowspan="2">Discharge permitted</td><td>Discharge only permitted in specific circumstances[2]
and ≥12 nm from the nearest land and en route</td><td>Discharge prohibited</td></tr>
<tr><td>Cleaning agents and additives[1] contained in deck and external surfaces wash water</td><td>Discharge permitted</td><td>Discharge prohibited</td></tr>
<tr><td>Carcasses of animals carried on board as cargo and which died during the voyage</td><td>Discharge permitted
as far from the nearest land as possible and en route</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
<tr><td>All other garbage including plastics, domestic wastes, cooking oil, incinerator ashes, operational wastes and fishing gear</td><td>Discharge prohibited</td><td>Discharge prohibited</td><td>Discharge prohibited</td></tr>
<tr><td>Mixed garbage</td><td colspan="3">When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply</td></tr>
</table>

1 These substances must not be harmful to the marine environment.

2 According to regulation 6.1.2 of MARPOL Annex V, the discharge shall only be allowed if: (a) both the port of departure and the next port of destination are within the special area and the ship will not transit outside the special area between these ports (regulation 6.1.2.2); and (b) if no adequate reception facilities are available at those ports (regulation 6.1.2.3).

Figure 6 – Simplified overview of the MARPOL Annex V discharge requirement

7.4.1.2 Specific requirements and guidelines

It is clear that the discharge of MARPOL Annex V residues can include many different waste streams. These wastes can differ in type, size and hazardousness. If a port recycling programme exists or is being developed, recyclables should be separated from non-recyclables (see chapters 8 and 9). The segregation practices on board should match the requirements of the recycling programme of the port. Information concerning recycling programmes and their requirements should be passed to the ships (see chapter 12). This may at the end enhance the re-use or recycling of the waste streams. In many cases this will lower the total cost of the waste handling, as environmentally sound disposal requires the most complex and therefore most expensive techniques.

The recommended garbage types that should be separated are:

- non-recyclable plastics and plastics mixed with non-plastic garbage;
- rags;
- recyclable materials:
  - cooking oil;
  - *glass;*
  - aluminium cans;
  - paper, cardboard, corrugated board;
  - wood;
  - metal;
  - plastics (including styrofoam or other similar plastic material);
- garbage that might present a hazard to the ship or crew (e.g. oily rags, light bulbs, acids, batteries, chemicals, medical waste etc.); and
- e-waste generated on board (e.g. electronic cards, gadgets, instruments, equipment, computers, printer cartridges, etc.).

Worthwhile mentioning is that some governments also have regulations for controlling human, animal and plant diseases that may be carried by foreign food wastes and materials that have been associated with them. These regulations may require special handling and/or sterilization techniques of these wastes. Therefore, it is strongly recommended to also separate this type of garbage and to deliver it separately to port reception facilities in accordance with the applicable laws and regulations of the receiving country.

7.4.2 Methodology for assessment of waste quantities

7.4.2.1 Data collection

Little reliable information exists concerning garbage production on ships, as it may vary depending on factors such as size and type of the ship, number of passengers and crew, shipboard garbage processing equipment (e.g. compactors, incinerators, etc.), available storage space on board, and waste laws and regulations applicable in the port of call. When determining the quantities and types of garbage on a per ship basis, the following factors have to be taken into account:

- types of garbage normally generated;
- ship type and design;
- ship operating route;

- number of persons on board (passengers and crew);
- duration of voyage;
- time spent in areas where discharge is restricted and/or prohibited; and
- time spent in port.

In order to determine what kind and capacity of port reception facilities are required, the amounts of waste per port must be established. Interviews with the ship's captain may provide valuable information. Therefore, the notification form, as mentioned in MEPC.1/Circ.834, appendix 2, may serve as a guideline for these interviews. Again, a competent authority may also choose to implement the use of the advance notification form by the ships' captain as a relevant source of information.

On the other hand, comparison with other similar ports may also give a rough estimation of the amounts and types to be expected.

The ISO standard 21070 on the management and handling of shipboard garbage entails in its annex A calculation methods in order to determine the expected amount of waste. Methods used primarily in characterizing municipal solid waste can also be used to characterize the garbage that will be received in a port.

In the specific case of cargo residues entrapped in washing water, the amount of waste to be delivered to a port reception facility may be very high (e.g. 300 m^3). If this is to be the case in the port concerned, it is advisable, as it is also done for MARPOL Annex II, to consult with the relevant cargo handling companies, tank cleaning companies and/or waste contractors in order to get a better insight of the amounts and types of washing waters to expect.

7.4.2.2 Data interpretation and port reception facility design

When data has been obtained from notification forms and/or via interviews, they have to be interpreted. On the basis of the types and quantities of the expected waste streams, an adequate port reception facility can be designed.

In general important design criteria are:

- the initial reception capacity (the amount that can be received from a ship, without causing undue delay for the ship);
- applicable national and/or regional laws and regulations concerning waste handling, recycling and disposal;
- the need for segregated storage of certain waste streams;
- the possibility to re-use materials;
- the processing and storage capacity for the waste streams;
- the choice of treatment processes; and
- the recycling and disposal options.

When the MARPOL Annex V residues are segregated on-board the ship, a port reception facility should be able to receive and store the different waste streams separately. This facilitates the possible re-use of materials, the recycling and further treatment of the waste streams. Appropriate and designated storage capacity and equipment is therefore indispensable.

7.5 Types and quantities of MARPOL Annex VI residues

7.5.1 MARPOL requirements regarding Annex VI residues

The main waste streams falling under MARPOL Annex VI are:

.1 Ozone-depleting substances (ODS), meaning controlled substances as defined in paragraph (4) of article 1 of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the said Protocol in force at the time of application or interpretation of Annex VI. The following are the major sources of ozone-depleting substances (ODS):

- refrigeration equipment;
- air conditioning equipment; and
- fire extinguishing equipment.

.2 Exhaust gas-cleaning residues, often referred to as scrubber waste. The type and amount to be expected will depend on the Exhaust Gas Cleaning System (EGCS), often called "scrubbers", installed and used on board ships. The process of the majority of systems can be divided into three basic steps:

- at first the exhaust stream from an engine or boiler is to be intimately mixed with water – either seawater or freshwater (or both); in case freshwater is used, also a reacting agent is added;
- a treatment plant on board can, after the scrubbing process, remove pollutants from the "wash" water;
- the sludge removed by the wash water treatment plant must be retained onboard for disposal ashore to port reception facilities as they cannot be burned in the ship's incinerators.

The scrubbers currently applied may be wet or dry systems.

Wet scrubbers can be closed or open loop types, or hybrid (open systems that can also be operated in a closed mode).

The open loop type is a system whereby water, taken from the sea and used for scrubbing, can be discharged back to the sea after treatment. The reason is that the alkalines HCO_3 and SO_4, which are present in the sea water, neutralise the sulphur oxides in the scrubber. The sulphate containing waste water can be re-circulated back into the sea, as long as it meets the discharge requirements as laid down in the 2009 Guidelines for Exhaust Gas Cleaning Systems (resolution MEPC.184(59)).

Scrubber systems may also be a closed type, whereby freshwater treated with an alkaline chemical as reacting agent (e.g. caustic soda) is used for neutralization and scrubbing. The wash water can be re-circulated and losses can be made up with additional freshwater. The scrubber sludge is to be retained in a storage tank, while a small quantity of the wash water is bled off to a treatment plant before discharge to sea.

Dry scrubbers use a packed bed of granulated hydrated lime as the scrubbing medium with calcium sulphate as the reacting product. Dry scrubbers are applied in a closed mode only, and the residue is a dry gypsum-like product that can easily be used as a raw material in construction works.

According to regulation 17 of MARPOL Annex VI, each Party undertakes to ensure the provision of facilities adequate to meet the:

- need of ships using its repair ports for the reception of ODS and equipment containing such substances when removed from ships;
- needs of ships using its ports, terminals or repair ports for the reception of exhaust gas cleaning residues from an exhaust gas cleaning system;

without causing undue delay to the ship, and

- needs in ship-breaking facilities for the reception of ODS and equipment containing such substances when removed from ships.

Therefore, Party States, after ratifying MARPOL Annex VI, have to provide facilities for the reception of ODS or equipment containing such substances, washing water from scrubbers and sediment from treatment plants on board.

7.5.2. Methodology for assessment of waste quantities

7.5.2.1. Data collection and interpretation

Little is known yet about the amount and types that will be delivered to port reception facilities.

Interviews based on the advance notification form (MEPC.1/Circ.834, appendix 2) can be a useful source of information. Comparison with ports with similar traffic, taking into account the location and characteristics of the port (specifically the geographical location in or outside an emission control area (ECA), which has an influence on the type of bunker fuel used and EGCS being applied) can also give viable estimations of the type and amount of waste to expect.

But the most useful information may come from manufacturers of exhaust-gas cleaning systems as well as from interviews with ship repair and conversion yards. The exhaust gas cleaning systems used by ships frequently using the port / repair yard will have a direct influence on the need for port reception facilities and the type and amount of waste that can possibly be delivered to these.

Also, the evolution on the EGCS market can give an indication of the amounts of scrubber waste that can be expected: in case ship owners give preference to open or hybrid systems, it can be expected that the amounts of scrubber waste to be delivered to a reception facility in port will be minor.

Given the fact that the type of equipment containing ODS or halocarbons is similar on land and on board ships, the facilities for these Annex VI residues most likely can be integrated with land-based collection and treatment facilities.

The particulate matter removed from the exhaust gas must in turn be removed from the wash water by a treatment plant to prevent it entering the sea. The amount of sludge not only depends on the fuel quality and, hence, the amount of particulates, but also on the amount of water remaining mixed with it after treatment. A typical amount to be handled would be approximately 0.6 tonnes per 100 tonnes of residual fuel consumed (for an open seawater system).

In general, at this stage, reception facilities might focus on creating the possibilities to receive these types of wastes. After primary storage, the MARPOL Annex VI residues can be sent to more specialised storage and treatment plants. Given the large similarities with comparable land-based waste streams, it will most likely be more efficient to send these waste streams, whether or not after primary storage, to specialised treatment plants. The further treatment and disposal options will be discussed in the following chapters 8 to 10.

7.6 Types and quantities of other ship-related wastes and residues

Wastes originating from the application of anti-fouling systems as well as ballast water sediments will mainly be generated at ship repair/conversion yards and/or ship recycling yards. Therefore, interviews with these yards and/or tank cleaning companies operating in dry docks/ship repair/conversion or recycling yards, will provide the most useful and relevant data.

A valid option in this case is to let the receiving yards take care of their own waste, as they will hereby follow the national and/or regional legislation and standards applicable. This does not necessarily mean that they will be able to treat/process those wastes. If these companies themselves cannot treat the wastes of the ships they repair, it should be ensured that the wastes are transferred to a specialized company for proper treatment and/or disposal (see chapters 8 to 10).

An additional interview with shipping companies, agents or owners will most likely not bring more added value to the data retrieved from repair/recycling yards. Given the fact that the residues are in most cases generated during repair/conversion/recycling, there is also no use of adding these waste streams to the advance notification form, which can be used for data collection of MARPOL residues.

CHAPTER 8 - Equipment alternatives to collect, store and treat ship-generated wastes

8.1 Equipment alternatives to collect, store and treat MARPOL Annex I residues (oily wastes)

8.1.1 Introduction

Oily wastes discharged to reception facilities are usually mixtures of oil, water and solids. The composition ratio of these wastes can differ considerably, depending on the type of oily wastes. The different types of oily wastes, listed in chapter 7.1, can be grouped as follows:

- oily bilge water;
- oily residues (sludge);
- oily tank washings;
- dirty ballast water; and
- scale and sludge from tank cleaning.

Oily residues (including waste oils) consist mainly of oil contaminated with water, whereas oily tank washings, bilge water and dirty ballast water consist mainly of water contaminated with a limited amount of oil. Sludges are a separate category, because of their high solids content, the fact that in most cases they are not easily pumpable, and contain a considerable amount of oil (50-75 %).

The reception of these wastes has to be followed by their treatment. Section 8.1.2 of this chapter will deal with the collection and storage equipment, and the rest of the chapter is dedicated to treatment technologies.

The prime objective of a treatment technology for oily waste is to remove oil from water and sediments, in order to produce an oil stream that is suitable for re-use or recycling. The second objective is to generate an aqueous effluent that meets the effluent discharge standards. To achieve the effluent discharge standard, several treatment steps may be required. They can be categorized as follows:

- primary treatment (Gravity separation);
- secondary treatment (Physical/chemical separation); and

- tertiary treatment (Biological/chemical treatment).

The effluent quality which can be achieved with each technology will be described in this chapter. The numbers given are indicative for typical oily wastes, but the actual effluent quality will depend on the influent quality (characteristics of the waste). A typical layout for a large port reception facility is presented in section 8.1.8, giving an overall view of a possible combination of processes, which incorporates all three treatment phases.

In order to understand the principles of the different separation techniques, it is important to know about the physical state and properties of oily waste. Oil is mainly insoluble in water. However, oil can be entrained in water as droplets of varying size and emulsions can be formed. The formation of emulsions can occur due to the presence of surface active agents (such as soaps) or by turbulent conditions in pipes, valves or high shear pumps. Emulsions frequently occur in bilge water, due to the use of detergents for cleaning equipment on the ship. If emulsions are not formed, the oil in water dispersion is relatively easy to separate, by using the difference in specific gravity of the water and the oil particles. This separation is enhanced by promoting coalescence of oil droplets. When two oil droplets coalesce, a larger oil droplet is formed, which has a higher rising velocity through the water layer. However, when emulsions are formed, coalescence is suppressed and oil/water separation will be more difficult, which necessitates the use of separation techniques which are not based on gravity separation alone, including the use of de-emulsifiers.

As mentioned above, the required effluent quality determines which techniques have to be used. However, the first separation will usually be a gravity separation. Techniques for this separation will be discussed in the next section.

8.1.2 Combined collection and separation equipment

The collection of oily wastes can be carried out in different ways (see sub-chapter 5.2.6.). Barges are a good option for floating facilities, as they have limited draught requirements and large collection capacity. These barges can either be motor barges, towed barges or other types. In any case, it is not advisable to use collection barges with oil/water separators on-board, since the time on the vessel will not be long enough for efficient separation. Furthermore, barges usually do not have sufficient space for installation of a separation unit. Additionally, in many ports, the discharge of effluent from a barge into the water is prohibited because of local/national water quality regulations.

On-shore collection can be carried out by tank trucks or at a central collection facility. In all cases, storage tanks with pumping facilities for the oily wastes will be needed, to which the ships, collection barges or collection vehicles (depending on which system is used for collection) can discharge their (collected) waste. Section 8.1.7 describes an example in which vehicles are used for collection.

8.1.3 Primary treatment (Gravity separation)

Buffering and equalizing

The discharge of wastes to port reception facilities is a batch process and the composition of the batches can differ considerably. This is, in general, not a good process basis for treatment technologies. Separation techniques will be most efficient if their inflow is relatively constant. This can be achieved by the use of buffering/equalizing tanks. The use of buffering/equalization tanks can increase the efficiency of a treatment plant considerably, at relatively low costs. The equipment is limited to a tank with a mixer. The size of the tank is determined by the average inflow of waste and by the capacity of the treatment plant. In this way, the process flow is continuous by using the tanks as buffers and the composition of the waste stream is equalized by mixing several batches of oily waste.

Settling tanks

The simplest form of gravity separation is to retain the oil/water mixture in a settling tank for a sufficient length of time to allow the oil, water and sediments to separate. During the separation it is important to maintain a stable oil/water interface. Turbulence in the tank will reduce the efficiency of the separation. This can pose a problem if a settling tank is in continuous operation. As a result, settling tanks either have to be operated batch-wise, or relatively large tanks are required. The addition of plate separators allow for continuous operation, with a relatively small tank.

The oil layer can be removed either by skimming or by overflow, and is suitable for re-use and recycling (see chapter 9.1). The water layer can be removed by simple draining, and collected for further treatment (biological and physicochemical). Regular tank cleaning is required to remove sediments that accumulate on the bottom of the tank, and that can be incinerated. The most regularly used separator of this type is the standard API-separator.

The effluent oil concentration from an API separator is 50-200 ppm, depending on influent quality.

Plate separators

Plate separators work on the principle of increasing the surface area for separation, resulting in a better separation. By using inclined plates, which are installed at an angle, the oil droplets move along the underside of the plate, sediments settle on the upper side of a down plate. This also promotes coalescence, and thus separation efficiency. Another technique to promote coalescence is the use of corrugated plates. Holes in the upper parts of the plates allow the coalesced oil droplets to float to the surface.

There are several types of plate separators available on the market, such as the corrugated plate separator and the parallel plate interceptor/separator, etc. An example of an inclined plate separator is given in figure 7. The water phase effluent quality reached with a plate separator is approximately 20-100 ppm, depending on the type of separator and the quality of the influent.

Skimmers

Usually a skimmer is an integral part of a separation installation. Basically there are two skimming mechanisms. The first mechanism scrapes the oil layer from the water surface using rotating scrapers or pipe skimmers. The second mechanism moves an oil adsorbing belt vertically through the water. At the other side of the belt, oil is removed from the belt by a scraper.

Examples of several skimmer types are given in figure 8.

Evaluation of primary treatment techniques

Gravity separation with settling tanks or with plate separators is very effective for removing the main part of free oil from an oil/water mixture. Sometimes, the oily waste stream is slightly warmed up because this enhances the separation. However, emulsions cannot be treated effectively with these methods, and emulsions frequently occur because of additives to the oil and the use of degreasers. In order to decrease the oil content in the water phase to values lower than those reached with gravity separation other techniques are required.

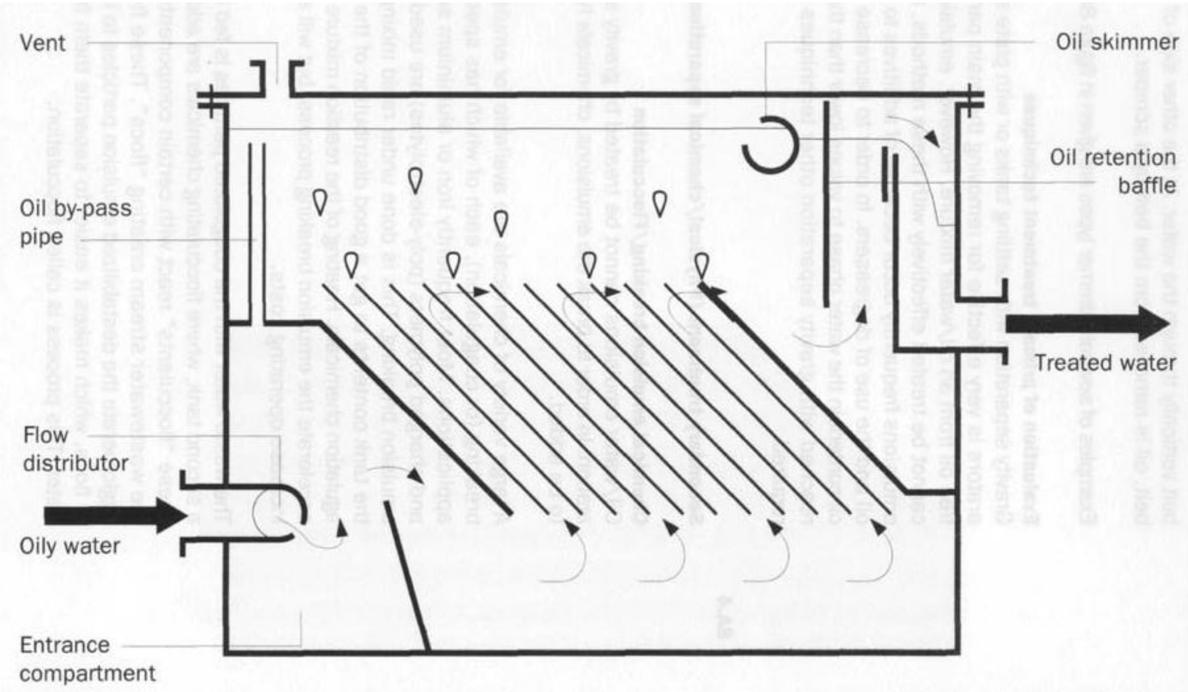


Figure 7 - Schematic drawing of an inclined plate separator

8.1.4 Secondary treatment (Physical/chemical separation)

Chemical emulsion breaking/Flocculation

Oil/water emulsions cannot be treated by gravity separation. In order to break the emulsions, chemicals (so called "de-emulsifiers") have to be added.

A large variety of chemicals are available for emulsion breaking (or coagulation), each of which has specific applications. Most frequently iron or aluminium salts and charged polymers (poly-electrolytes) are used for emulsion breaking. This is done under rapid mixing of the tank contents to get a good distribution of the coagulation chemicals. Heating of the reaction mixture will accelerate the emulsion breaking process, but will also increase operating costs.

The waste water with the coagulated particles is fed into a second tank, where flocculating chemicals are added. These "flocculants" react with certain components in the wastewater stream creating "flocs". These flocs agglomerate the destabilized emulsion particles to larger flocs, which makes it easier to separate them from water. This process is called flocculation.

In the flocculation tank very careful mixing is required (contrary to the coagulation process), to establish a gentle contact among the coagulated oil particles, while not putting too much shear on the flocs, so that break-up of the flocs is prevented. A typical layout of a coagulation/flocculation unit is given in figure 9.

The equipment needed for coagulation/flocculation is rather simple: a reaction vessel with mixer and injection pumps for the needed chemicals. Important process control parameters are:

- dosing rates of chemicals;
- pH; and
- agitation speed.

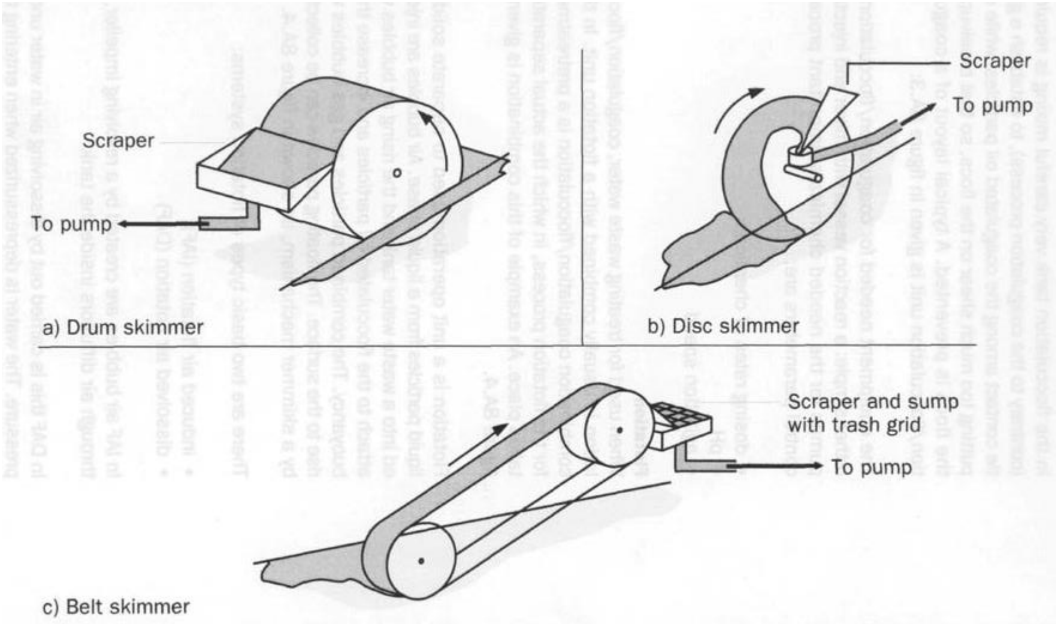


Figure 8 - Examples of different skimmer types

Flotation

When used for treating waste water, coagulation/flocculation is usually combined with a flotation unit. In this combination coagulation/flocculation is a pre-treatment for the flotation process, in which the actual separation takes place. An example of this combination is given in figure 10.

Flotation is a unit operation used to separate solid or liquid particles from a liquid phase. Air bubbles are injected into a waste water tank and the rising air bubbles will attach to the flocculated oil particles and increase their buoyancy. The combined particles and gas bubbles will rise to the surface. The floating particles can be collected by a skimmer mechanism, as shown in figure 10.

There are two basic types of flotation systems:

- induced air flotation (IAF)
- dissolved air flotation (DAF)

In IAF air bubbles are created by a revolving impeller, or through air diffusors inside the tank.

In DAF this is carried out by dissolving air in water under pressure. The water is depressurized when entering the flotation tank. At depressurization air bubbles are formed which rise to the liquid surface. For small systems the whole waste water stream will be pressurized, but for large systems only a part of the wastewater stream will be pressurized. Both systems are shown in figure 10.

The efficiency of flotation systems can be increased by installing plates (e.g. corrugated plates) in the flotation tank. This will promote the separation, because of the coalescence occurring between the plates. Flotation systems are commonly applied for the separation of oil and water and a water phase effluent quality of 20-40 ppm can be achieved with this technique.

The separated oil phase, however, contains a lot of water and has to be treated with a centrifuge, prior to reuse as e.g. fuel.

Filtration

Solids and emulsified oil, which have not been removed in the primary treatment step, can be efficiently removed by the use of filters. The term filters incorporates a wide range of treatment technologies. However, for oil/water separation there are two basic type of filters:

- coalescence filters; and
- precoat filters.

A number of processes take place in the filter, resulting in separation of oil from the water stream. The main processes are adsorption and coalescence.

Precoat filters consist of a thin support, on which a "precoat" is brought before filtration, thereby building up a filter cake. The material used for precoat is usually sawdust or diatomaceous earth.

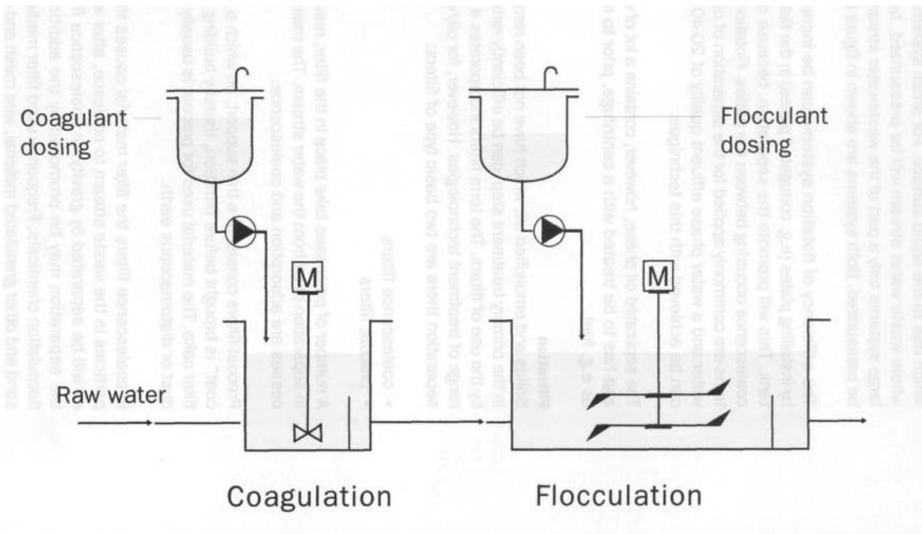
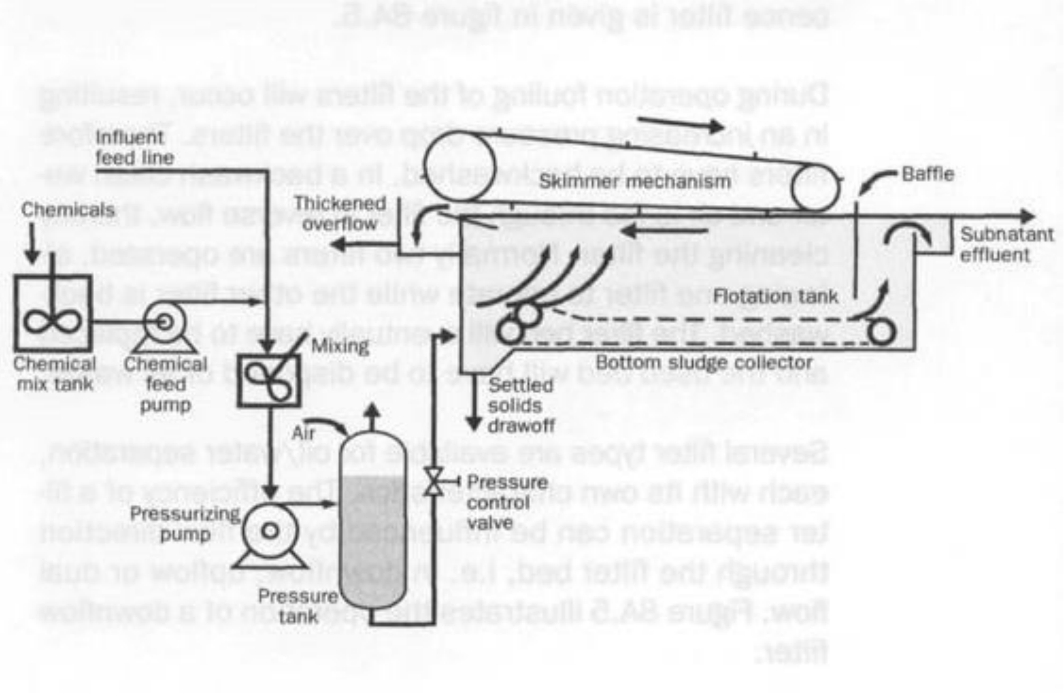


Figure 9 – Typical layout of a coagulation/flocculation unit



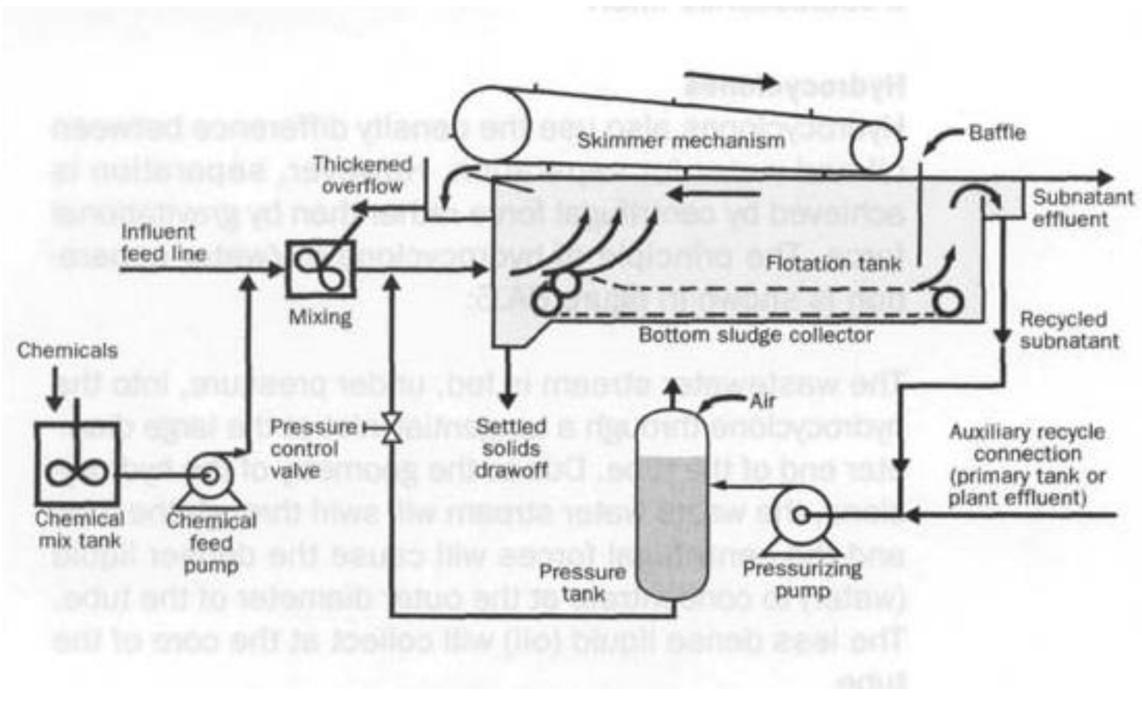


Figure 10 - Dissolved air flotation with a flocculation unit

In coalescence filters the filter material causes the oil particles in the waste stream to coalesce, after which oil will be separated by gravity. In coalescence filters the separation may be promoted by the addition of flocculation chemicals. Frequently used filter media are sand and other granulated material, wire mesh and even crushed walnut shells have been successfully utilised. Combinations of these materials are also used (dual-media or multi-media filters). An example of a coalescence filter is given in figure 11.

During operation fouling of the filters will occur, resulting in an increasing pressure drop over the filters. Therefore filters have to be backwashed. In a backwash clean water and air is fed through the filter in reverse flow, thereby cleaning the filter. Normally two filters are operated, allowing one filter to operate while the other filter is back-washed. The filter bed will eventually have to be replaced and the used bed will have to be recycled or disposed of as waste (see following chapters).

Several filter types are available for oil/water separation, each with its own characteristics. The efficiency of a filter separation can be influenced by the flow direction through the filter bed, i.e. in downflow, upflow or dual flow. Figure 8A.5 illustrates the operation of a downflow filter.

The water phase effluent oil concentration of these filter units is approximately 20 ppm, which can be lowered to approximately 5 ppm when flocculation chemicals are added. However, emulsions cannot be treated well with a coalescence filter.

Hydrocyclones

Hydrocyclones also use the density difference between oil and water for separation. However, separation is achieved by centrifugal force rather than by gravitational force. The principle of hydrocyclone oil/water separation is shown in figure 12.

The wastewater stream is fed, under pressure, into the hydrocyclone through a tangential inlet at the large diameter end of the tube. Due to the geometry of the hydrocyclone, the waste water stream will swirl through the tube and the centrifugal forces will cause the denser liquid (water) to concentrate at the outer diameter of the tube. The less dense liquid (oil) will collect at the core of the tube.

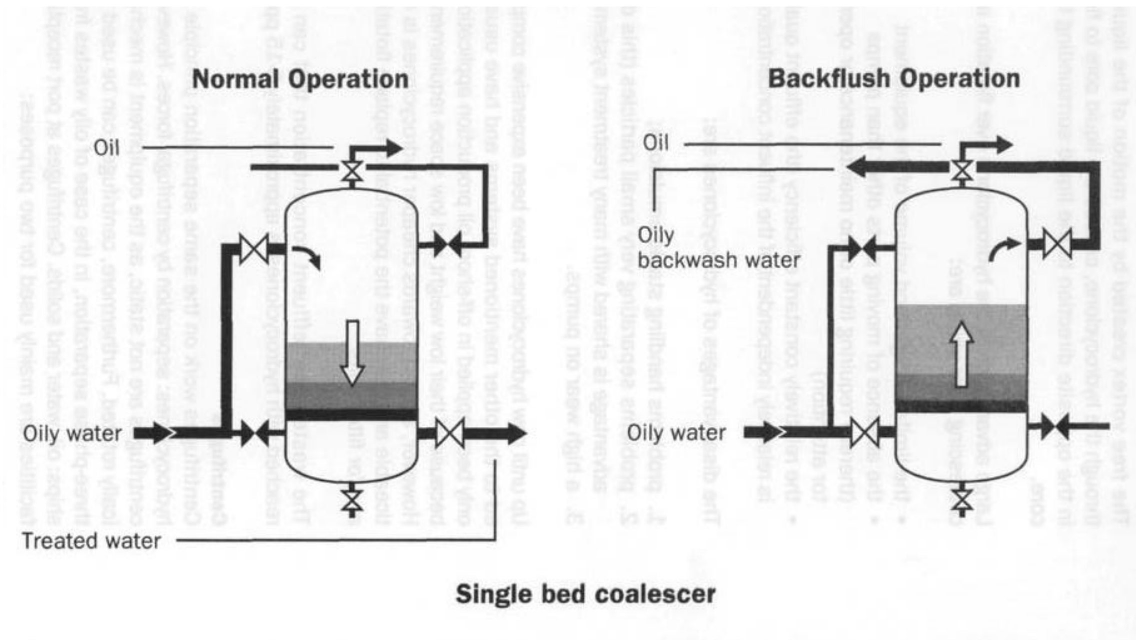


Figure 11 – Principle of normal and backwash operation for a single bed coalescer

The free vortex created by the motion of the liquids through the hydrocyclone, causes the liquid core to flow in the opposite direction to the liquid surrounding the core.

Large advantages of the hydrocyclone over flotation and coalescing filter units, are:

- the limited weight and volume of the equipment;
- the absence of moving parts other than pumps (thereby requiring little or no maintenance or operator attention); and
- the relatively constant efficiency (the effluent quality is relatively independent of the influent concentration).

The disadvantages of hydrocyclones are:

- problems handling stable emulsions;
- problems separating very small particles (this disadvantage is shared with many treatment systems); and
- a high wear on pumps.

Up until now hydrocyclones have been expensive compared to the other mentioned systems and have usually only been applied in off-shore oil production applications because of their low weight and low space requirements. However, a trend towards cheaper hydrocyclones is noticeable and they have the potential to replace flotation and/or filter units.

The waste water effluent concentration that can be reached with hydrocyclones is approximately 5-15 ppm.

Centrifuges

Centrifuges work on the same separation principle as hydrocyclones: separation by centrifugal forces. However, centrifuges are not static, as the equipment is mechanically rotated. Furthermore, centrifuges can be used for three-phase separation, in the case of oily wastes from ships: oil, water and solids. Centrifuges at port reception facilities are mainly used for two purposes:

- dewatering and desludging of oil; and
- dewatering of sludges.

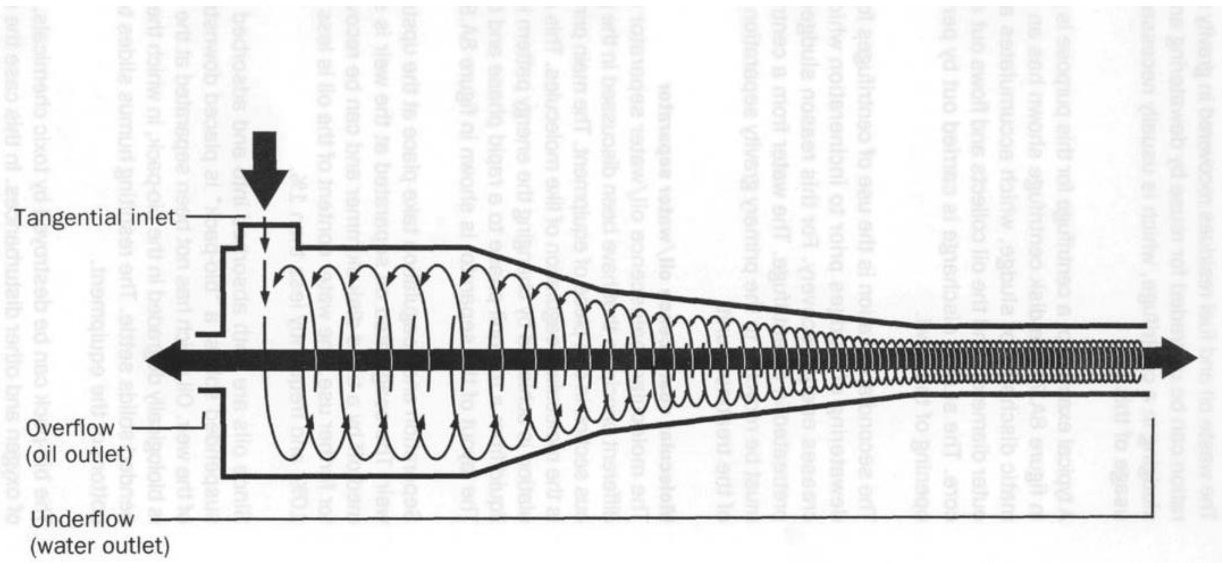


Figure 12 – Principle of hydrocyclone oil/water separation

The waste oil and fuel residues recovered in gravity separation can be upgraded for reuse by dewatering and desludging in a centrifuge, which is usually necessary for usage of this oil.

A typical example of a centrifuge for this purpose is given in figure 13. The disk centrifuge shown has an automatic discharge of sludge, which accumulates at the outer diameter, and the oil collects and flows out at the core. The sludge discharge is carried out by periodic opening of the bowl.

The second application is the use of centrifuges for the dewatering of sludges prior to incineration which increases energy recovery. For this reason sludges are pre-treated in a centrifuge. The water from a centrifuge must be recycled to the primary gravity separation step of the treatment unit.

Molecular coalescence oil/water separator

The molecular coalescence oil/water separator uses different principles that have been discussed in the previous section in one piece of equipment. The main principle is the molecular coagulation of like molecules. This coagulation is achieved by changing the energy pattern in the liquid from a tranquil phase to a rapid phase and back. The layout of the separator is shown in figure 14.

Separation and coagulation take place at the upstream weir. The coagulated oil separated at the weir is skimmed off by a tilted disk skimmer and can be recovered for further use. The water content of the oil is less than 10%, and frequently less than 1%.

Since oils are both absorbed into and adsorbed onto suspended solids, a "bio-pack" is placed downstream of the weir. Oil which has not been separated at the weir, is biologically degraded in the bio-pack, in which the suspended solids settle. The resulting humus slides to the bottom of the equipment.

The bio-pack can be destroyed by toxic chemicals, lack of oxygen and other disturbances. In this case the dead biomass will rise to the top of the equipment and is prevented from going out into the water course by a deflector.

Detergents reportedly do not affect the separation efficiency and the water effluent concentration of oil is 1-5 ppm.

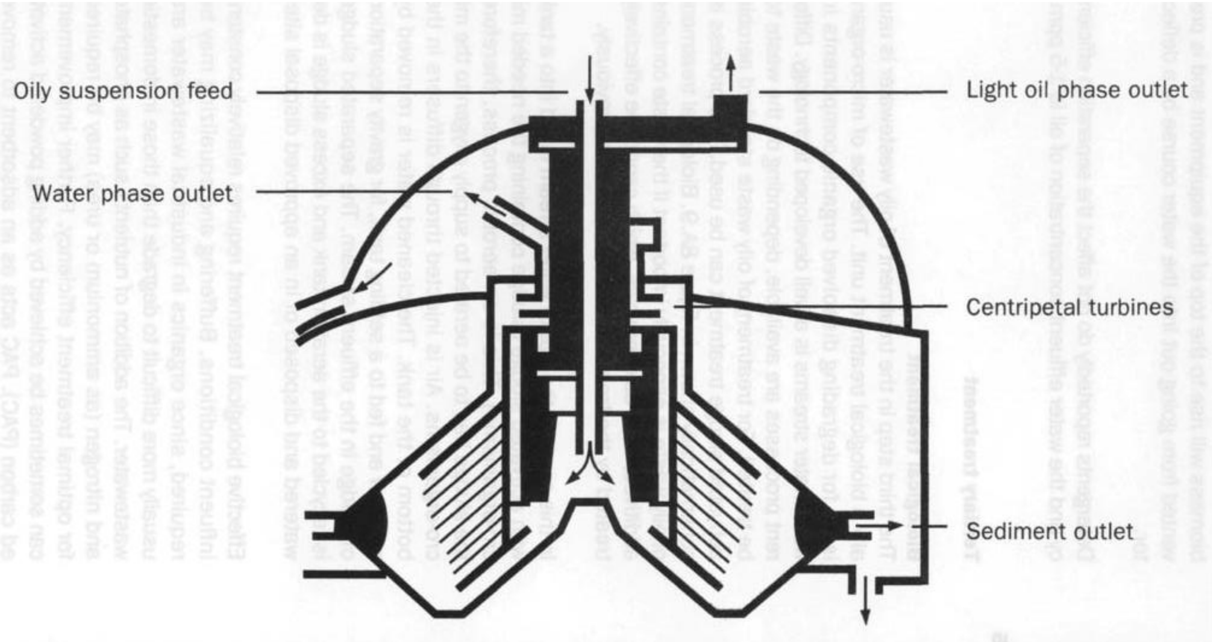


Figure 13 – Three-phase disk centrifuge with automatic sludge discharge

Membrane separation

A system which has been successfully used for the separation of oil/water mixtures, as a secondary treatment step, is the membrane filter. The principle of a membrane is simple: the structure of the membrane and its physical/chemical characteristics allow certain components to pass through and blocks the passage of other components. The working principle of a cross-flow membrane is shown in figure 15.

Examples of crossflow membrane processes are ultrafiltration (UF) and microfiltration (MF). UF membranes have smaller pore sizes and operate at higher pressure than MF membranes and are most commonly used for oil/water separation.

Only a small volume of water permeates through the membranes with each pass, the wastewater has to be fed back into the filtration system several times to achieve the effluent quality stated below. As a result larger pumps are needed than in other secondary treatment systems. Membrane systems require frequent cleaning if large volumes of free oil are pumped through them.

Membranes can treat emulsified oil. Polymeric membranes will function approximately one year, whereas for ceramic membranes 3-5 years may be reachable.

Advantages of membrane systems are that they are suitable for treating emulsions, they are fail-safe (free from operator error) and they have small space requirements. The water effluent quality will range from 2-15 ppm oil, depending on the amount of detergents present in the oily wastewater.

8.1.5 Tertiary treatment

Biological treatment

The third step in the treatment of oily wastewater is usually a biological treatment unit. The use of micro-organisms for degrading dissolved organic components in wastewater streams is a well-developed technology. Different processes are available, depending on the waste to be treated. For treatment of oily waste standard aerobic activated sludge treatment can be used. This process is schematically shown in figure 16. Biological treatment of oily waste is especially important if the waste contains additives, such as chemicals, which cannot be effectively treated by the treatment steps described previously.

In this process the waste water stream is led into a tank with activated sludge (sludge containing the needed micro-organisms). This is an aerobic process. Therefore, the sludge has to be aerated to supply oxygen to the micro-organisms. Air is injected through diffusers in the bottom of the tank. The cleaned water is removed by overflow and fed to a setting tank, for gravity separation of sludge in the effluent stream. The separated sludge is recycled to the aeration tank and excess sludge is dewatered, further dried and incinerated or disposed of in an approved disposal site (for recycling and disposal options see chapters 9 and 10).

Effective biological treatment requires relatively constant influent conditions. Buffering and equalizing may be required, since organics in industrial wastewater are usually more difficult to degrade than those in domestic wastewater. The addition of nutrients such as phosphate and nitrogen (as ammonium or urea) may be required for optimal treatment efficiency. Further improvement can sometimes be achieved by adding powdered activated carbon (PAC). PAC acts as an adsorbent to remove organics from the wastewater which are not easily degraded by the biological process.

The activated sludge process is widely used for treating domestic and industrial wastewater. Other types of biological treatment, applying the same basic principles, comprise amongst others:

- sequenced batch reactor (aeration + settling in one tank); or
- rotating biological contactor.

The discharge level of oil in the effluent can be reduced to less than 1 ppm by biological treatment, but requires considerable operator training and attention to process procedures.

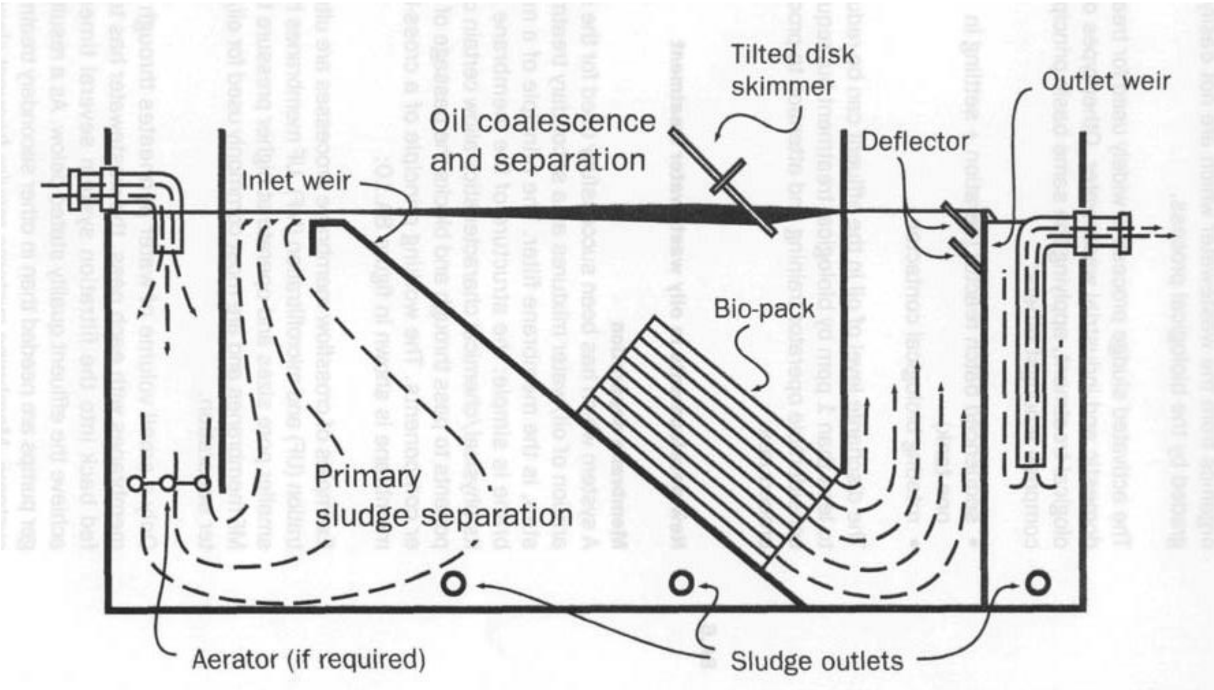


Figure 14 – Molecular coalescence oil/water separator

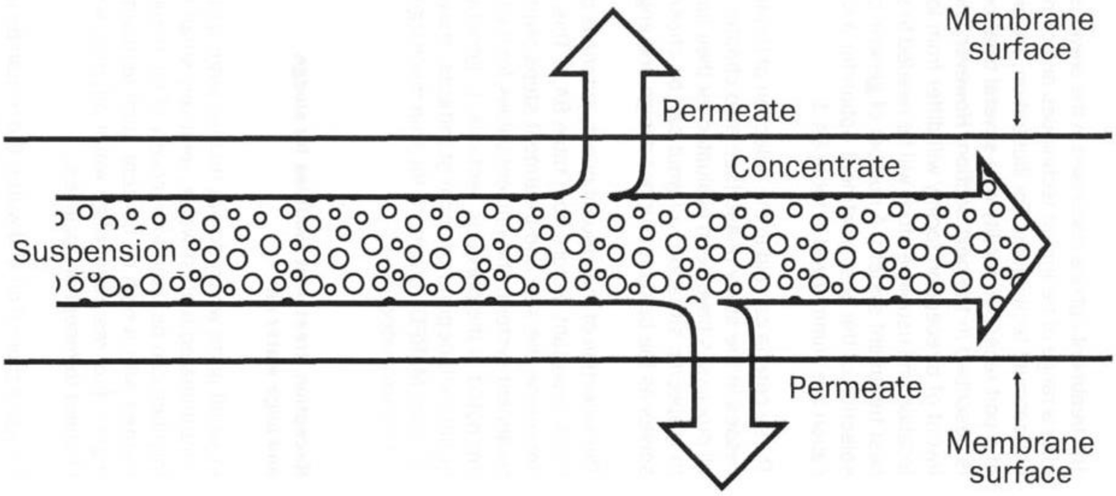


Figure 15 – Working principle of a cross-flow membrane

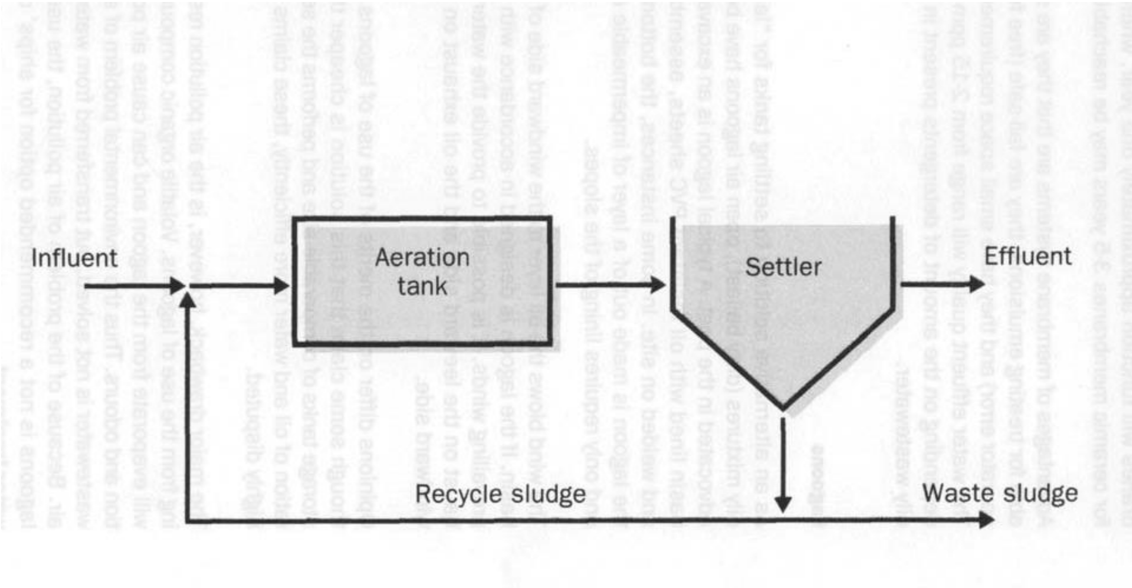


Figure 16 – Schematic layout of the activated sludge process

8.1.6 Selection of treatment processes

The treatment options discussed in the previous sections offer a range of treatment techniques and combinations of treatment techniques. For illustration, a typical layout of a port reception facility with several treatment steps is described in the next section. However, the optimal layout of a reception facility will differ from location to location and usually a study will be needed to select the best treatment system. A number of general criteria for selection of the best treatment option for a specific location are summarized in table 5.

These criteria can, when combined with local/national waste policy requirements and goals, aid in the selection of treatment processes in the study phase (see also chapter 5). When all processes have been evaluated for their applicability to a specific situation, a layout can be chosen, which serves as the basis for further design and engineering.

The selection of the effluent quality criteria is one of the most important factors from table 5. This value will determine the size and treatment steps required for a treatment system. The effluent values for each process are noted in the previous sections. In general effluent quality will depend on local standards. However, the 15 ppm MARPOL standard for ship discharges should not be exceeded.

8.1.7 Reception/treatment facilities for sludge and bilge water oil

In small ports, which do not receive large quantities of contaminated ballast waters or washing waters, relatively small reception facilities can be used for the recovery of oil. In these ports wastes with a high oil content such as used lubricating oil, fuel residues, sludges, etc., will be discharged to reception facilities.

By separation of oil and water, the oil can be recovered and reused (see also chapter 9). The water effluent can be discharged after treatment. In these cases, relatively low cost installations are required. These might consist of small storage tanks with a separation unit, either shore-based or floating.

Factor	Comment
1. Process applicability	The applicability of a process is evaluated on the basis of past experience, data from full-scale plants and pilot data from plant studies. If new or unusual conditions are encountered, pilot-plant studies are necessary
2. Applicable flow range	The process should be matched to the expected volumes of wastes
3. Applicable flow variation	Most unit operations and processes work best with a constant flow rate, although some variation can be tolerated. If the flow variation is too large, flow equalization may be necessary
4. Influent-wastewater characteristics	The characteristics of the influent affect the types of processes to be used and the requirements for their proper operation
5. Inhibiting constituents	What constituents are present that may inhibit treatment and under what conditions?
6. Climatic constraints	Temperature affects the rate of reaction of most chemical and biological processes. Freezing conditions may affect the physical operations.
7. Reaction kinetics/selection	Kinetics and reactor geometry are important for reactor sizing
8. Performance	Usually this is measured in terms of effluent quality
9. Treatment residuals	Types and amounts of residuals produced should be known or estimated. Pilot plant studies
10. Environmental constraints	Environmental factors such as wind directions may restrict the use of certain processes, especially if odours are produced
11. Chemical requirements	What chemicals and in what quantity must be available for a long period of time for the successful operation of the process?
12. Energy requirements	Present and future energy requirements must be known for a cost-effective design
13. Other utilities	Which other utilities are required for a good operation of the process?
14. Reliability	How reliable is the process and under which conditions? What are the effects of shock loadings?
15. Complexity/Training	How complex is the process and which level of operator training is required?

16.	Ancillary processes required	Which support processes are required?
17.	Compatibility	Can the process be easily combined with existing facilities? Can plant expansion be accomplished easily?
18.	Spare parts	Which spare parts are required and how easily can they be obtained?
19.	Currency	In which currency can the equipment be purchased?

Table 5 – Overview for selection criteria for treatment options

Figure 17 illustrates the layout of a small, low cost facility for the reception of non-cargo oily wastes, capable of receiving up to 10.000 tonnes of oily waste annually (from up to 2,000 ships' calls per year).

In this installation, sludge and bilge water oil are discharged into a primary storage tank, which may be mobile or fixed. In this tank the oil/water mixture will settle and the top oil layer can flow through an overflow pipe, into a secondary storage tank, from where it can be pumped into a mobile tank for further use. The water layer in the bottom of the tank is drained to an oil/water plate separator. The oil phase from the separator can be pumped to the mobile tanks. The water phase will be fed through a secondary treatment unit before discharge to surface water. The selection of the secondary treatment unit (see also section 8.1.4), will depend on the specific conditions of the port.

8.1.8 Typical layout of reception/treatment facilities for Annex I wastes

In figure 18 a typical layout of a larger port reception and treatment facility for Annex I and II wastes is shown. The plant also has a tank cleaning facility.

The treatment equipment in this facility includes:

.1 a buffering/equalizing tank;

.2 a plate separation;

.3 a flocculation/flotation combination;

.4 a centrifuge; and

.5 a biological treatment.

In this facility the oily sludges and bilges are treated by a centrifuge, the sludge sediments are disposed (through incineration or disposal at a licensed disposal yard) after oil separation and the recovered oil is used as fuel in the boiler house, to generate hot water for the tank cleaning activities.

The effluent water stream, which leaves the facility, has been treated to comply with the local/national discharge requirements and can be discharged to surface water.

This layout is only one of several combinations of treatment technologies, and is used to illustrate the combination of various treatment processes. Important factors in the layout are of course the type of wastes to be received and the desired/required effluent quality.

As indicated in previous sections, every port has its own specific characteristics that influence the layout of reception facilities, including the possible presence of local industry that also needs waste treatment facilities. In small ports, without local industries in its vicinity, a smaller facility with fewer treatments steps might be sufficient, such as the reception/treatment facility for sludge and bilge water oil, which was discussed in the previous section.

8.1.9 Reception facilities for oily ballast water and washing waters

In view of the large amounts of ballast water or washing waters and their relatively low oil content, it might be advantageous to build special reception facilities for ballast water and washing waters. In some countries the industry or terminal that receives or loads the oil, also receives and processes the oily ballast water and washing waters from oil tankers. Facilities for ballast water treatment use the same equipment as general reception and treatment facilities for oily wastes. However, the facilities required are much larger. These facilities can be constructed on-shore, whereas the collection point for oily waste might either be on-shore or on-ship. At single buoy moorings far from the shore, or when relatively small amounts of waste have to be collected in a widespread area, floating facilities may have certain advantages over land based facilities. They can also serve as a temporary solution, during construction of on-shore facilities.

8.1.10 Central treatment plant for oily and chemical wastewater

Where many ports are located relatively near to each other, or when there is a substantial amount of industrial activity in the port's vicinity, a central treatment plant for oily and chemical wastewater might be an economic solution. In this case, only storage facilities are required in each port, and the waste is transported to the central treatment plant. This means that there will be extra costs for transporting the waste, but the total cost for a central treatment plant might be less than the cost for several local treatment plants. An economic analysis is necessary to determine the best solution for a local situation.

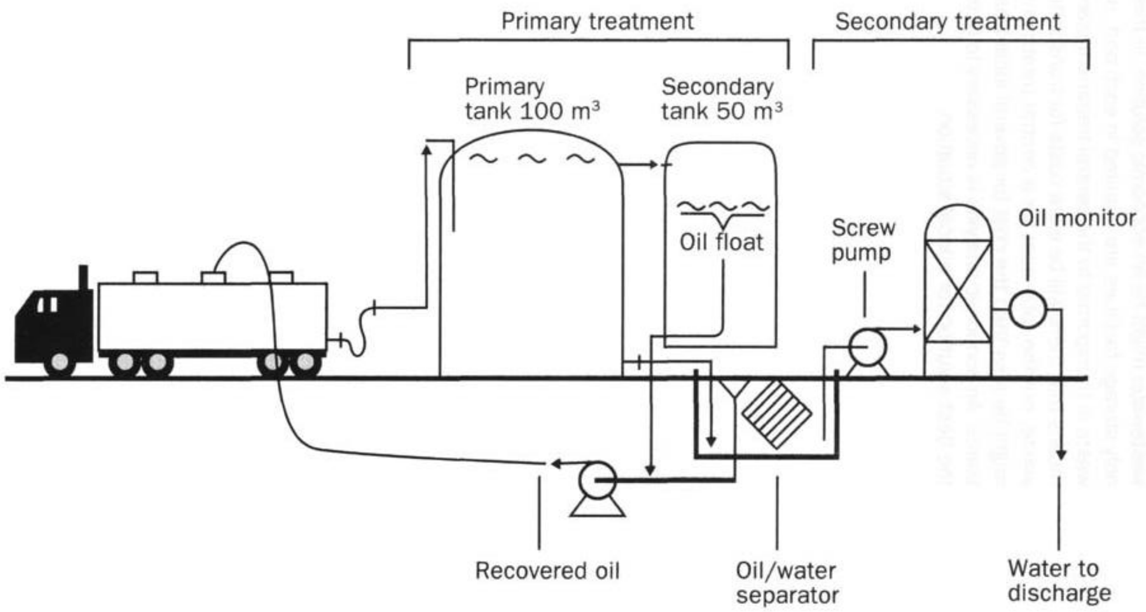


Figure 17 – Layout of a typical low-cost reception facility for small ports

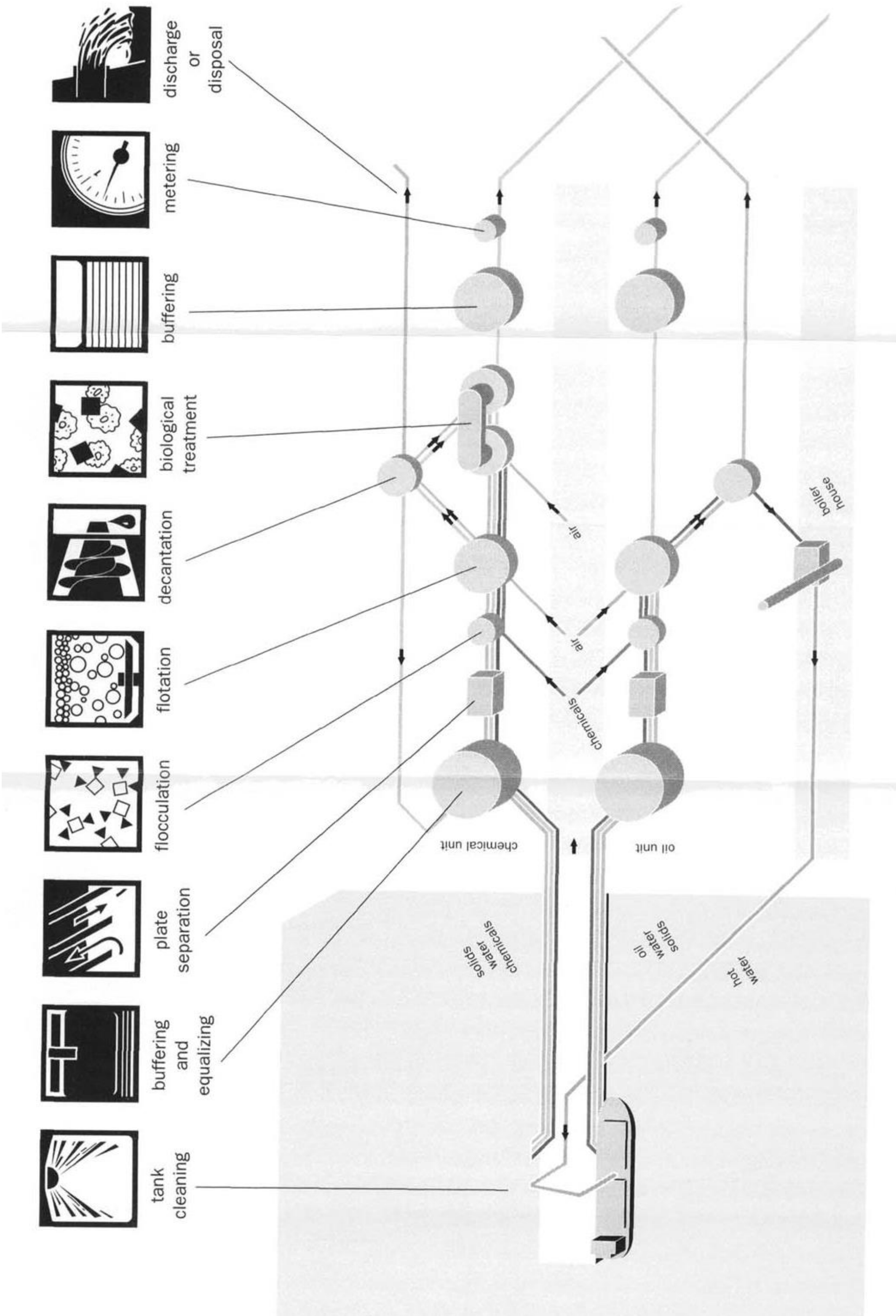


Figure 18 – Typical layout of a reception facility for Annex I and II

8.2 Equipment alternatives to collect, store and treat MARPOL Annex II residues (Noxious Liquid Substances)

8.2.1 Introduction

Worldwide a large number of chemicals are transported by ship. Whereas oil tankers are dedicated to the transport of oil, chemical tankers usually carry a wide variety of products. This necessitates regular cleaning of the tank, as indicated in chapter 7.2, and therefore tank cleaning has grown into a large-scale activity.

Tanks are usually cleaned with hot water, with the possible addition of detergents. Some chemicals (for instance isocyanates) cannot be cleaned with water only, and specific solvents are required for tank cleaning.

The main problem for an Annex II port reception facility is that the received waste can contain a wide variety of chemicals, each with their own special properties, such as solubility in water, toxicity, etc.

Treatment methods are usually based on these physical/chemical properties, and it is, therefore, hard to define a general treatment path for processing Annex II wastes. It is important when operating such an installation, to precisely analyze the received waste before processing it, to determine if they can be treated or re-used in the available processing facilities and to determine if the components present in the waste might disturb the operation of the facilities (for instance components which are toxic for the micro-organisms in a biological treatment unit). A chemical distillation plant may be able to process washing water containing a certain (valuable) chemical through distillation in such a way that, after distillation, it can dispose the water and re-use the chemical in its regular process.

From tank cleaning activities, prewashes and remaining tank washings must be discharged to a reception facility and any water subsequently introduced (which has a lower chemical content) may preferably be discharged to reception facilities, although they are usually discharged at sea. Main washes however if discharged to reception facilities, must be accepted. In this chapter, the possible treatment technologies for MARPOL Annex II wastes will be discussed. In this discussion the same step approach is followed as for Annex I wastes:

- primary treatment (Gravity separation);
- secondary treatment (Physical/chemical separation); and
- tertiary treatment (Biological/chemical treatment).

A large number of techniques are similar to those used for treatment of MARPOL Annex I wastes. Therefore those techniques which are specific for treatment of Annex II wastes will be discussed, and the other techniques, addressed in chapter 8.1, will only be briefly mentioned in their application for Annex II wastes.

For the underlying principles of the latter techniques reference is made to chapter 8.1.

8.2.2 Options for collection equipment

MARPOL Annex II wastes usually result from tank cleaning activities and therefore the option exists to combine tank cleaning facilities with reception facilities. This will require pumps and storage tanks. It is customary for ships to wash their own tanks. In this case pumps and storage tanks are needed at a central place. The handling of Annex II wastes requires strict adherence to safety measures. The most important aspect for reception of Annex II wastes is ensuring chemicals are not mixed, as this may create extremely dangerous situations.

8.2.3 Primary treatment (Gravity separation)

Buffering and equalizing

As for oily wastes, the buffering and equalizing of MARPOL Annex II wastes will result in a continuous and smoother operation of the processing facilities. The tank used for buffering/equalizing might also be used as a settling tank. Of course, it is very important to monitor the mixing of chemicals in the buffer tank to prevent unwanted reactions in the tank. Some chemicals are not allowed to be mixed at all. Therefore, an analysis of the waste and a thorough check of possible chemical reactions with the waste that is already in the tanks is absolutely necessary before discharge to a reception facility.

Settling tanks

Settling tanks can be used for gravity separation of the waste. A problem with MARPOL Annex II wastes is that many chemicals are soluble in water, in which case gravity separation will not be effective. Therefore, the application of settling tanks will depend on the types of chemicals which are handled in the port, and chemicals which are soluble in water will usually be handled separately from insoluble chemicals.

Plate separators

The use of plate separators for MARPOL Annex II wastes has the same problem as the use of settling tanks. Gravity separation by either settling tanks or by plate separators renders a chemical layer which is relatively water-free. However, the composition of this layer may be a mixture of chemicals that may prohibit recycling (see also chapter 9.2). In order to achieve lower chemical contents in the water, or to remove components which are soluble in water, other water treatment technologies are needed which will be discussed in the next sections.

8.2.4 Secondary treatment (Physical/chemical separation)

Chemical emulsion breaking/flocculation

The principle of this technique is described in chapter 8.1. Some chemicals might require the use of special coagulants/flocculants to form flocs. Furthermore some chemicals might inhibit the coagulation/flocculation reactions, and also the pH influences the reactions. Therefore careful monitoring of the influent of the unit and of the pH in the unit is required. Usually the emulsion breaking/flocculation is used as a pre-treatment for separation techniques, such as flotation or filtration.

Flotation

In flotation, air bubbles are used to enhance separation of water and chemicals. The same technique that was described in chapter 8.1 for oily wastes can be used for MARPOL Annex II wastes which are non-soluble. Flotation/flocculation combinations are often applied for this purpose.

Stripping

Stripping is a process in which volatile components are removed from a waste stream by counterflow with a gas stream. The component(s) to be removed dissolves in the gas stream. Therefore, a large contact area is needed to allow the components to transfer from the liquid to the gas stream. Stripping is usually carried out in a stripping tower, in which liquid is sprayed from the top and gas is fed from the bottom. The stripping tower is usually a packed column, i.e. a column filled with packing material. In this way a counter-current flow is achieved, with a high gas/liquid contact area. An example of a stripping tower is given in figure 19.

Stripping can be carried out with different types of gases. Frequently used stripping gases are steam and air, to extract chemicals from a liquid stream.

Evaporation

If the chemicals in the wastewater stream are not volatile, the water can be removed from the waste by evaporation. In port reception facilities an evaporation process might be used to concentrate chemical streams. In this method the wastewater stream is heated to the water boiling point and fed to a packed column. The evaporated water will leave the column as top product, and the chemicals will leave the column as bottom product.

This method can be advantageous when certain chemical waste cannot be processed by a biological treatment unit because of high concentration of chemicals or toxicity of the waste. By evaporation the chemical content of the water stream is reduced to enable biological treatment, and the concentrated chemicals stream can be more easily incinerated because of the low water content.

The energy requirements for this method are high though, as water has to be evaporated. In order to minimize the energy need a pre-treatment is usually necessary, such as a centrifuge operation.

Activated carbon adsorption

Activated carbon is carbon that has been treated to enhance the adsorption of certain components on the carbon surface. The wastewater stream is fed through a filter bed of granular activated carbon, in which certain components will adsorb. Figure 20 shows a typical example of an activated carbon column.

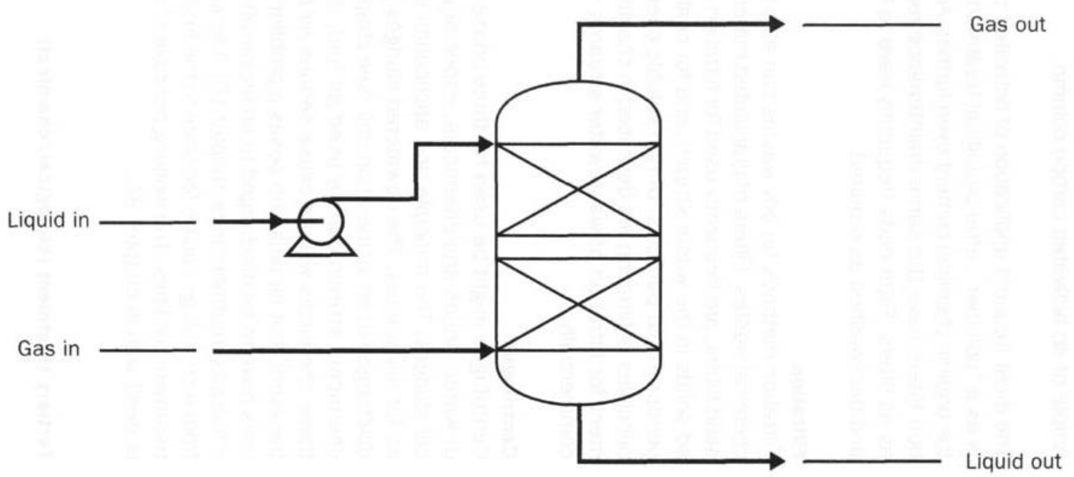


Figure 19 – Schematic principle of a stripping tower

The most frequent application of activated carbon beds is as a "polisher" after biological treatment, to reduce the organic chemical content even further. Activated carbon filters have the same maintenance requirements as all filters. Filter beds frequently have to be changed and backwashed as required. In most cases the backwash residue will be incinerated or disposed of (see chapter 9 and 10).

Filtration

Filtration methods for oily wastes can also be used for chemical wastes. Filters of granulated material, such as sand filters, are frequently used for filtration of suspended solids in the waste stream, and for coalescing suspended liquid particles, of non-soluble chemicals. The principles of filtration are described in chapter 8.1. Equipment for filtration of wastewater streams is available commercially.

Centrifuges

Centrifuges might be used for three-phase separation of water, solids and chemicals, especially for chemical sludges. The principle and application is the same as for oily wastes: the dewatered sludges (solids) are discharged to an incineration unit (see chapter 10), the chemicals stream can, in case this will not lead to air pollution, be used as fuel. In the event that air pollution poses a problem, the chemicals will have to be discharged to an incineration unit with a flue gas treatment (see chapter 10). The water stream from a centrifuge can be fed back to the first step of the treatment facilities. The working principle of a centrifuge is dealt with in chapter 8.1.

Distillation

Through distillation, mixtures of chemicals/water can be separated, based on the differences in volatility in a boiling liquid mixture.

Distillation is a complex treatment method and the cost for building and operating this treatment plant is very high. Therefore, distillation of chemical washing waters, as a stand-alone port reception facility will rarely occur.

Chemical plants, as the receivers of the initial cargo, might, when adequate distillation units are available at the plant, consider distilling chemical washing waters in order to recover (valuable) chemical components for immediate re-use in existing chemical processes art the site.

Given the high level of expertise needed and the fact that distillation of chemical washing waters will mainly occur in existing plants (being the receiver of the cargoes), this treatment method will not be discussed into detail in this manual.

8.2.5 Tertiary treatment (biological/chemical)

Biological treatment

The third step in the treatment of wastewater containing chemicals, is usually a biological treatment step. Different sorts of treatment processes exist. Anaerobic treatment is effective for the treatment of concentrated chemical streams. However, this treatment is very sensitive to toxic materials. The use of an anaerobic process in port reception facilities is not very feasible, since the facilities will usually receive a variety of chemicals, some of which are very toxic, in varying concentrations. The usual biological treatment process in port reception facilities therefore is the aerobic activated sludge process. The principle of this process is described in chapter 8.1.

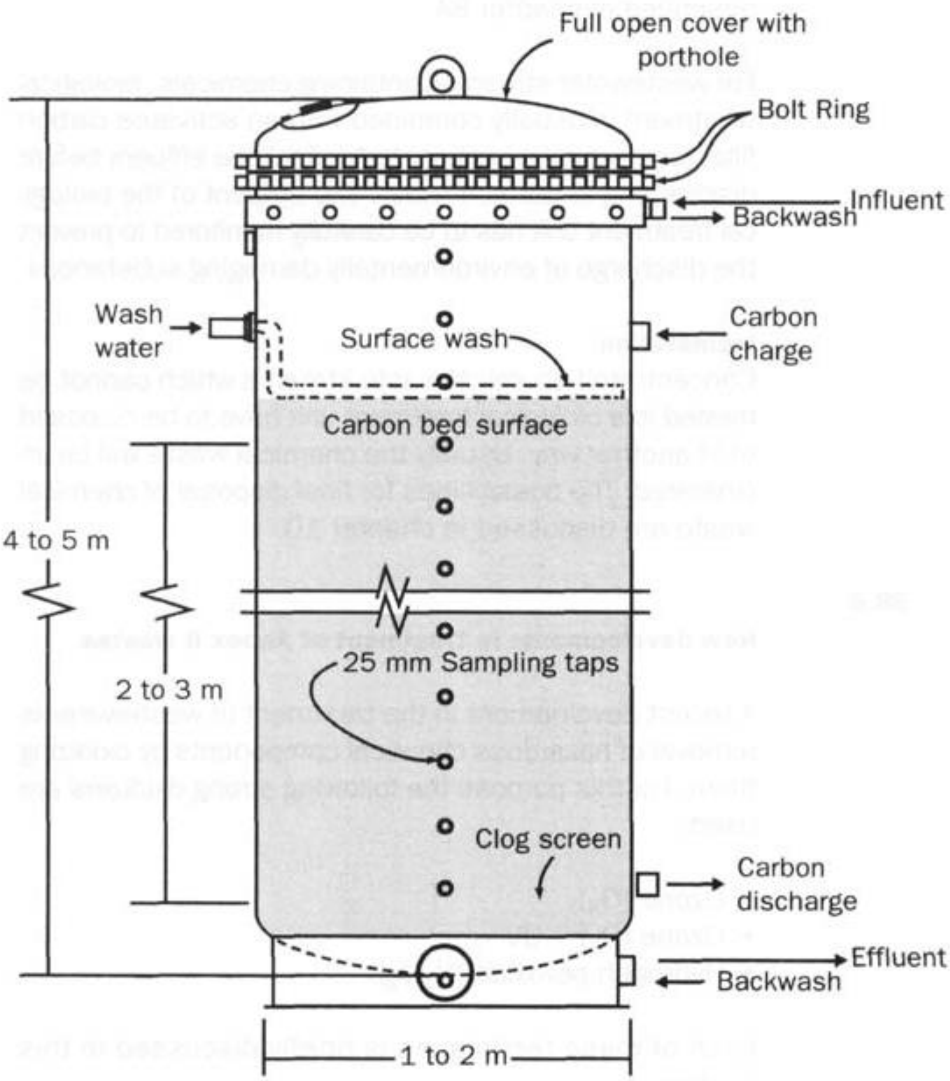


Figure 20 – Typical activated-carbon adsorption column

For wastewater streams containing chemicals, biological treatment is usually combined with an activated carbon filter (see previous section) to "polish" the effluent before discharging to surface water. The effluent of the biological treatment unit has to be carefully monitored to prevent the discharge of environmentally damaging substances.

Incineration

Concentrated and/or extremely hazardous chemical waste streams, which cannot be treated in a biological treatment unit, have to be disposed of in another way. Usually the chemical waste will be incinerated. The possibilities for final disposal of chemical waste are discussed in chapter 10.

Oxidation

A recent development in the treatment of wastewater containing chemicals is removal of hazardous chemical components by oxidizing them. For this purpose the following strong oxidizers are used:

- Ozone (O_3);
- Ozone (O_3) + UV; or
- Hydrogen peroxide (H_2O_2).

Each of these techniques is briefly discussed in this section.

.1 Oxidation by ozone

Ozone (O_3) is a very powerful oxidizer. Because ozone is a relatively unstable gas, it is generated on-site from air or pure oxygen, with an ozone-generator.

An advantage of oxidation by ozone is that no sludge or other chemical residuals are formed. Furthermore, ozonation is not affected by changes in pH. The ozone is usually fed through a diffuser into the water reaction tank. The converted gas stream is removed from the tank and in most systems recycled to the ozone generator. Ozone is especially used for the oxidation of cyanide and phenolic compounds. Oxidation with ozone is most feasible for wastewater streams containing low levels of oxidizable material.

Modern ozone systems are completely automated. The ozone concentration in the gaseous effluent is continuously monitored and ozone generation is controlled on the basis of this concentration. On the outlet of the reactor an ozone conversion step has to be used because ozone is very toxic.

.2 Ozone oxidation with UV radiation

An improvement of the ozonation process is a combination with UV radiation. UV radiation works as a catalyst for the ozone oxidation. Components can be oxidized by ozone alone. It also reduces the ozone requirements compared to conventional ozonation systems.

.3 Oxidation by hydrogen peroxide (with UV)

Hydrogen peroxide (H_2O_2) is a powerful oxidizing agent and has been used to oxidize phenols, cyanides, sulphur compounds, and metal ions. Hydrogen peroxide in the presence of a metal catalyst effectively oxidizes phenols over a wide range of temperature and concentrations. The process is sensitive to pH, with an optimum pH range of 3 to 4 and efficiency decreasing rapidly at both higher and lower values. However, compared to ozone it is more selective and less reactive. This process can be improved by combination with UV radiation.

8.2.6 Selection of treatment processes

The treatment options discussed in the previous sections offer a range of treatment techniques and combinations of treatment techniques. A typical layout of a port reception facility with several treatment steps is described in the next section. However, the optimal layout of a port reception facility can differ from location to location and a study will be needed to select the best treatment possibilities/layout/location, etc. A number of general criteria are important to select which treatment option is the most feasible for a specific location. These criteria are summarized in table 5.

These selection criteria can facilitate the selection of treatment processes in the study phase (see also chapter 5). When all processes have been evaluated for their applicability to a specific situation, a layout has to be chosen, which serves as the basis for further design and engineering.

In the selection of a treatment path the local/national effluent standards and the type of chemicals to be received (see also chapter 7.2) are important. For every situation, a study will be necessary to determine the best process options.

8.2.7 Typical layout of a port reception facility for MARPOL Annex II wastes

In figure 21 a typical layout is shown of a port reception facility for MARPOL Annex I and Annex II wastes, with primary, secondary and tertiary treatment. The facility consists of the following elements:

.1 a buffering/equalizing tank;

.2 a plate separation;

.3 a flocculation/flotation combination;

.4 a centrifuge; and

.5 a biological treatment.

In the treatment facility chemical layers that are separated from the water are either sent to the boiler house (where they are burned for heating of the wash water), or sent to an incinerator equipped with an exhaust gas cleaning system, if their use as fuel would cause air pollution. The chemical sludges are dewatered in a centrifuge and sent for incineration or final disposal (see also chapter 10). The shown facilities are only a possible combination of treatment technologies, and serve only as an illustration. The best option for a port reception facility for Annex II wastes depends on the specific port situation, as indicated in the previous section. Options for both recycling and final disposal of residues are discussed in the next chapters.

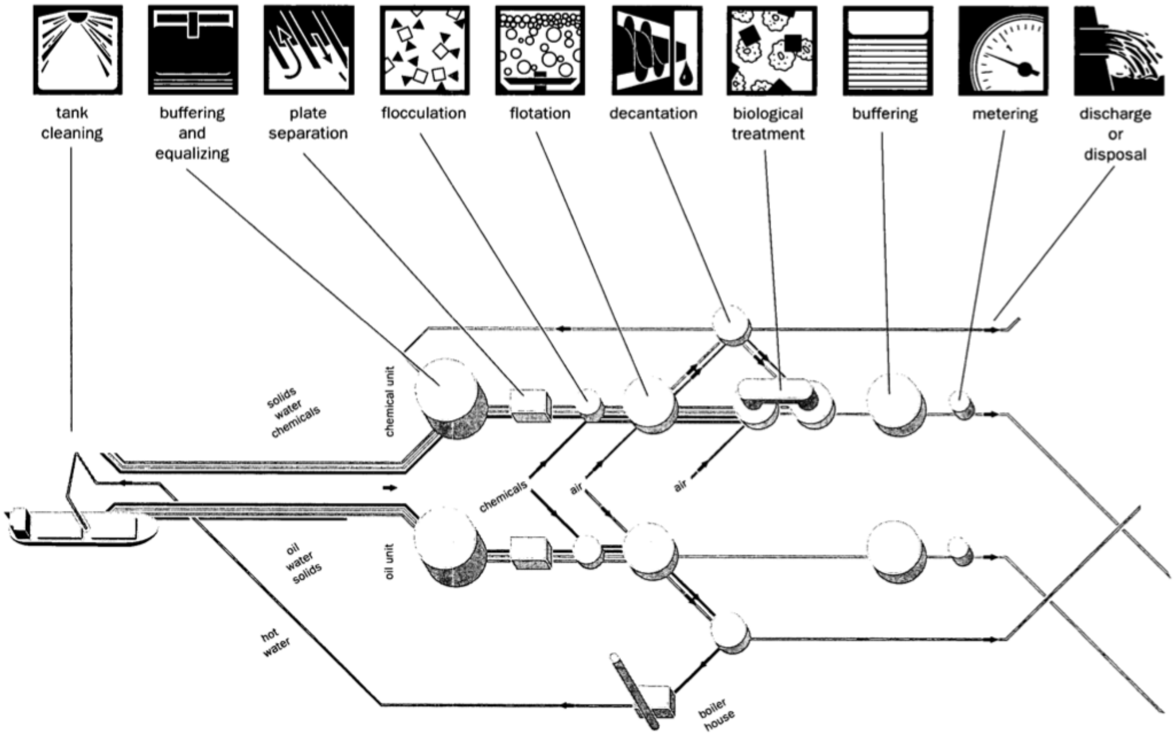


Figure 21 - Typical layout of a reception facility for Annex I and II

8.3 Equipment alternatives to collect, store and treat MARPOL Annex IV residues

8.3.1 Introduction

Annex IV to MARPOL does not only cover all waste water from toilets and urinals, but also drainage from medical premises via wash basins, wash tubs and scuppers located in such premises, and from spaces containing living animals or other waste water when mixed with these drainages.

This means that sewage from ships does not only cover black water (fecal and urinal waste) and mixtures of black water, grey water (generated from activities such as laundry, dishwashing, and bathing) and food stuffs, but may in some cases also include mixtures with oil and other substances. Also sewage sludge and bio-residues from ships equipped with on board Advanced Waste Water Treatment Systems (AWTS) fall under the MARPOL definition of sewage.

As the specific composition of sewage varies (due to several factors such as ship type, number of passengers, length of the voyage and use of on board wastewater treatment systems), pre-treatment is an important step, in order to generate a homogenous waste stream that can be treated efficiently afterwards.

8.3.2 Receptacles for MARPOL Annex IV

Collection of sewage can be done using either mobile or stationary receptacles.

Taking into account the substantial volumes of sewage that can be delivered to a port reception facility by a single ship, mobile collection preferably needs to be done using a barge. As trucks only have limited capacity for the adequate collection of sewage, their use may lead to an unnecessary delay for the delivering ship.

Reception of sewage can be organized either by temporary storage in tanks, or by pumping the sewage directly into the municipal waste water system or a sewage treatment facility. Regulation 10 of MARPOL Annex IV has specified standard dimensions of flanges for sewage discharge connections to enable pipes of reception facilities to be connected with the ships' discharge pipeline.

It is also worth noting that it is the ship that pumps sewage into the reception facility, and therefore, it is the ship that is responsible for the pumping capacity. Therefore, pumping capacity of ships should have a certain minimum level.

8.3.3 Pre-treatment of sewage

Flow equalization can be achieved using equalization basins.

Several types or a combination of primary treatment of sewage can be applied, depending on the characteristics of the delivered sewage and the amounts of black and grey water:

- sieving;
- plate separators, used for the collection of oil and fat;
- sand traps;
- coagulation/flocculation; or
- hydrocyclone.

Most of these pre-treatment techniques have been described in detail in previous sections.

8.3.4 Secondary treatment

Secondary sewage treatment is designed to substantially degrade the biological content of the sewage, derived from human waste, food waste, soaps and detergent. In most cases the settled sewage is treated using aerobic biological processes:

Biological sewage treatment

In a biological sewage treatment system, purifying micro-organisms break down the organic pollutants in the sewage. These micro-organisms consume oxygen that is added through the use of aerators. During the purification process, the micro-organisms grow as flocs (biosludge or activated sludge). These flakes are then separated from the treated sewage by settling or by membrane filtration.

Sequential batch reactor (SBR)

To reduce costs the purification process and the settling are done in the same basin. The different steps of the treatment process are then performed alternately one after another.

Therefore this type of sewage treatment is called a sequential batch reactor (SBR). The purification process in a SBR consists of at least four steps:

- supply with un- or pre-treated sewage;
- aeration;
- settlement; and
- discharge of treated effluent.

Membrane bioreactor (MBR)

Membrane bioreactors (MBR) are micro-filtration or ultra-filtration membranes, in order to separate treated sewage from sludge flocs. These membranes have a pore size less than 0.1 microns and separate all of the bacteria and suspended matter from the treated sewage.

8.3.5 Tertiary treatment

The purpose of tertiary treatment is to provide a final treatment stage to further improve the effluent quality before it is discharged to the receiving environment (sea, river, lake, wetlands, ground, etc.). Depending on the desired quality of the receiving waters (drinking water, swimming water, etc.), more than one tertiary treatment process may be used at any treatment plant. This can be done by filtration, nutrient removal, nitrogen removal or phosphorous removal.

8.4 Equipment alternatives to collect, store and treat MARPOL Annex V residues (garbage)

Equipment for handling garbage in a port basically should facilitate the reception, segregation, temporary storage and subsequent transport of garbage. Part of the garbage that will be delivered in the port may be recycled (see section 9.3). Actual processing of garbage in the port for purposes other than transport (compacting) is not very likely to occur, unless there is substantial industrial activity in the port area so waste handling and treating processes from both shipping and land-based activities can be combined.

The basic equipment for an adequate port reception facility includes the receptacles for garbage and the means for its transportation.

8.4.1 Receptacles for MARPOL Annex V wastes

A variety of containers, bins, and dumpsters is used for collecting garbage. Receptacles in the first place need to be functional and easy to use.

Shipping companies frequently entering a port can consider using re-usable containers. Major advantage is the time that can be saved. A full container can be immediately replaced with an empty container of the same size and type. In that case, good and clear arrangements should be made with a port reception facility/waste contractor.

Factors to consider when evaluating alternatives and selecting receptacles for MARPOL Annex V wastes include the following:

Capacity

Receptacle capacity should match demand, both in terms of size/capacity and number of receptacles that is required, and space availability. Large receptacles may not be suitable if the available space is very limited. Small receptacles, such as barrels, are not suitable for bulky garbage, and/or require frequent emptying.

Clearly, also the type of ships influences the necessary capacity, as e.g. cruise ships generate a lot more garbage than other commercial shipping. Also in e.g. fishing ports, specific capacity might be reserved for fishing nets, as this type of waste can be quite voluminous.

Ideally, the emptying schedule is assessed at the same time that the receptacle needs are assessed and the two are selected to complement each other. The emptying schedule has implications for labour and collection vehicle requirements. More frequent collection reduces health and safety concerns and requires less storage space, but may increase costs through the use of more vehicles, which also leads to increased CO_2 emissions, and labour. Emptying schedules should be revised periodically and adjusted if necessary.

Requirements for handling seasonal fluctuations in demand for waste disposal should be considered when determining receptacle capacity.

It should be noted that annex A of ISO 21070 on the management and handling of shipboard garbage, provides information and examples regarding the calculation of the amounts of waste to be expected.

Type of receptacle

The number and types of receptacles used will depend on the number and types of MARPOL Annex V wastes to be collected separately. For example, receptacles used for collecting recyclables should be easily distinguishable from those used for non-recyclable garbage. Taking into account the recent evolution towards a more cyclic economy and the increased interest and value in the recycling of wastes as a potential source of raw material, specific attention should be paid to the maximum collection of segregated garbage.

Also, where special national standards are applicable for one or more types of wastes, such as quarantined food waste or medical waste (e.g. sealed, leakproof containers), port reception facilities for garbage should meet these standards. For drift wood or bulky wastes such as fishing nets, stockpile areas using pallets or designated areas with signs can be used.

It should be noted that section 4 of ISO 21070 on the management and handling of shipboard garbage addresses possible practices to segregate different types of garbage, and provides an example of a colour-coding labelling system.

Another consideration for selecting the type of receptacle is the compatibility of the receptacle – in terms of unladen weight, maximum load and size – with the available means of transport and other handling equipment such as forklifts and cranes. Since experience in some ports has shown that receptacles for garbage can be the object of littering, vandalism and theft, consideration should be given to selecting receptacles with characteristics which discourage their abuse or misuse.

The receptacles for garbage collection may be placed on the ship, while in the port. In that case, wire sling attachments may be required. The receptacles must be compatible with the maximum load of the available cranes. Receptacles should be constructed of durable materials, and equipped with lids to control vermin, to prevent litter spreading on the quayside and to prevent litter spreading on the quayside and to prevent offensive odours.

The provision of port reception facilities for garbage should neither compromise the health and safety of seafarers and port workers nor compromise the hygiene and vermin control efforts within the port. Moreover, the reception of wastes should not interfere with business of the port.

In some small ports and marinas, the port's reception facilities for garbage have been used by local citizens (non-port users) for dumping their home garbage, creating an additional burden for the port. To avoid this, access should be made inconvenient for local citizens (e.g. by using an electronic entrance badge).

Information on the waste handling capabilities, including waste handling equipment, can be found in ISO/DIS 16304 on the arrangement and management of port waste reception facilities.

See figure 22 for an illustration of various types of containers and other receptacles.

To reduce the volume of the garbage, stationary compactors or baling equipment may be used (see figure 23. Cost savings, e.g. costs for transportation of garbage, may be realized.

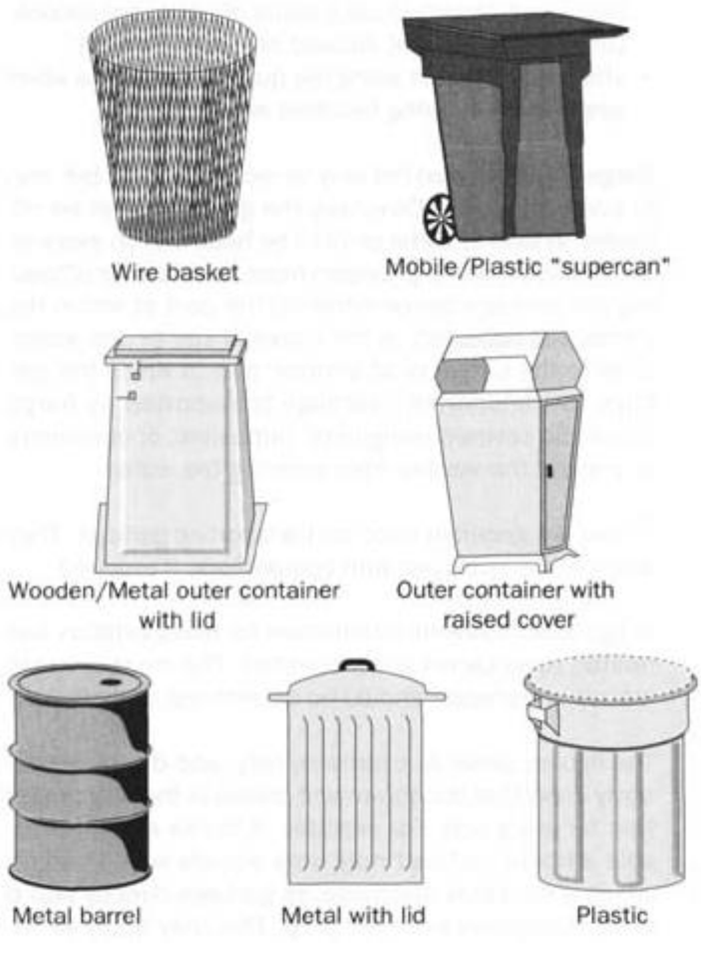


Figure 22 – Examples of receptacles

8.4.2 Transportation

Several types of transportation and handling equipment may be used, such as:

- barges;
- trucks; or
- other handling equipment, such as hoists and forklifts.

Barges are useful when:

- use of trucks or other vehicles in the proximity of the ship is not permitted, as a result of safety regulations (often trucks are not allowed on docks or piers); or
- ships do not berth along the quay, for example when single buoy mooring facilities are present.

Barges may be used not only to receive wastes but also to compact and segregate waste. Obviously the garbage must be offloaded to land at some point to be hauled to a place for further segregation in order to increase recycling options, or to an incinerator or landfill. Some provision must be made for offloading the garbage barge either in the port at which the garbage is collected, at the recycling or disposal site (if it is accessible to the barge) or at another port to which the garbage is transported. In case hazardous garbage is transported to a port in another country, the requirements of the *Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal* should be met.

Garbage transported by barge should be covered using nets, tarpaulins, or containers to prevent the wastes from entering the water.

Trucks are generally used for transporting garbage. They also can be equipped with compactors, if required.

In figure 24 several alternatives for transportation and related receptacles are presented. The most suitable means of transport should be determined by each port.

The figures serve as examples only, and do not necessarily imply that the equipment shown is the only proper type for every port. For example, if trucks are not available, a tractor and cart may work equally well. In some cases a ship may discharge its garbage directly into a truck that drives onto the ship. This may apply for instance to ferries and roll-on-roll-off vessels.

8.4.3. Port security

As ships calling a port in many cases tend to deliver their ship-generated garbage in that port, as they do not like to keep the garbage on board too long for hygienic reasons, collection operations by waste haulage contractors may occur quite frequently. This may lead to increased movements and traffic in the port area with a come and go of trucks/barges, posing additional pressure on port security.

Therefore, the port authority, preferably the Harbour Master's office, might develop a specific permit or licensing scheme for the different contractors collecting ship's waste, including an overview of the trucks/barges that are used to collect the waste.

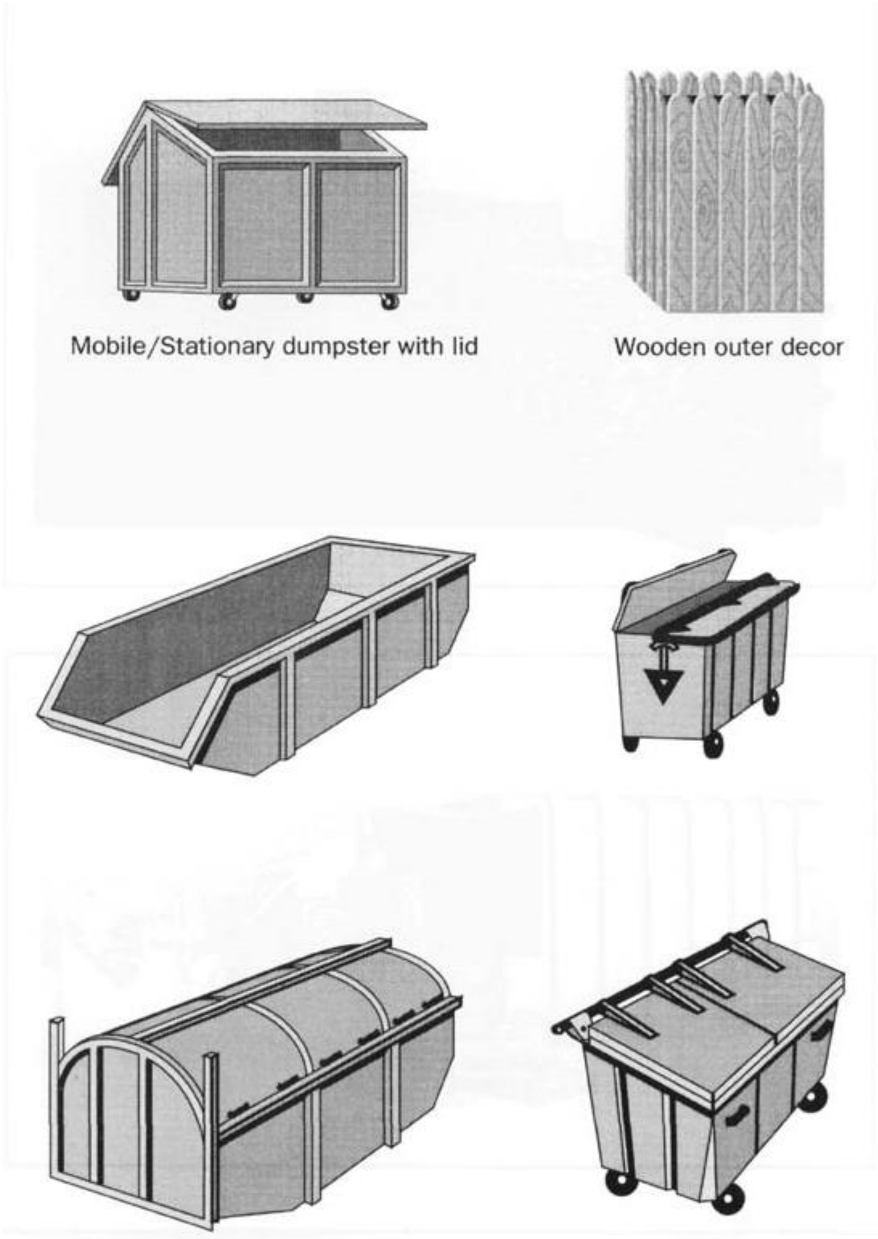
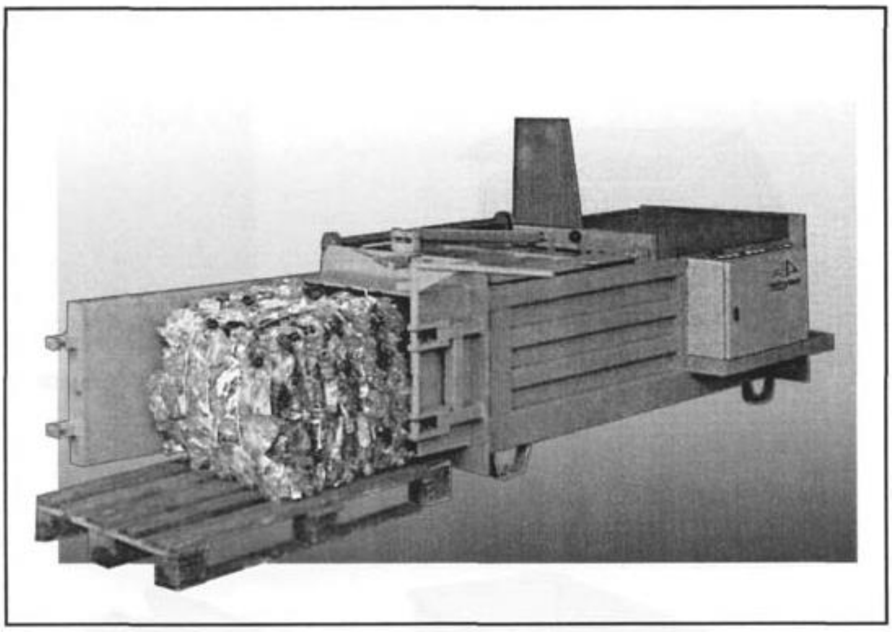
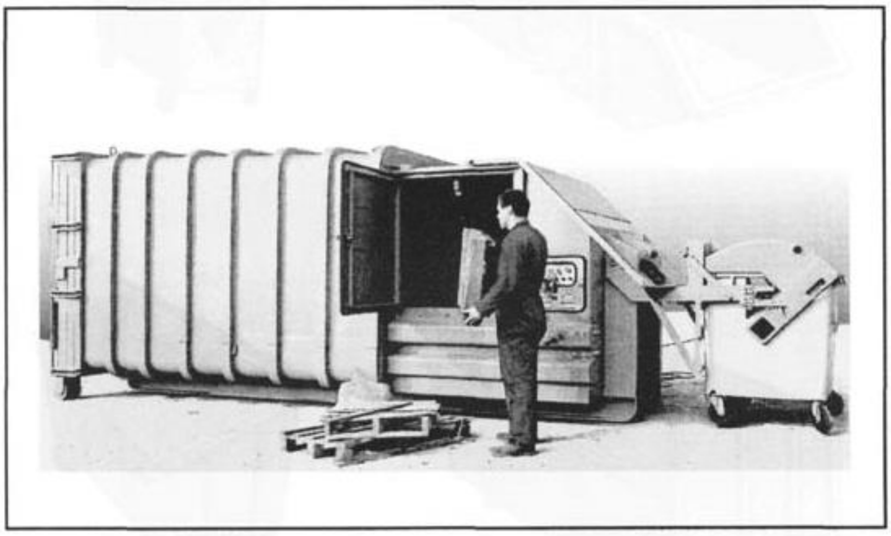


Figure 22 (continued) – Examples of receptacles





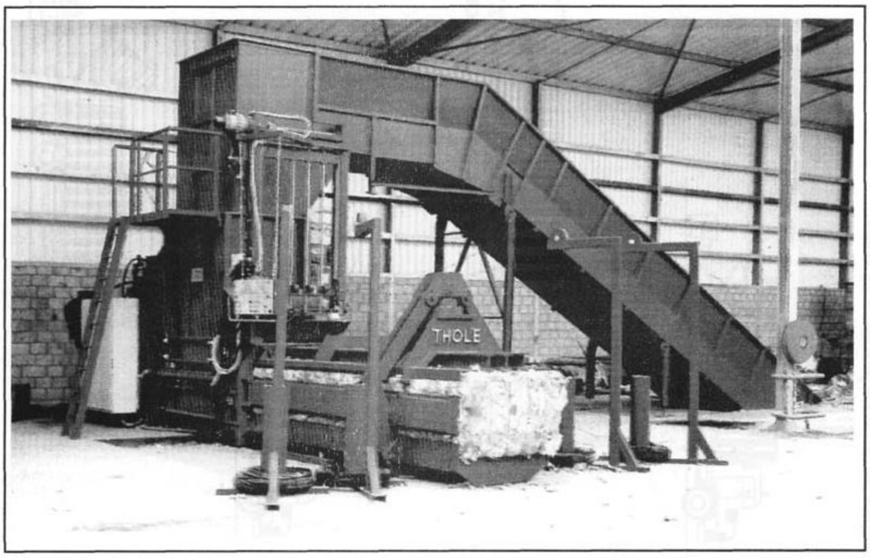
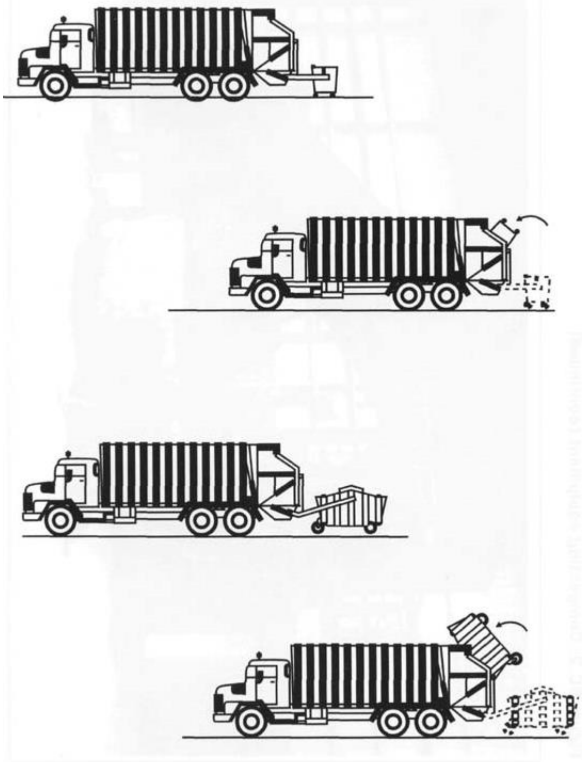


Figure 23 – Compacting equipment



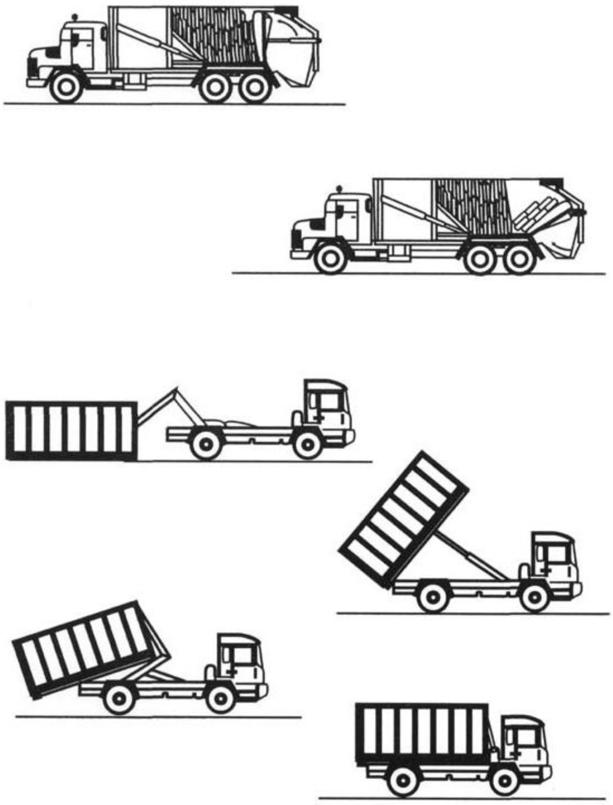


Figure 24 – Transportation by truck

8.5 Equipment alternatives to collect, store and treat MARPOL Annex VI residues

8.5.1 Introduction

Although MARPOL Annex VI has entered into force in 2005, including the requirement for the provision of reception facilities in ports for ozone-depleting substances (and equipment containing them) and residues from exhaust gas cleaning systems, not much information is currently available on the amounts and characteristics of Annex VI waste to be expected, nor on collection practices.

There are two main residues classified under MARPOL Annex VI:

Ozone-depleting substances (ODS)

The following are the major sources of ozone-depleting substances (ODS):

- refrigeration equipment;
- air conditioning equipment; and
- fire extinguishing equipment.

Residues from exhaust gas cleaning

Depending on the type of scrubbers, the residues will be different:

- dry scrubbers generate a gypsum-like residue. As these types of scrubbers are currently not often being used or trialed, not much information is available. According to the producer, the used granulate that has to be disposed off the vessels is collected the same way as the supply is organized;
- wet scrubbers in open loop use sea water for the cleaning of the exhaust emission. The waste water that contains sulphur, soot and various metals ends up into the sea, so in principle there is no delivery to a port reception facility;
- wet scrubbers in closed loop use fresh water stored on board and an agent for cleaning the exhaust. There is then an extra step that treats the first waste water stream. Sludge containing the soot and metals is generated, which needs to be delivered to a port reception facility, as it is not allowed to incinerate scrubber sludge on board. Still, a yellowish water containing sulphur is discharged to the water.

8.5.2 Collection, storage and treatment of ODS

Collection, storage and treatment of ODS and equipment containing ODS from ships is very similar with practices for devices on land.

Disposable equipment on board containing ODS such as broken refrigerators and expired fire-extinguishers should be placed in adequate receptacles or separate places on board in such a way that segregated discharge to port reception facilities is possible.

The collection of broken devices can be carried out in different ways. Barges can be an option, when equipped for ship-to-ship transfer of rather large devices (e.g. with cranes). These barges can be motor barges, towed barges or other types. In any case, it is advisable to use collection barges with enough on or below deck capacity to safely store the disposable equipment.

For very large devices, on-shore collection at a central collection facility is in most cases a better option. In all cases, appropriate storage room will be needed, to which the ships, collection barges or collection vehicles (depending on which system is used for collection) can deliver and safely store their (collected) waste.

The most appropriate way of storage of these devices is under shelter on an impervious floor. On top, the period of storage should be kept as short as possible, especially when the equipment is broken and when there is a substantial risk of leakage of ODS into the atmosphere.

Although the temporary storage can be inside the port area, the treatment in most cases will not. This again depends on the port area and its degree of industrialization. The treatment and recycling/disposal of the equipment will take place in highly specialized treatment plants by trained personnel (see chapter 9 and 10).

This is even more so for the treatment of equipment containing ODS on board. The manipulation of such devices should be undertaken by trained and specialized technicians. They must not refill leaking equipment and must use proper recovery/recycling equipment and methods to prevent the release of ODS and halocarbon alternatives into the environment.

The technicians should make sure that the ODS are properly packed and contained before sent for recycling and/or disposal. Facilities for the recycling or disposal of unwanted ODS are limited (see also chapter 9 and 10). In most cases, ODS that are not reusable in their current state must be sent to an appropriate facility for recycling, conversion or destruction. These facilities might not be located within the own State territory, given the high degree of specialization and expertise needed. In this case, the sender should be aware of the possible applicability of international requirements regarding the transboundary movement of this waste, as mentioned in the *Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal.*

8.5.3 Collection, storage and treatment of residues from exhaust gas cleaning

Not much information is currently available on the volumes of waste that are generated by different types of scrubbers. However, some producers report that the amount of sludge generated is approximately 0.1 to 0.4 kg/MWh, while others indicate a sludge generation of 0.2 kg/MWh from a seawater scrubber.

Taking into account the relatively limited amounts of these MARPOL Annex VI wastes to be expected, collection by truck/barge will provide adequate service.

The receptacles should in any way be watertight and sheltered during transport and storage, in order to avoid drainage of possible contaminants in the sludge to water and/or soil.

The storage, treatment and disposal of exhaust gas cleaning residues can be integrated with similar waste streams originating from land-based exhaust gas cleaning systems. In some cases the residues can be re-used after the recycling process as construction material (see chapter 9). If possible, preference should be given to this type of treatment, since it clearly serves the goals of the circular economy. Given the high degree of specialization needed to treat this waste type, transboundary movement of the waste to a treatment and/or disposal plant might be necessary when there is no in-land expertise available.

8.6 Equipment alternatives to collect store and treat other ship related wastes and residues

8.6.1 Introduction

Wastes originating from the application of anti-fouling systems as well as ballast water and its sediments will be mainly generated at ship repair/conversion yards and/or ship recycling yards.

A valid option in this case is to let the receiving yards take care of their own waste, as they will follow the national and/or regional legislation and standards applicable. This does not necessarily mean that they will be able to treat/process those wastes. If these companies themselves cannot treat the wastes of the ships they repair, it should be ensured that the wastes are transferred to a specialized company for proper treatment and/or disposal (see chapters 9 and 10).

8.6.2 Collection, storage and treatment of ballast water and sediment

In some circumstances, ballast water can be exchanged at sea during a ship's voyage. If not, ships should have certified on-board ballast water management systems for ballast water as specified in the Ballast Water Management Convention (BWMC).

In cases where the ballast water management system is malfunctioning, the delivery to a port reception facility might be necessary. Notwithstanding the fact that the BWMC does not require party States to provide reception facilities for ballast water, a party State or port State may choose to do so.

In that case, the receiving facilities should be big enough to receive large quantities of ballast water (an individual vessel ballast water capacity can go up to several thousand m^3). The swiftest way to collect these amounts of waste is undoubtedly by collection barge or by delivery at a fixed port reception facility on land (with appropriate free storage capacity), equipped with appropriate pumping capacity.

Little is known yet on the optimal treatment of ballast water, once it is delivered to a port reception facility (fixed or floating). The most feasible option, and at this moment still under investigation, seems to be to equip an inland barge with on-board ballast water management systems. It is clear that the provision of this type of facility will be very expensive and probably only possible in big commercial ports.

Facilities for the treatment of ballast water on land are currently not widely available. It is likely that the techniques used will be based on those used on board of ships (use of active substances or physical processes).

In any case, the discharge of untreated ballast water on land or in the port/inland waterways should be avoided, as it is unknown what the damage of the invasive species would be to the environment concerned (where the water would be discharged at/to), and may also lead to substantial socio-economical costs and health impacts.

On the other hand, after entry into force of the BWMC, party States to this convention will have to ensure the provision of adequate reception facilities for sediments from ballast tanks in ports and terminals where cleaning or repair of ballast tanks occurs.

After removal of the sediment from the ship, the sediments should be stored in in watertight and sheltered containers/drums in order to avoid leakage/drainage into the soil/water during storage and transport.

Little is known yet on the treatment of ballast water sediments, as the Convention has not yet entered into force (see also chapter 9 and 10). The most likely treatment option is for the sediments to be incinerated after pre-treatment (dried and de-watering unit), which could make it possible to recover the sediments' calorific energy. Also, disposal in a controlled landfill might be an option, although in that case it must be looked at to avoid leakage to surface waters.

8.6.3 Collection, storage and treatment of waste from the application of anti-fouling systems

When removing antifouling from a ship's hull, care should be taken that the marine environment, or the people that work with these coatings, do not become exposed to harmful chemicals.

By no means should old antifouling coatings be burnt off in open air in a dry dock or shipyard, as this would put the workers and people in the immediate vicinity at risk, as well as it would harm the (marine) environment by release of contaminants to air/water/soil. All antifouling paint residues should therefore be treated as contaminated/toxic waste and should be disposed of in accordance with local environmental and/or waste disposal regulations. Incineration in a specifically designed facility for the disposal of hazardous waste might be a preferred solution.

In any way, the removal of all antifouling coatings should only be undertaken at licenced facilities/repair, conversion or recycling yards by appropriately trained personnel.

Depending on the technique used to remove the paint, waste streams are generated. During the removal process all wastes should be contained and all reasonable measures should be taken to prevent that wash waters containing paints and particles are flushed from a dry dock, slipway or hardstand when the vessel is being treated. Moreover, all waste containing antifouling should be treated with extreme care since they all contain possible biocides.

Waste water should be collected for recycling or can be discharged to the sewer, when the process is licensed and the discharge is authorised by the competent authorities. Discharge to the sewer, however, remains difficult as anti-fouling paints may contain very toxic chemicals and waste water treatment plants often depend on bacterial processes.

Contaminated grit and other paint residues should be kept in sealed containers before being sent for final disposal. Where antifouling paints have been removed from older vessels, it can be assumed that the paint residue contains tributyltin (TBT) and should be transported to a licensed facility for treatment or safe disposal. In absence of a licensed disposal system, contaminated sediment should be directed to a landfill lined with an impermeable liner to prevent leaching of waste materials into ground or surface water (see chapters 9 and 10).

Ship maintenance and recycling facilities should also adopt measures (consistent with applicable national and local laws and regulations) to ensure that viable biofouling organisms are not released into the local aquatic environment.

CHAPTER 9 - Recycling options for ship-generated wastes

9.1 Recycling options for MARPOL Annex I residues

9.1.1 General methodology

The process of planning and implementing a waste management programme is described in chapter 3. Basically, it is applicable to any kind of waste regardless of its composition. Part of such a program is the definition of recycling options for the various types of waste. Recycling is defined as a process in which materials, which are otherwise destined for final disposal, are collected, (re)processed and reused. These materials, recyclables, still have useful chemical or physical properties after having served their original purpose.

Obviously, the valuable and recyclable constituent of MARPOL Annex I wastes is oil. In figure 25 a general flow diagram of these wastes is presented, highlighting recycling options.

These options will be discussed in respect of oil that is recovered in port reception facilities from ships waste, but may also be relevant for the processing of oil that is collected when cleaning up operational or accidental spills at e.g. terminals.

An analysis of each port will be required to establish which options are feasible. Key issues for the successful recycling of oil are:

- the anticipated quality and quantity of recovered oil; and
- the analysis of local markets, their requirements and opportunities.

9.1.2 Recycling options for MARPOL Annex I wastes

The recycling options for recovered oil comprise:

- redistillation;
- use as fuel; and
- applications in civil works.

Redistillation

Recovered oil can be mixed with crude oil and redistilled in a refinery. There are a number of constraints that must be resolved before a refinery will accept recovered oil for redistillation:

- the recovered oil should basically be free of non-oil contaminants, such as solids, solvents and a substantial amount of water. The salt concentration will generally not be a problem, as all refineries operate a crude desalting unit. Substantial concentrations of metals may be detrimental to downstream processing units (poisoning of catalysts). Unless information about the composition of the recovered oil can be made available to refineries, they may be reluctant to accept the oil; and

- the added value of recoverable distillate products must be sufficient to cover processing and handling costs, otherwise additional reimbursement must be provided.

Once a substantial quantity (which is determined by the available tankage) of oil has been collected, samples should be taken and analysed. If a refinery will accept recovered oil for redistillation, the amounts to be processed will be limited to a very small fraction of the refinery throughput. Even so, this recycling route can provide an outlet for substantial amounts of recovered oil.

Another option is to build a (small) distillation unit which is dedicated to processing waste oil. Such plants have been operated profitably in several countries. The waste oil is distilled in several stages of increasing temperature and vacuum. Design of such a plant requires specialized engineering skills and experience.

The feasibility of such a plant depends, among others, on the available quantities of oil to be processed. The quantities of oil recovered from ship-generated oily wastes in a port may not be sufficient to justify such a plant. However, the feasibility should be assessed on a national level, where it can be incorporated in the national structure of waste oil collection and processing, including land-based sources of waste oil. Again, this illustrates the need of an integrated waste management approach (chapter 3).

Use as fuel

Recovered oil can be used as fuel for land-based industrial installations equipped with exhaust gas cleaning systems, such as boiler houses, furnaces, cement production, etc. In general, the recovered oil is blended in relatively small quantities with the regular fuel oil. This option depends on the existence of local industry such as (petro) chemical plants and power plants, and the capability to produce recovered oil of an acceptable quality, i.e. free of unwanted contaminants and a low water and solids content. In most States, however, blending of waste oil with regular fuel is prohibited unless the mixture is incinerated in a licensed incineration plant equipped with exhaust gas cleaning systems.

Using recovered oil as fuel generates gaseous combustion products, some of which are harmless but some of which will contribute to air pollution (e.g. SO_2 and Particulate Matter) and have an impact on human health. As the composition of recovered oil is not well defined it may contain a range of additives, metals, detergents, chemicals and other substances. Incineration of recovered oil, in particular at relatively low temperatures, may therefore contribute significantly to air pollution (SO_x, NO_x, Particulate Matter, etc.) and health problems. This applies in particular to small scale reuse options which are difficult to control. Large scale industrial use of recovered oil as fuel may also contribute to air pollution, but due to the limited number of users and possibly the presence of exhaust gas cleaning systems, it is easier to control and monitor.

Where there are bunkering facilities in a port, recovered oil may be blended with bunkers. It should be noted, however, that in most States blending of recovered waste oil in bunker fuels is not allowed, as mixing waste with products in many cases is prohibited.

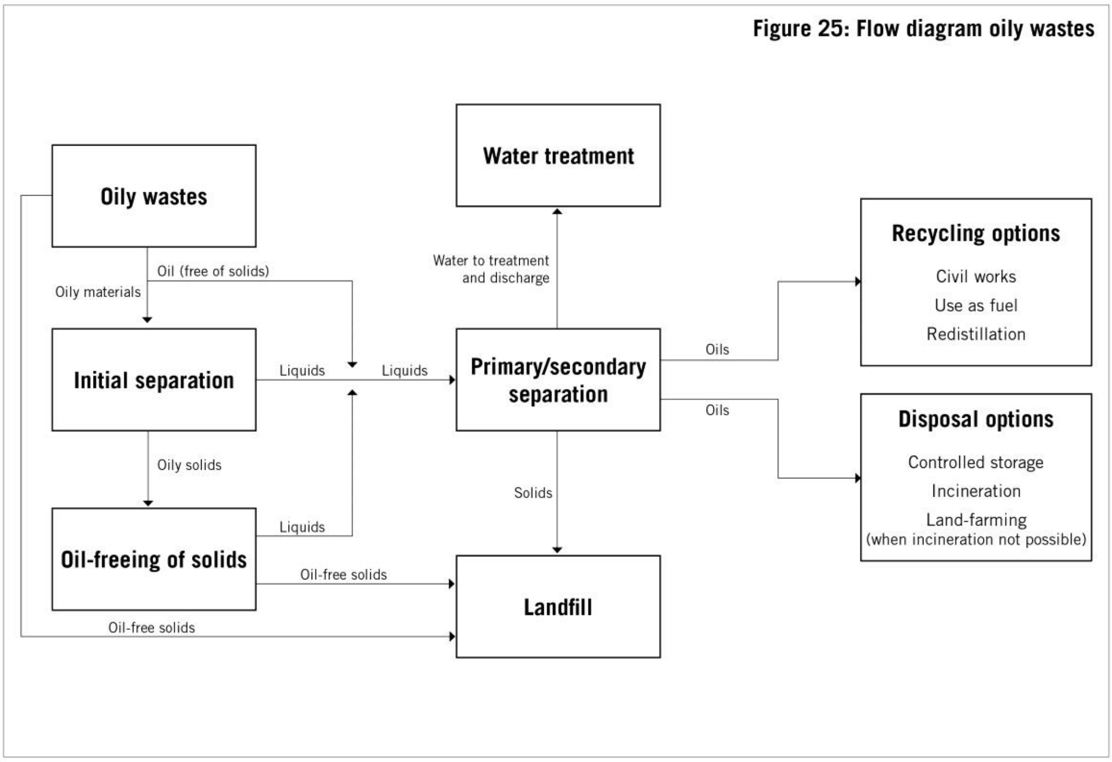


Figure 25- Flow diagram oily wastes

Some important issues when considering the use of recovered oil as fuel are summarized below (see also chapter 10):

- depending on the waste oil composition, very high temperatures may be required to eliminate all hazardous organics;
- incineration of waste oil may result in air pollution and health problems (dust, heavy metals, dioxins) and extensive flue gas treatment may be required to reduce emissions to the air; and
- combustion products may be corrosive, requiring sophisticated equipment and construction materials.

Applications in civil works

Waste oil and oily sludges have reportedly been reused in road construction and dust control or as wood preservative. It will be difficult to establish the environmental impact of these options, as they will vary with the local climate and soil structure. However, severe environmental problems (soil and ground water contamination, migration of hazardous substances) can be the result of these applications. These options are not environmentally sound and should not be adapted.

9.2 Recycling options for MARPOL Annex II residues

9.2.1 General methodology

The process of planning and implementing a waste management programme is described in chapter 3. Basically, it is applicable to any kind of waste regardless of its composition. Part of such a program is the definition of the recycling options for the various types of waste. Recycling is defined as a process in which materials, which are otherwise destined for final disposal, are collected, (re)processed and reused. These materials, recyclables, still have useful chemical or physical properties after having served their original purpose.

9.2.2 Recycling options for MARPOL Annex II residues

Annex II wastes may consist of:

- cargo residues;
- tank washings; and
- dirty ballast.

Tank washings occur very frequently, see chapter 7.2. Cargo residues and dirty ballast occur on rare occasions only (spillage, accidents, technical failures, etc.).

These categories are listed in order of declining chemicals content. Cargo residues obviously may consist entirely of one chemical, but it will be on rare occasions only that liquid residues must be discarded as waste, instead of being added to the cargo and/or used as product. Tank washings contain typically more than 99% water and less than 1% of the chemical to be cleaned. Some products, e.g. isocyanates, cannot be washed with water and require use of a solvent. Dirty ballast will contain very low concentrations of chemicals.

Given the variety of chemicals that are subject to the provisions of MARPOL Annex II, it is very difficult, if not impossible, to identify general options for recycling. Some oil-like chemicals may be used as fuel, or their – in most cases high – calorific energy can be recovered when incinerated. Most chemicals, however, do not have physical or chemical properties that make them suitable for other than their original purpose. For these substances, recycling is therefore equivalent to reclamation of product.

Most, if not all, of the chemicals subject to the provisions of MARPOL Annex II will be used as raw materials or intermediates in chemical production processes. An industry using these chemicals may have facilities and equipment to process the waste that is generated during cargo unloading and tank washing in the port. Processing may include not only recovery techniques such as stripping or distillation, but also treatment in a wastewater treatment unit or recovery of the calorific value through incineration in heating systems or boiler. This option may be the most cost-effective solution and should be investigated before considering alternative solutions.

Reclamation in a central plant has to be considered, if processing by the local industry is not possible. Techniques for product reclamation, which are essentially non-destructive, have been described in section 8.2. Application of these techniques generally requires segregation of wastes, as mixtures of chemicals are always more difficult to treat. Dedicated installations often will be required, which are generally expensive to operate. A careful analysis will be necessary to establish the opportunities for such installations. The alternative is to construct multi-purpose wastewater treatment plants. See also section 8.2 for a description of techniques.

9.3 Recycling options for MARPOL Annex IV residues

9.3.1 General methodology

The process of planning and implementing a waste management programme is described in chapter 3. Basically, it is applicable to any kind of waste regardless of its composition. Part of such a program is the definition of the recycling options for the various types of waste. Recycling is defined as a process in which materials, which are otherwise destined for final disposal, are collected, (re)processed and reused. These materials, recyclables, still have useful chemical or physical properties after having served their original purpose.

In case of MARPOL Annex IV waste, the main valuable and recyclable constituent is the nutritional value.

9.3.2 Recycling options for MARPOL Annex IV waste

Recycling of MARPOL Annex IV waste in general means the recovery of its nutritional value. This is only possible when interfering elements, such as detergents, chemicals, etc., have been eliminated before using pre-treatment techniques (see chapter 8.3). However, also other recycling techniques can be applied.

Possible recycling options for Annex IV waste are:

Use as fertilizer or soil conditioner:

It is clear that sewage or sewage sludge will only be acceptable for usage as fertilizer or soil conditioner when they are not contaminated with other materials, such as chemicals, oil or metals (especially Zn, Cu, Ni or Pb).

When sewage/sewage sludge is used as fertilizer, the nutrients (N, P, Ca, K, Mg) present in the sludge are used as food for plants and crops. When used as a soil conditioner, the sewage sludge is mainly used for improvement of the soil structure through the organic matter present in the sludge.

Use as sealing material:

Sewage sludge can be used as an alternative sealing layer in a composite cover, e.g. to cover dumping sites. Studies have indicated that sewage sludge is effective for reducing oxygen diffusion to underlying tailings, and that as a poorly permeable material it can prevent water seepage.

Incineration and/or co-incineration:

When sludge is incinerated together with fuel, one speaks of co-incineration. Both dewatered and dried sludge can be incinerated or co-incinerated. Possible installations for incineration and/or co-incineration of sewage sludge are waste incineration plants, power plants (pulverized coal power plants, coal plants) and cement kilns.

New techniques that are also applied for sewage sludge are pyrolysis and gasification, and vitrification.

9.4 Recycling options for MARPOL Annex V residues

9.4.1 General methodology

Implementing a waste management program has been addressed in chapter 3. Part of such a program is the definition of recycling options for MARPOL Annex V waste (garbage). Recycling is defined as a process in which materials, otherwise destined for disposal, are collected, reprocessed and reused. These recyclables still have useful physical or chemical properties, after having served their original purpose.

Recycling of garbage collected in a port should not be isolated from recycling garbage generated by land-based sources. Especially in smaller ports, the amount of ship-generated garbage will often be relatively small compared to municipal garbage. The benefits of recycling garbage may include:

- it is an important step towards a circular economy, as it saves (scarce) raw materials;
- it saves energy;
- it reduced the impact on the environment, for example by minimizing the amounts of waste which have to be landfilled; and
- it produces revenues by selling collected recyclable wastes or secondary raw materials.

Contrary to disposal methods for MARPOL Annex I and II wastes, in many countries, landfilling is a common method to dispose of garbage. More than for Annex I and II wastes, which will be regulated because of their hazardous nature, the benefits of recycling Annex V wastes generally have to be demonstrated clearly to minimize the obvious solution of landfilling. The waste management strategy as described in chapter 3 is an important tool in this process, as both ship-generated wastes and land-generated wastes may contain valuable materials, which could be reused as a resource material for other industrial activities. Therefore, discarding these wastes is an inefficient use of resources, and recycling options should be explored (cradle-to-cradle approach). Also, landfilling of garbage is not always an obvious solution, e.g. on islands where only limited area is available.

Garbage that is subject to special safety regulations (e.g. quarantined food wastes, medical wastes) generally cannot be recycled. Furthermore, it should be noted that Annex V wastes can also contain or can be contaminated with hazardous materials (e.g. solvents, used batteries, light bulbs), which hampers recycling and re-using possibilities.

9.4.2 Recycling options for MARPOL Annex V wastes

Garbage contains a variety of materials, such as wood, metal, paper, plastics, food wastes and glass. Further subdivision can take place, for example metal wastes may consist of aluminium, ferrous and non-ferrous materials. Recycling of garbage requires segregation, as already indicated.

Some segregated streams can be used as raw materials for various types of industries, for example:

- metal can be sold as scrap and subsequently reused in steel mills, aluminium smelters, etc. Recycling scrap can lead to substantial energy savings when compared to production from primary resources. Obviously, it also saves raw materials (ores);
- paper wastes can be reused in paper or cardboard manufacturing. Considerable savings in energy and raw materials consumption (wood) can be achieved;

- organic wastes can be composted and used for soil improvement. A substantial volume reduction can be established for organic wastes. However, in many states food wastes from international shipping are to be incinerated;
- glass can be reused in glass production. Again, considerable energy savings are possible when compared with glass production from natural materials. However, materials such as silicates and sodiumcarbonate are not scarce;
- some plastics can be recycled if properly segregated. Mixed plastics can be used to create other products with less demanding physical requirements;
- used cooking oil can be recycled through refining into different types of biodiesels. In some cases, waste contractors financially compensate the delivery of used cooking oil;
- the recycling of used electric and electronic equipment can, in most industrialized countries, be fully integrated with the treatment of land-based waste streams. The electric/electronic devices are dismantled and the waste streams originating from the dismantling process are manually or mechanically segregated (cables, plastics, metals, etc.). Those segregated materials can then be re-used as a raw material;
- fishing gear: lately, the industry is developing interest for the recycling of discarded fishing lines and nets. Hence, both plastic and steel can be, after recycling, segregated and re-used again in other applications. The technology for this recycling process is currently under development and, therefore, it cannot be applied yet in every port/State. Another possibility is the use of used fishing gear as a source of energy in licensed incineration plants. Where possible, preference should be given, however, to the re-use of the materials since it avoids that the materials are lost and it saves additionally a significant amount of CO_2 emissions; and
- incinerator ashes can, after a thorough pre-treatment (e.g. sieving, pulverizing) and, if necessary, stabilization and cleansing, be used as a construction material. Depending on the quality of the ashes, and the treatment techniques used, it can be used as a high-grade or low-grade construction material. If not, it would have to be disposed of at a licensed landfill. Stabilization would be necessary in order to prevent the leaching of hazardous contaminants and monitoring.

A major constraint of all these options is that the industry re-processing these wastes does not always already exist in a country. If such is the case, segregation of wastes and recycling still proves to be a viable option as, due to the transition towards a circular economy, more and more industries are seeking alternatives for using waste as possible raw material, and the economic value of segregated waste will increase. In addition, due to their increased economic value, it might be more interesting to transport segregated waste streams to regions where reprocessing industry is present. In that case the requirements of the Basel Convention on the transboundary movements of wastes will have to be taken into account.

In any case, the individual segregated wastes should meet the quality standards that are applicable to the regular raw materials used by manufacturers. Both reduced disposal costs (dumping or incineration) as well as revenues of selling the recyclable materials may result in a viable recycling program.

If the markets for recyclables as described above do not exist, recycling of port generated wastes will be very difficult to implement. The amounts of segregated garbage, and in particular ship-generated garbage, will never justify construction and operation of new production plants to recycle these wastes. Alternatively, local small-scale recycling options may be investigated, but it is questionable whether these can justify the administrative and operational costs for segregating wastes.

If co-ordinated with land authorities, joint recycling projects could answer the small-scale problem. The total waste stream from all sources in region could create a market.

Chapter 15 provides information on how to start a port-based recycling programme.

9.5 Recycling options for MARPOL Annex VI residues

9.5.1 General methodology

The process of planning and implementing a waste management programme is described in chapter 3. Basically, it is applicable to any kind of waste regardless of its composition. Part of such a program is the definition of the recycling options for the various types of waste. Recycling is defined as a process in which materials, which are otherwise destined for final disposal, are collected, (re)processed and reused. These materials, recyclables, still have useful chemical or physical properties after having served their original purpose.

9.5.2 Recycling options for MARPOL Annex VI wastes

In case of MARPOL Annex VI waste, recycling is not always possible. A distinction can be made between practices regarding ozone-depleting substances and equipment containing such substances, and exhaust gas cleaning residues.

Ozone-depleting substances (ODS):

According to MARPOL Annex VI and the requirements of the Montreal Protocol, when servicing or decommissioning systems or equipment containing ODS, the gases are to be duly collected in a controlled manner and, if not to be reused on board, are to be landed to appropriate reception facilities for banking or destruction. Any redundant equipment or material containing ODS is to be landed ashore for appropriate decommissioning or disposal.

Residues from Exhaust Gas Cleaning Systems (EGCS):

Although currently not much information is available on the characteristics of EGCS residues/scrubber sludge, it is expected that these sludges are (highly) acidic and contain substantial amounts of salts and heavy metals. Therefore, it is rather difficult to develop pre-treatment techniques, in order to prepare these residues for possible recycling. Dry scrubbers on the other hand, that are applied in a closed mode only, generate a dry gypsum-like residue that, according to the producer, can easily be re-used as a raw material in construction works. As only few ships are currently equipped with EGCS, very little waste treatment facilities have assessed recycling possibilities for EGCS residues. This may change in the upcoming years, when more ships will have EGCS and want to deliver the residues to port reception facilities. As scrubbers are already being used in land-based industries, possible recycling options might be found there.

9.6 Recycling options for other ship related wastes and residues

9.6.1 General methodology

The process of planning and implementing a waste management programme is described in chapter 3. Basically, it is applicable to any kind of waste regardless of its composition. Part of such a program is the definition of the recycling options for the various types of waste. Recycling is defined as a process in which materials, which are otherwise destined for final disposal, are collected, (re)processed and reused. These materials, recyclables, still have useful chemical or physical properties after having served their original purpose.

9.6.2 Recycling options for other ship-related wastes

Ballast water and ballast water sediment

In order to be able to treat ballast water, the receiving facilities should be big enough to cope with large quantities of ballast water (one discharge could go up to tens of thousands m^3).

Facilities for the treatment of ballast water on land are currently not widely available. It is likely that techniques used will be based on systems like those installed on board ships.

In any case, the discharge of untreated ballast water on land or in the port/inland waterways should be avoided, as it is not known what the ecological and/or socio-economic damage of the invasive species would be, and it may not be permitted under the Ballast Water Management Convention or local regulations.

The ballast water sediments could – in theory – be incinerated after pre-treatment (dried and de-watering unit) in licensed incinerators or go for landfill (possibly after stabilization and/or sterilization). As the BWMC has not yet entered into force, it is difficult to foresee to what extent recycling/disposal techniques are feasible (from a technical and economical point of view).

Wastes form the application of anti-fouling systems

Wastes originating from the removal of anti-fouling systems should be processed carefully, as they might contain biocides.

Waste water should be collected for recycling or can be discharged to the sewer, when the process is licensed and the discharge is authorised by the competent authorities. Discharge to the sewer, however, remains problematic as anti-fouling paints may contain toxic chemicals that might destroy the bacterial cleaning processes in waste water treatment plants.

Contaminated grit and other paint residues should be kept in sealed containers before being sent for final disposal.

CHAPTER 10 - Options for final disposal

10.1 Introduction

The technical options discussed in chapter 8 of this manual are (except biological treatment) all treatment methods, which only separate the wastes in different fractions. Some of these fractions can be recycled, as described in chapter 9. However, for the substances for which re-using or recycling is not a feasible option, and which cannot be handled by a biological treatment unit or by a chemical oxidation unit, the final disposal problem remains. In this chapter the options for final disposal of ship-generated wastes are discussed.

10.2 Waste disposal plan

An essential part of a waste management strategy is the development of a waste disposal plan. The development of a waste management strategy is described in chapter 3 of this manual. A waste disposal plan gives a complete overview of the different types and quantities of the waste streams to be processed, and for every specific waste stream the processing/treatment paths and the options for recycling and final disposal. A good way to present a waste disposal plan is in the form of a "block scheme". Figure 25 in chapter 9.1 of this manual is an example of such a waste disposal block scheme, in which the waste streams are not quantified. It is important to indicate the amount of waste in every waste stream, for instance on an annual or monthly basis. In this case, the block scheme, combined with a proper waste administration, makes the waste streams "traceable" up to the final disposal place.

There are basically three options for final disposal:

- incineration;
- land farming; and
- controlled storage/landfill.

Each of these options for final disposal will be discussed in the next paragraphs.

10.3 Incineration

Incineration of wastes is a suitable final disposal option for wastes which can be converted into environmentally acceptable substances for combustion, usually in combination with flue gas treatment of the combustion products. This means that the feasibility of incineration strongly depends on the type of waste to be processed. In general, one can say that organic wastes or wastes primarily containing organic matter can be incinerated and that wastes primarily consisting of inorganic matter cannot be incinerated, However, it must be pointed out that although this guideline is generally true, suitable waste candidates for incineration may be eliminated if this guideline is used too rigidly without consideration of the particular waste situation.

The following general comments, which are related to the waste compositions, apply:

Hydrocarbons:

If the waste consists of pure hydrocarbon, without fixed nitrogen, halogens or metals and is not mixed with inorganic components (e.g. salts), disposal by incineration is relatively simple. Care should be taken when incinerating waste oils, since they often contain various chemical additives. In a feasible combustion environment, the hydrocarbons will combust to CO_2 and water vapour.

Wastes containing fixed nitrogen or ammonia:

If either of these components is present in the fuel mixture, up to 85% of these components will be transformed to NO_x by one-step combustion. In this case, however, a two-step combustion is applied, in which the first step takes place in a reducing atmosphere, and the second step in an oxidizing atmosphere (free oxygen is present only in the second step). In this way NO_x formation is minimized.

Chlorinated hydrocarbons:

If combusted, chlorine from organic compounds will be totally converted into HCl and Cl_2. HCl might be recovered or neutralized to NaCl, but for Cl_2 this is not possible. Therefore the combustion process has to be carried out at high temperatures (over 1200 °C), high amounts of water vapour and a limited surplus of oxygen, in order to minimize Cl_2 formation.

Waste containing sulphur:

When waste containing sulphur is combusted, more than 95% of the sulphur is converted to SO_2 and less than 5% to SO_3. If SO_2/SO_3 emission limits are exceeded, a desulphurisation scrubber has to be installed. In this scrubber a NaOH or soda solution is used, leading to the formation of Na_2SO_3, which is converted into Na_2SO_4 by a wet oxidation step.

Brine wastes:

Inorganic salts are quite often present in oily residues, in which case special measurements have to be taken in the combustion process. For instance a declined combustion chamber, with an outlet for molten salt at the lowest point of the chamber might be necessary combined with venturi scrubers for salt removal from the flue gas.

As can be expected from the foregoing comments, different types of incinerators exist, for combustion of different waste types. Usually liquid wastes are atomized at the entrance of the reactor, in order to achieve a better combustion. Another important aspect for incinerators is the calorific values over 18.6 MJ/kg (8,000 Btu/lb) maintain a flame, and wastes with heating values below 11.6 MJ/kg (5,000 Btu/lb) require auxiliary fuel for combustion. This of course influences the economics of the system.

In figure 10.1 a typical layout of an incinerator with heat recovery and flue gas treatment is given:

The incinerator shown in figure 10.1 is typical for the incineration of wastes containing chlorine or sulphur. The HCl, Cl_2, SO_2 and SO_3 which are formed during combustion are removed from the flue gas by quenching and scrubbing with an aqueous sodium hydroxide or soda solution. Also a heat recovery system is incorporated in the structure. For every particular situation the economic feasibility of heat recovery has to be investigated. An important aspect in this is whether or not there is a heat demand (e.g. for stream production) at the incineration site.

Solids combustion poses a special problem for incinerator design. A major problem is that solid wastes (including sludges) are usually not pumpable or atomizable. Therefore particle size reduction must be applied, by techniques such as crushing, grinding and shredding. However, these techniques are very power intensive. An advantage of solid waste incinerators is that they are multi-purpose. When properly designed, the same incinerator can be used for industrial and municipal wastes. The incinerators described in this chapter are land-based industrial incinerators. The use of ship incinerators on shore, is not recommended.

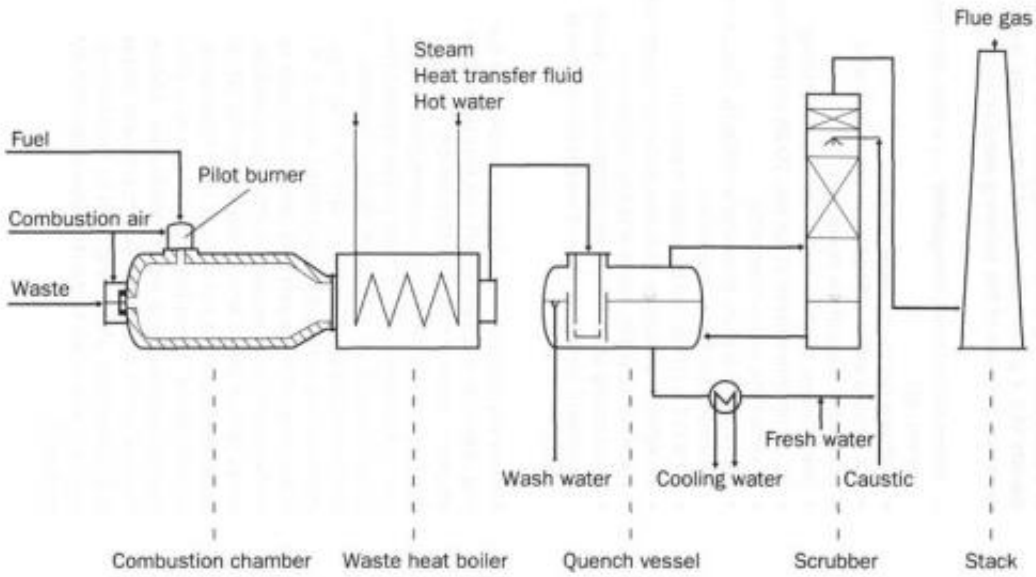


Figure 26 – Typical layout of an incinerator with heat recovery and flue gas treatment

10.4 Controlled storage/landfill

A frequently applied disposal method is to dispose of waste by dumping at a controlled storage or landfill site. This requires the use of a dedicated site, closed to public access and fenced, on which waste can be dumped. Using a landfill does not mean the uncontrolled dumping of waste on land, as is unfortunately still a too often applied practice. Areas above aquifers and encatchments used for public water supply should not be used.

In order to dump waste in a controlled and environmentally acceptable way, a number of provisions are needed. A normal controlled storage site requires several impervious layers, like a mineral layer and a plastic foil layer, to prevent contamination of ground water from percolation water. Furthermore, a draining system has to be provided with sampling points, offering the possibility to check the ground water quality. Landfills also utilize sealing layers to prevent precipitation from penetrating into the landfill body.

For very toxic waste more provisions are required, for example a concrete pit and a roof on the dumping facility, as well as more stringent safety and package requirements. At higher temperatures a fire hazard may develop. Of course transportation equipment and trained labour force is needed for operation of the controlled storage site.

Controlled landfill also requires many years of aftercare, treatment and monitoring, even long after the last disposal was made. This should be taken into consideration when plans for controlled landfills are made. The destination of the site, after closure of the landfill, and the standards required will also have an effect on the total cost of the project.

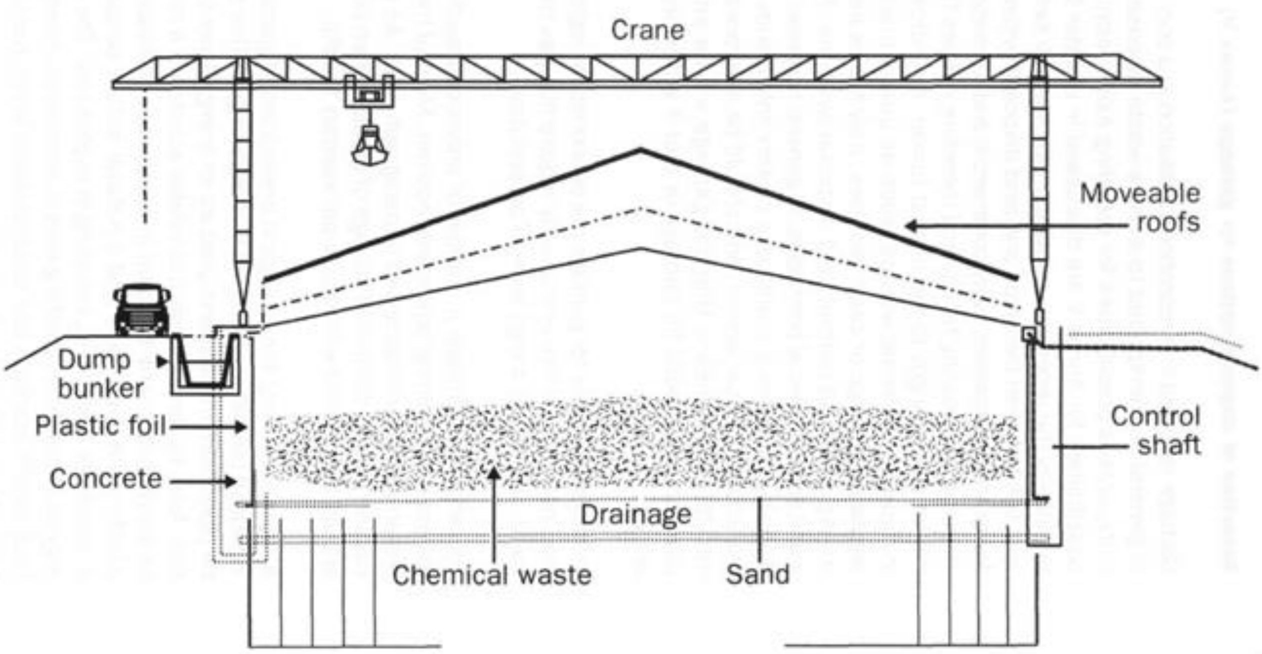


Figure 27 – Typical controlled storage site for hazardous chemical waste

10.5 Selection of disposal options for oily wastes (MARPOL Annex I)

An overview of the disposal and recycling options for oily wastes is given in figure 28. The recycling options are addressed in chapter 9.1. In figure 28 the final disposal options are highlighted. These correspond with the options described in the first paragraphs of this chapter: incineration, land farming and controlled storage. Economics will in general decide what the most feasible options are for oily wastes. Usually these wastes are oily solids, as most liquid oily waste can be used as fuel oil.

Incineration:

This is by far the most recommended disposal technique when taking into account the recommended waste management hierarchy. There are several types of incinerators for oily wastes, such as the rotary kiln, multiple hearth, fluidized bed, conventional furnace and vortex type. Not every type of waste can be handled by a specific incinerator. Usually they are designed on a specific feed quality and quantity. Therefore, the type of incinerator should correspond with the type of waste to be burned.

Another important aspect is that pollution should not be transported to the air. Certain waste compounds can cause serious air pollution, requiring the need of a flue gas treatment, which might considerably influence the economics of the process.

Land farming:

Land farming is a possible technique for destruction of oily wastes, when incineration is not possible. However, it should be guaranteed (through analysis of the waste oils) that the oily waste stream is not contaminated with non-biodegradable substances such as chemical waste. Chemical pollution of an oily waste stream might not only decrease the microbial population of the soil significantly, which will affect the time needed for the total destruction of the oil, but it will additionally contaminate the soil. In monitored and proper circumstances, the naturally occurring microbial population in the soil destroys 80-90% of the oil within 2-3 years. An advantage of land farming over controlled storage or landfill is that the waste is destroyed by biological processes instead of only being immobilized at a certain place.

Controlled storage:

Controlled storage should only be applied to oily wastes with a low hydrocarbon content (less than 3%) and a high solids content, and only when incineration is not possible. Oil or liquid oily wastes should never be dumped on a landfill. Waste might be treated with binding agents such as lime with additives. The purpose of this treatment is to render the waste physically and chemically more suitable to serve as filling material. An example of a controlled storage site for oily wastes is given in figure 29:

Here the waste layer is covered with an impermeable layer and then with soil; almost no destruction of the waste takes place. Of course, as noted in section 10.4, groundwater should be regularly checked for contamination.

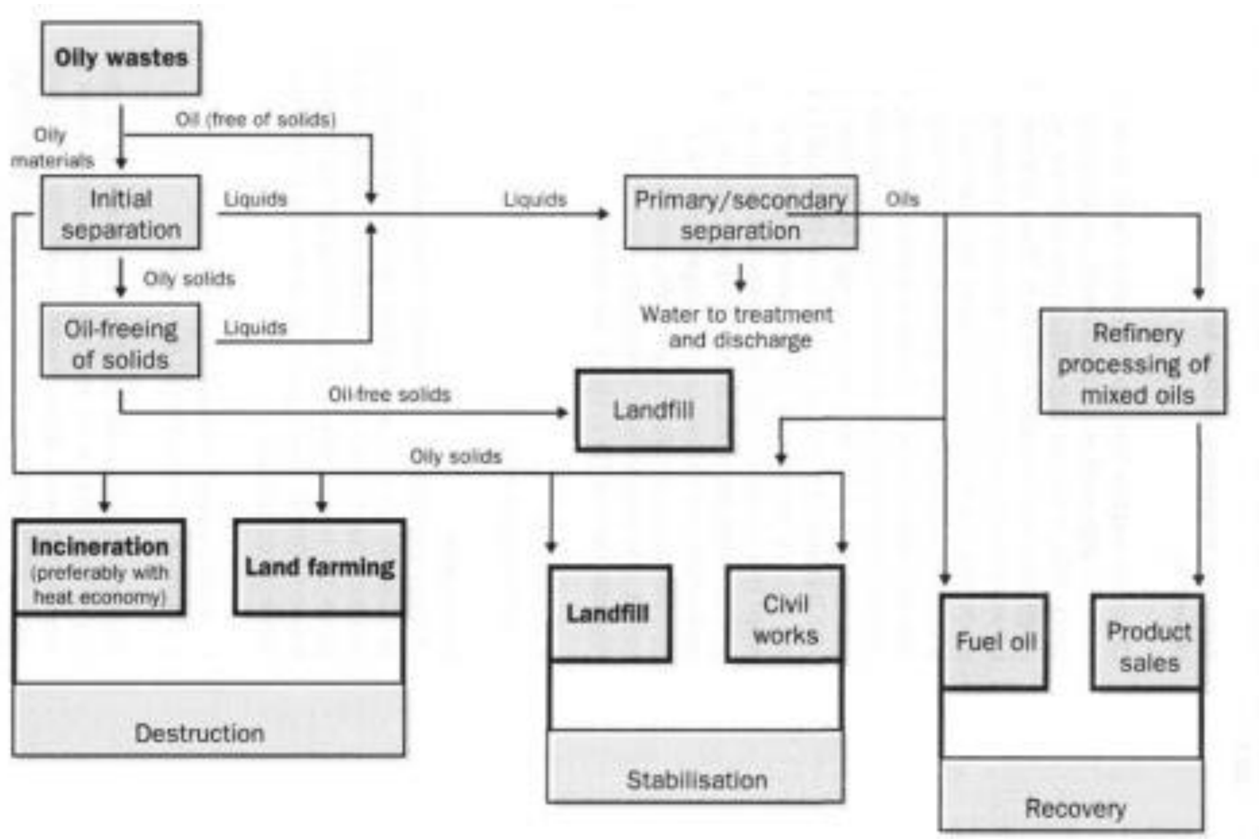


Figure 28 – Disposal options for oily wastes (Annex I)

10.6 Selection of disposal options for chemical wastes (MARPOL Annex II)

Chemical wastes from port reception facilities can consist of a large number of components, especially in large ports. This of course depends on the different types of cargo which are handled in the ports. Each of these components may have its specific physical, chemical and processing properties. As indicated in chapter 9.2, the industry for which the cargo is shipped generally has the best facilities to dispose/recycle chemical wastes, resulting from the tank washing of their chemical carriers. For instance, mixing with a plant feed stream might be possible, and also the water treatment systems of a chemical factory are usually "dedicated" to the wastes in their plants. When this is not possible, the waste has to be received by a port reception installation and processed. Chemicals, which can neither be discharged into the sea nor be treated biologically or chemically, will have to be disposed of in another way.

Principally, there are two final disposal options for MARPOL Annex II substances:

- incineration; and
- controlled storage.

Incineration:

Of these two options, incineration is the preferred option, as it usually converts wastes into harmless substances, and because it brings about a substantial volume reduction of the waste. In addition, when the MARPOL Annex II waste has a high calorific value, this can be recovered through the use of steam or heat exchangers. However, economics will decide which option to follow. Three important parameters in the economic selection are:

- calorific value of the waste;
- chemical composition of the waste; and
- waste legislation applicable (incl. emission standards).

The economic importance of the calorific value is obvious: if this value is too low, expensive auxiliary fuel is needed. In general, a mix of wastes with different calorific values will be fed to an incinerator. A typical feed composition for large-scale waste incinerators is:

20%	bulk solids
20%	packed solids
15%	pastes/sludges
45%	Liquid.

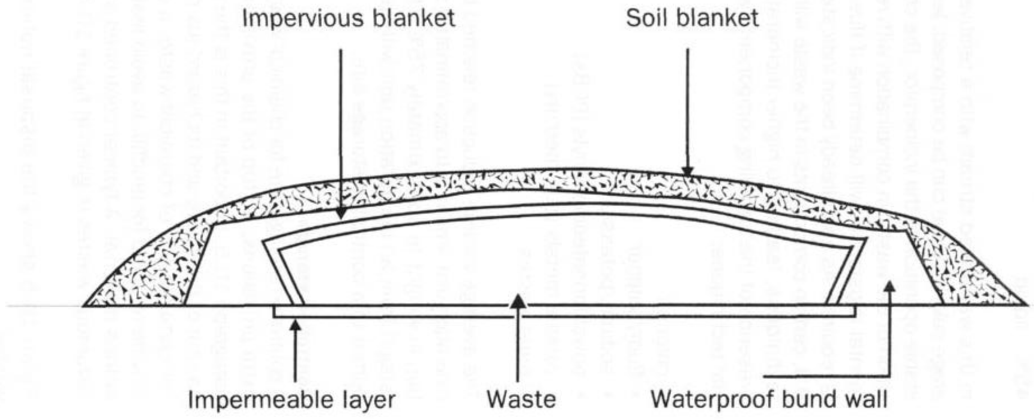


Figure 29 - Typical controlled storage site for oily wastes

In this way a feed stream with a relatively constant average calorific value can be composed, leading to a more stable operation of the incinerator. The chemical composition of the waste, in combination with relevant environmental legislation, will determine if flue gas treatment is required. As has already been indicated in section 9.2, certain components in the waste will require special techniques, leading to higher incineration costs. The presence of the following components will require special techniques:

- chlorine;
- fluor/sulphu;
- sodium/potassium;
- polychlorinatedbiphenyls (PCBs);
- volatile metals (e.g. mercury); and
- brine wastes.

A modern incineration unit can, in average, reduce the waste by approximately 90% in volume and by approximately 75% in weight. The rest stream (slags) from an incineration unit will have to be transported to a controlled storage site.

Controlled storage:

A controlled storage site for chemical wastes may require extra provisions, on top of the provisions indicated in section 10.4. Important in this regard is the percolation behaviour of the waste and its hazardous characteristics. For certain types of chemical waste, a concrete basin may be required for landfill, to avoid leaking of the hazardous material. A typical controlled storage site for hazardous wastes is given in figure 30:

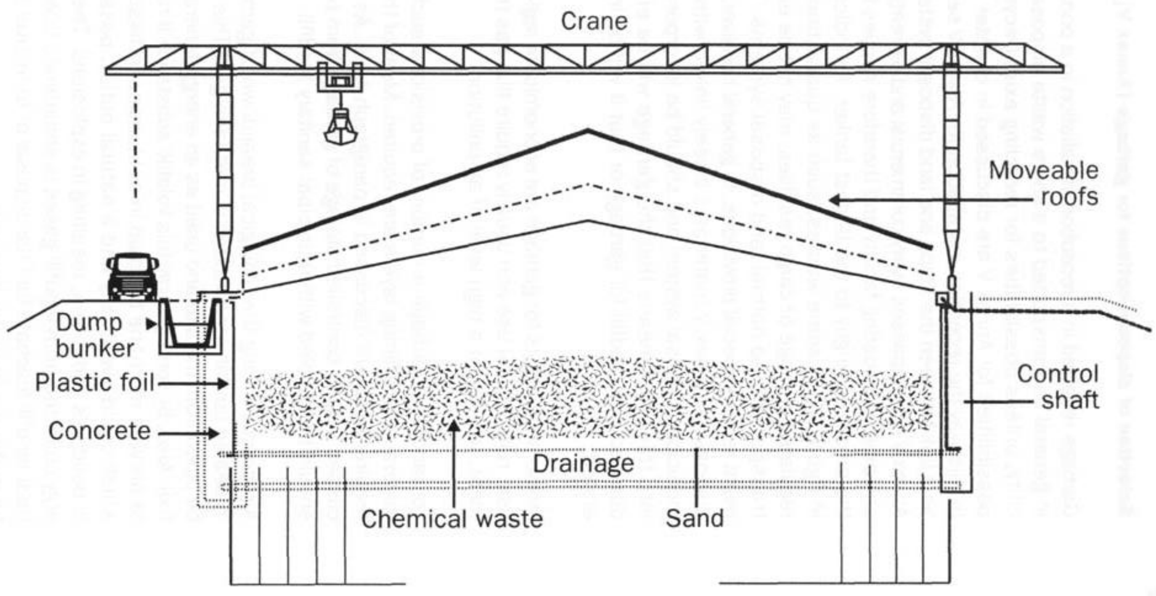


Figure 30 – Typical controlled storage site for hazardous chemical waste

Figure 31 shows the disposal options for Annex II wastes:

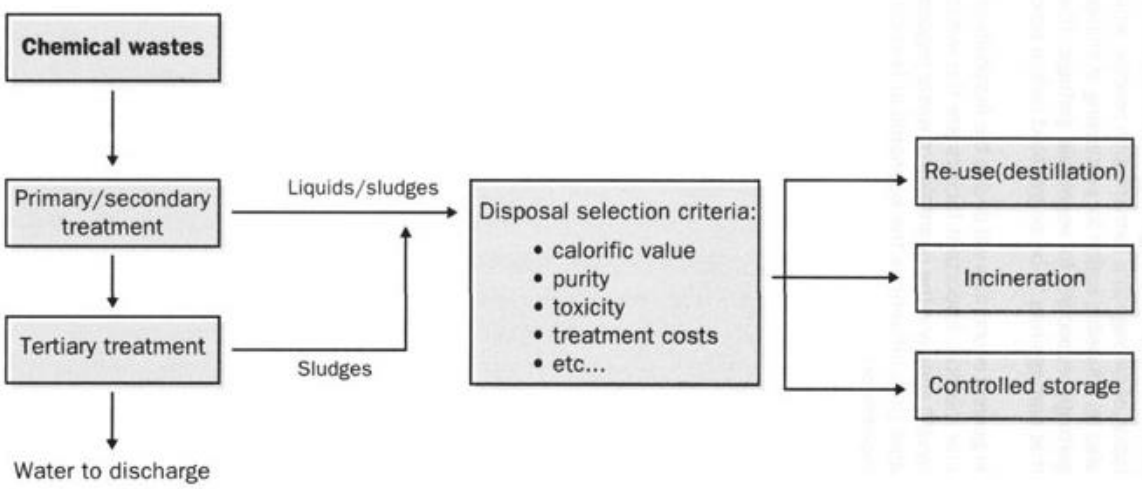


Figure 31 – Disposal options for Annex II wastes

10.7 Selection of disposal options for sewage (MARPOL Annex IV)

In most cases sewage can be entirely (biologically) treated, alongside with land-based sewage streams (grey/black water). When applicable legislation standards are met, the treated water can be discharged into the surface water (docks/river/lake/sea). In addition, when conditions relating to sludge composition and treatment are fulfilled, it can be re-used as fertiliser on land or soil conditioner (see chapter 9).

Most waste water treatment sludge is not suited to be used as a fertiliser or as a soil conditioner, because of possible contamination. The only remaining options are those for final disposal. The following techniques can be used for these sludges:

- incineration (with or without energy recovery); or
- controlled storage (landfill or use as a sealing material in a landfill).

In both cases a dewatering process is necessary. There are several processes possible to dewater, ranging from natural dewatering to the use of specially designed filters and centrifuges. The limit of mechanical dewatering lays around 40% dry matter (depending on the type of sludge). A higher level of dewatering can for example be obtained through the adding of chemicals.

Incineration

Before being incinerated the sludges should be dried properly. This can take place in conventional or specialized dryers. After drying, as in the case for MARPOL Annex I residues, this sludge can be (co-)incinerated using several types of incinerators, such as the rotary kiln, cement kilns, and lignite kilns. Not every type of waste can be handled by a specific incinerator. Usually they are designed on a specific feed quality and quantity. Therefore, the type of incinerator should correspond with the type of waste to be burned.

Another important aspect is that pollution should not be transferred to the air. Certain components in the waste can cause serious air pollution, and therefore a flue gas treatment may be required, which might considerably influence the economics of the process.

Controlled storage/landfill

- **Landfill**

  Sludge, depending on the quality, composition and hazardousness, can be dumped into a controlled landfill. Before being put in a landfill, care should be taken that the impact of the dumping on the environment and the health of local residents is kept to a minimum. Also the safety and stability of the landfill should be taken into account when dumping sludge. For these reasons, sludge will need to be dried and stabilized before put in a landfill. Dried sludge also prohibits the growth of micro-organisms, which has a positive effect on the stability of the landfill. In some cases, mechanical dewatering only will not be sufficient, and solidification may be necessary.

  Several methods and techniques exist for the solidification/stabilization of dried sludge. A common technique is based on the addition of CaO, commonly known as quicklime. Adding quicklime will not only improve the solidness of the sludge, but will also lead to an additional disinfection of the sludge through an increase of the temperature during the process. Again, different installations for the blending of the waste and materials exist.

  Sludge can also undergo a composting process, before being put on a landfill. As in that case a large part of the organic materials will have disappeared leading to a dryer and more solid composition, dumping composted sludge will improve the geophysical stability of the landfill.

- **Sealing material landfill**

  The purpose of a sealing layer is to prevent water leaking into and seeping out of the sealed zone, and prevent oxidation of the underlying materials.

Therefore, the sealing layer is composed of a homogeneous layer of poorly permeable soil materials, surmounted with a seal made of welded foil materials. Sewage sludge can be treated in such a way that it may serve as such poorly permeable soil material. Again, several processes exist, e.g. the above explained solidification through quicklime. In that case the treated sludge replaces other materials such as natural clay, sand and bentonite mixtures and soil-water glass mixtures.

As for all landfill sites, monitoring and aftercare (average 10 years) are needed, in order to prevent the leaching of hazardous materials such as heavy metals and to monitor the stability of the landfill.

10.8 Selection of disposal options for garbage (MARPOL Annex V)

Garbage received in a reception installation in a port will, in general, be transported to a shore waste disposal facility, unless possibilities for recycling exist (recycling possibilities for Annex V are discussed in chapter 9.4). In this way the reception installation for Annex V serves as a link between the ships and land disposal systems. Annex V encompasses every commercial and recreational shipping and boating facility and therefore applies from the smallest dinghy to the largest tanker.

As indicated in figure 10.6, some wastes, such as quarantined or regulated garbage or cargo residues, may not be easily transportable to normal land disposal systems. This might require special provisions.

In some cases, the disposal of MARPOL Annex V material is closely linked with the municipal disposal system and can be incorporated into this. This means that the garbage will be either dumped at a landfill for garbage (if not combustible) or that it will be incinerated.

Incineration plants for garbage are economic for regional use, not for local use and usually require flue gas treatment, to prevent a high level of air pollution.

For landfill of garbage a number of provisions such as mineral and draining layers are required. Most of these requirements are discussed in section 10.4. As discussed before, controlled storage of garbage from ports can be coupled with municipal sanitary landfill.

A useful resource during the biological breakdown of garbage in sealed landfill repositories is methane gas. This can be piped from the site and used as an energy generating fuel. Also, by venting away this volatile substance it helps to prevent methane build-up in subterranean fissures, which could eventually find a natural outlet, possibly in buildings and towns, resulting in explosions. The energy collected from landfill gases is sometimes used to treat landfill leachate for final disposal or to recover useful materials from the leachate.

Another garbage treatment option is the fermentation of garbage in a fermentation reactor, which might also be a feasible option for proceeding of ship-generated garbage, especially for vegetable garbage. This means that garbage has to be segregated before processing.

In general, economics will decide the feasibility of a particular method. Important factors are the availability of landfill sites and the quantities of waste regionally available (this influences the economical feasibility of an incinerator).

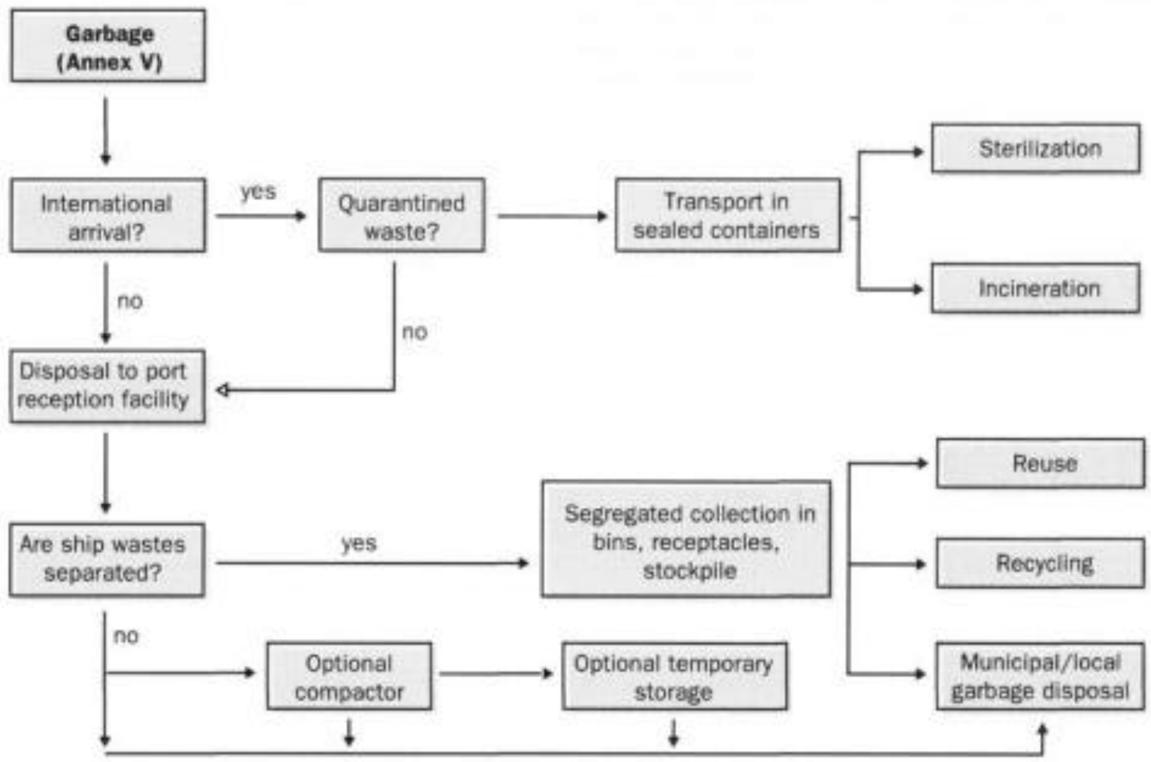


Figure 32 - Options for port handling and disposal of Annex V wastes

10.9 Selection of disposal options for MARPOL Annex VI residues

As mentioned in chapter 9, recycling of MARPOL Annex VI residues is not always possible. Distinction can be made between practices regarding ozone-depleting substances and equipment containing such substances, and exhaust gas cleaning residues.

Ozone-depleting substances (ODS)

Ozone-depleting substances, when not suitable for reclamation or banking, should be sent for destruction. This process takes place in highly specialized destruction facilities. These plants can be especially designed to destroy ODS, or they can be waste incineration plants (which burn waste as a fuel) that are also capable to incinerate ODS, if licensed to do so.

The two main types of destruction plants are:

- destruction by incineration (in e.g. rotary kilns, industrial furnaces, cement kilns); and
- destruction by using plasma technology.

Residues from exhaust gas cleaning systems (EGCS):

As only few ships are currently equipped with EGCS, very little disposal facilities have assessed possibilities for EGCS residues. This may change in the upcoming years, when more ships will have EGCS and want to deliver the residues to port reception facilities.

10.10 Disposal options for other ship-related wastes and residues

Ballast water and ballast water sediment

The ballast water sediment can – in theory – be incinerated after pre-treatment (dry and de-watering unit) in licensed incinerators or go for landfill (possibly after stabilization and/or sterilization). As the Ballast Water Management Convention has not yet entered into force, it is difficult to foresee to what extent recycling/disposal techniques are feasible (from a technical and economical point of view).

Wastes from the application of anti-fouling systems

Waste water and contaminated grit and other paint residues can be disposed of through incineration (after pre-treatment) and/or controlled storage/ landfill.

CHAPTER 11 - Establishment and operation of reception facilities (including funding mechanisms)

11.1 Introduction

When considering the financial aspects of the establishment and operation of port reception and treatment facilities there are two main issues, both of which will be described in this chapter:

- funds must be secured to cover the investments pertaining to design and building of the facilities; and
- costs related to operating the facilities must be covered.

Regarding the investments, guidance is given as to which resources should be considered. The methodology to assess the magnitude of the investments is described in chapter 5, "Planning reception facilities". Regarding the operating costs, it is obvious that a system must be designed to absorb or recover these recurring costs. In this chapter guidance is given in selecting a system which is best suited to the port's conditions and traffic. Basically, such a system can be based on two principles:

- the "polluter pays" principle; and
- the "shared costs" principle.

The "polluter pays" principle implies that the waste generators have to pay for the reception, treatment, recycling and environmentally sound disposal of the waste they generate. The principle can be applied not only to ships, but is also generally applied to land-based generators of waste. Application of the polluter pays principle may require the implementation of a monitoring and control system to track the production, handling (incl. transport) and disposal of wastes and ensure compliance with the law.

The "shared costs" principle entails that all costs are shared by society, usually by allocation from governmental tax revenues. From a business economical point of view, this system is not a real cost recovery system. Also, specifically regarding the subject of ship-generated waste, it can be questioned whether the use of tax payers' money for the management of waste generated by other stakeholders is an approach worth considering. Low interest loans or tax credits to waste generators and reception facilities, however, can be used as an incentive to improve operations and stimulate waste minimization. This system will also require a monitoring and control system to ensure compliance.

In practice, a system which embodies the polluter pays principle will aim for 100% cost recovery. A combination of the two principles will result in a system with partial cost recovery, as the costs are partially covered by the port and/or the government, either at the local or national level. A system which embodies the shared costs principle is actually a non-cost recovery system, but nonetheless still a system to cover (some of) the costs of a reception facility.

The following alternatives are addressed in this chapter:

- the direct fee system;
- the contract system;
- costs of disposal included in port dues;
- the fixed fee system;
- the combined system; and
- the free-of-charge system.

The first five systems are options for cost recovery; the last system is considered as a non-cost recovery system.

In the design of a cost recovery system the following items should be considered in determining the fees to be charged:

- capital costs (interest and depreciation) of equipment, land acquisition;
- labour, including operation of the facilities, supervision, administration and training of personnel;
- maintenance and spare parts;
- other consumables such as power and chemicals;
- costs for final disposal of wastes (including costs for storage and transport);
- revenues from recyclable materials and delivered services.

In this chapter the various cost recovery systems are evaluated. The evaluation entails the following criteria:

1. the influence of the system on good housekeeping on board (e.g. prevention and segregation of waste) and the expected environmental effects;

2. the parties to be involved in the system;

3. the relation between the system and possibilities for monitoring and enforcement;

4. supporting arrangements; and

5. financial effects for ports and other authorities.

Most of these criteria can be assessed in a qualitative manner only. Once the basic design of a reception facility has been completed, reliable estimates of the investments and operating costs can be made (see chapter 5). These estimates can be used to calculate "unit prices"; costs per m^3 or ton of waste collected and treated, costs per ton of cargo, or costs per ship or ship category. Such calculations will ease the decision-making process and the choice for a cost recovery system.

Criterion 2 mentioned above refers to the following stakeholders: the government and authorities, the shipowners and ship operators, the port authority and the port reception facilities. Involvement of government and authorities, for instance, can concern the monitoring of compliance with regulations and enforcement (see chapter 13), financial and administrative matters, and operational matters (collecting and treating wastes; see chapter 8). The role of each party varies with each cost recovery system. In this chapter the port authority is interpreted as the organization that runs and operates the port. This organization can be semi-governmental or private.

Regarding supporting arrangements (criterion 4), several general arrangements are possible. These are summarized in section 11.7, "Incentives to encourage good practice". Furthermore, each cost recovery system will have its specific methods to support the system.

This chapter focuses primarily on the financial aspects of port reception facilities. It should be recognized that the waste a "port reception facility" receives is by definition from ships, even though the treatment and disposal of the wastes may be at a facility that handles other wastes as well.

Furthermore, it should be noted that waste reception, recycling, treatment and final disposal are not necessarily executed by one party. For example, several companies may provide only specific services, such as transport, separation of oily wastes, operation of a landfill, etc. Obviously, all these steps have cost implications, which must be taken into consideration when calculating the total operating costs. These costs are primarily the result of a country's national environmental legislation and regulations and not so much of the obligations of MARPOL.

Whether a cost recovery system interferes with inter-port competition depends on several factors. This manual advocates regional solutions for the establishment of port reception facilities, which might avoid the problem of inter-port competition within a certain region. Inter-port competition might be created when the cost recovery systems in competing ports contribute to large differences in port dues, waste fees or other charges or to complex administrative matters for the shipowner. In practice, however, it is highly unlikely that a ship will avoid a particular port because of the high port dues when it has to (un)load there. Besides that, it seems unlikely that waste fees significantly affect inter-port competition, since the contribution of the waste fees to the port dues and other charges is only a small percentage. However, inter-port competition is also possible in other ways. Ports could also compete in terms of services rendered or in terms of the environmental provisions like a port reception facility with a good, fast service.

This chapter is structured as follows. The characteristics of each cost recovery system are discussed in section 11.2. In section 11.3 the relation between the types of waste and waste streams and the financing scheme are examined. Section 11.4 deals with the funding for the establishment of the port reception facility and section 11.5 with the possibilities for financing of a port reception facility on a regional basis. In section 11.6 the management of the financing system is discussed. Finally, the incentives to encourage good practice are summarized in section 11.7.

11.2 Characteristics of different cost recovery systems

11.2.1 The direct fee system

The direct fee system embodies the polluter pays principle and normally requires payment on delivery of the wastes to the reception facility: ships (or consignor) pay a charge per lot or per ton of waste delivered. Charges may be further differentiated for specific categories of wastes, depending on the delivered services (pumping times, night/weekend shifts, the need for specific receptacles, etc.) and/or treatment required.

Theoretically, the direct fee system should stimulate waste minimization practices on board and thus should have a positive influence on good housekeeping. At the same time a direct fee system always provides some disincentive to ships, since it may encourage illegal discharge at sea, in order to avoid costs.

In the direct fee system the port reception facility and the shipowners or operators are the most important parties. Involvement of (governmental) authorities in the operational phase may be restricted to monitoring and enforcement, which are required for successful application of this cost recovery mechanism (and are also required to enforce MARPOL and applicable national/local environmental regulations), in order to:

- prevent ships from discharging their wastes in open sea;
- ensure that reception facilities and treatment plants comply with applicable environmental standards; and
- ensure fair competition between reception facilities regarding the treatment prices.

To support the direct fee system a mechanism to control the fees for waste reception and processing may be necessary. In the direct fee system it is important to find a good balance between prices for waste reception and treatment on the one hand, and the willingness of the ship to deliver waste on the other. The possible disincentive of the fee system towards the delivery of waste, can be overcome by introducing compulsory discharge for certain types of ship-related wastes. This requires the adoption of regulations. Moreover, control must be strict and adequate.

Assuming that the port reception facility is a private or semi-governmental company, the direct fee system does not have a financial effect for the port authority or other authorities. The risk the direct fee system carries for a port reception facility is comparable to the risk of operating any business: it does not ensure a fixed income and it can be difficult to estimate the necessary/optimal capacity of the facility.

11.2.2 Contract system

A contract system involves the signing of a contract between the port reception facility in a certain port with a shipowner or ship operator. This system is especially applicable to ships that call frequently at the same port (e.g. fishing vessels, fixed container or ro-ro lines, or ferries) and in cases where the type (and quantity) of waste delivered can be specified in advance. The contract may include the payment of a yearly or monthly fee, for which the ship can deliver its wastes without additional charges. A contract could specify a maximum volume of waste that could be delivered during the contract period. The maximum volume of waste and the subscription rate can be calculated using the information in chapter 7, the data on waste production mentioned in the oil and garbage record book, or they could be based on, for example, the ship's boiler horsepower (BHP) or the (estimated) fuel consumption of the ship and the kind of fuel used.

A contract usually restricts the volume of wastes delivered by a certain category (type and/or size) of ship. This can be made negotiable, which enables a shipowner to unload a specific volume of waste from a number of ships without being specific as to the volume per individual ship. This flexibility can allow the owner of a number of vessels to compensate for the possible reduced amounts of delivered waste of more modern (i.e. cleaner) ships with the delivered waste of older (i.e. more polluting) ships, in case the older ships have to deliver more waste than is permitted according to the contract. This encourages the delivery of waste by the older ships and is likely to lead to less illegal discharges.

The drawback of this system is that it might not particularly stimulate waste minimization practices or waste segregation on board. Minimization or segregation might be encouraged by a discount on the subscription rate if the ship segregates her waste and can incorporate waste reduction targets. Nevertheless, the contract system encourages waste delivery by the ship at the contracted port reception facility.

A contract system can include several parties, depending on the way the contract is concluded:

- a contract between the parties directly involved, i.e. the port reception facility and shipowner;
- a contract between several parties: the government, an intermediary organization or responsible NGO (non-governmental organization), organizations of shipowners, and the port reception facilities (to be passed by a covenant).

The first type of contract can be individual from the point of view of the shipowner (one shipowner negotiates a contract with one or more port reception facilities) or collective (a group of shipowners negotiate a contract with one or more port reception facilities). This is also possible for the second type of contract. In this type of contract the national/local authorities and/or responsible NGO can play a role in the negotiation of the contract. They can assist in the establishment of an organization which carries out all the administrative work in relation to the contract, such as organizing a tendering procedure, collecting the subscriptions, tracking the volumes of waste delivered by the ships, make arrangements for transport and waste treatment, etc.

The contract system does not require extensive monitoring and enforcement. The ships are already stimulated to deliver their waste by the subscription rate they pay each period (month/year). Furthermore, it should be cheaper to deliver waste on fixed contract prices that are agreed by the parties involved and can thus be controlled. The second type of contract provides the best means for monitoring the operations at the port reception facility, in case the administrative work is carried out by an intermediary organization.

The contract system has the advantage that it ensures the port reception facility of a certain yearly revenue. For the shipowners and operators it has the advantage that the costs of delivery at the port reception facility are fixed for the term of the contract.

11.2.3 Costs of delivery included in port dues/charges

As the name of the system already says, costs of delivery, treatment and disposal could also be included in port dues/charges. This would therefore result in an increase of the port dues. The charges could be differentiated for particular ship categories, for instance based on ship type, size, kind of fuel used, fuel consumption, crew or passenger number, or depending on the type of waste. In case of general cargo ships, it should be taken into account that wastes may be partly cargo-associated. The charges could also apply to a certain type of waste, for instance ship-related or cargo residues.

Including the costs of disposal in port dues/charges is an example of an entirely indirect cost recovery system. Another example of such a cost recovery system would be the so-called "no special fee" system, in which every ship, whether the facilities are used or not, has to pay a fee together with the port dues. In this and other indirect systems the charges collected by the port authority or another organization have to be reallocated to the port reception facilities.

These systems include an incentive not to discharge waste at sea, as ships will have to pay the fee irrespective of the actual use of the reception facility.

The drawback of this system is that waste minimization practices on board are not directly rewarded by reduced fees. This cost recovery mechanism can even result in more than average waste production on board, for example by neglected maintenance. The system may also lead to ships holding waste on board that already should have been disposed of elsewhere, because the ship has to pay the dues regardless of the waste quantities.

As the charge is unavoidable, however, the costs of delivery will be an incentive for legal disposal and illegal discharge will be less likely to occur. Another advantage of the charge being paid by all ships that call at the port is that the charge can be relatively small. Furthermore, this system may entail a simplification of administrative matters for the shipowners.

In the costs of disposal included in port dues/charges system the port authority can take care of the reception and treatment services themselves, launch a tendering procedure and/or make arrangements with companies who are able to do so. Enforcement and control will be required, but since the charge is unavoidable it is likely that these might be less extensive than for the direct fee system. Of course, this requires that procedures for disposing waste will not result in undue delay.

A disincentive of this system is that ships visiting the port at short intervals may pay relatively more than other ships for the disposal of their wastes. A remedy may be to exempt a ship from paying for the rest of the year once it has called at the port for a specified number of times. Choosing a contract system in these cases, might be a better and simpler option.

The financial effect of this system for ports is likely to be positive, since all ships have to pay the port dues, whether they deliver waste or not.

11.2.4 Fixed waste fee system

The fixed fee system can be considered as a derivative of the system where costs for collection and disposal are included in port dues/charges. The costs for collection and disposal in a fixed fee system are separated from the port dues as a surcharge, but still have to be paid together with the port dues.

Just like the system where costs are included in port dues/charges, the fixed fee system does not directly charge for the delivered waste. Therefore, it also does not reward waste minimization practices on board with, for instance, reduced fees, although incentives schemes can be built into such a system, such as the obligation of developing waste reduction plans and the introduction of waste reduction targets. The costs of discharge will be an incentive for legal disposal of wastes ashore and illegal discharges will be less likely to occur. A condition for this is, of course, that the service at the port reception facility must not cause undue delay. Another advantage is that, because the charge is being paid by all ships that call at the port (irrespective of the use of the port reception facilities), this charge can be relatively small.

The port authority or an intermediary organization can play an important role in this system. They can collect the fixed fee and develop a scheme to pass it on to the port reception facility/facilities. This might complicate administrative matters, but does not have to be a problem if the parties involved have a correct and up-to-date administration.

Also, strict enforcement and controls will be required. But since the charge is unavoidable, it is likely that these might be less extensive than for the direct fee system. Of course, this requires that procedures for disposing waste will not result in undue delay.

Arrangements to support this cost recovery system can be discounts or exemptions on the fixed fee for ships that call the port at short intervals.

11.2.5 Combined system

The combined system implies that every ship pays a fixed fee, plus an extra charge dependent on the amount and type of waste delivered. The extra charges are paid to the port reception facilities, while the fixed fee is collected by the port authority or an intermediary organization which passes it to the port reception facility. This might complicate administration, but does not have to be a problem if the parties involved operate a correct and up-to-date administration and monitoring system. Some ports today already apply web-based information and monitoring systems, which reduce eventual administrative burdens to a minimum.

The combined system encourages waste minimization practices and waste segregation on board, since this will reduce the extra charges to be paid. But it entails also a slight disincentive for waste delivery since the extra charge is avoidable by illegal discharge of the waste. Advantage of the fixed charge is that, just like when the costs are included in the port dues/charges, because the fixed charge is being paid by all ships that call at the port, the fixed and/or the extra charge can be relatively small. Another incentivizing mechanism that can be implemented is that when the ship can prove that waste was recently delivered in another (previous) port, they could obtain a (partial) refund.

Generally, a good balance between the fixed fee and the extra charge is important for the successful application of this cost recovery system.

The port reception facility, the port authority or the intermediary organization are mainly involved in this system, because of the payments. Enforcement and control will be required. Since the extra charge is avoidable in case when no extra waste is being delivered, it is likely that these monitoring and inspections need to be slightly more extensive than for the system where costs of disposal are included in port dues/charges systems. The authorities have to seek a good balance between the fixed fee and extra charges.

Arrangements to support this cost recovery system can be discounts for ships that are managed, operated or equipped in a way that they generate reduced quantities of waste, or exemptions on the fixed fee after calling at the port for a certain number of times for ships that call at the port at short intervals. Also, a contract basis might be a preferable arrangement for these vessels.

11.2.6 Free-of-charge system

The free-of-charge system embodies a concept where the costs for the collection, treatment and disposal of the wastes are paid by the community (local, regional or national). This system is actually not really a cost recovery system, since the operational costs of the port reception facility are not covered by directly charging the ships for the reception of wastes ("free of charge"). However, since the operation of a port reception facility is never free of costs, resources have to be allocated, such as:

- government subsidies, using for example general tax revenues paid by society; and
- revenues of specific taxes.

As with the costs of disposal included in port dues, the free-of-charge system will not encourage waste minimization practices on board ship. However, waste delivery in a port is likely to be stimulated by this system and illegal discharge at sea will be reduced, mainly because there are no reasons not to deliver the waste if the service is adequate and discharge procedure are easy and fast.

As the free-of-charge system is not accordance with the "polluter pays principle", it requires a large involvement of the national or local authorities. They have to finance the expenses of the port reception facility from the revenues from taxes or subsidies.

This system does not require extensive control and enforcement measures to verify compliance of ships with disposal regulations. There are indications that this system may attract waste, but by developing a regional strategy leading to the provision of similar services in other ports in a region this may be avoided.

Although it is likely that the image of a port may benefit from free-of-charge reception facilities, there is as yet no indication that this factor influences the decision of ship operators to move to ports (provided that the port fits the trading pattern) providing free or less costly reception facilities. With better enforcement of the discharge standards, this would probably be different. The free-of-charge system has a negative financial effect for the authorities, since they have no financial benefits in this situation.

11.3 Relation between types of waste/waste streams and financing schemes

From the previous section it may seem that a port reception facility can only use one specific cost recovery system for all types of wastes. In practice, different cost recovery systems are used for different types of waste. The type and volume of waste and waste streams a port reception facility receives strongly depend on a number of factors:

- the kind of ships calling at the port (i.e. size, type);
- the number of ships calling at the port;
- the duration of the journey since the last port of call;
- the discharge of waste permitted under MARPOL during the journey of a ship;
- the level of service and adequacy provided by the reception facility (waiting times, pumping capacity, etc.); and
- types of cargo handled in a port.

A thorough analysis of all these factors must be carried out for any port to determine the type of waste to be expected, the annual volumes as well as quantities on an average day and in case of maximum delivery. To determine which cost recovery system is appropriate, several factors must be considered, such as:

- the results of the analysis mentioned above;
- resources for monitoring and enforcement; and
- parties willing and able to participate in the operation of port reception facilities.

It follows that, since so many factors need to be considered, there is no clear relationship between a cost recovery system and a particular type of ship-generated waste. Nevertheless, some considerations are presented in the next sections to provide some guidance with respect to the section of a cost recovery system. A number of cases are identified in terms of frequent callers and the size/type of the ships. It should be noted that these are only relative terms; it is not possible to state that one system is better than another for a specified number of ships calling frequently or a certain number of similar ships.

11.3.1 Waste from engine room (MARPOL Annex I)

Waste from engine rooms concerns used lubricating oil, fuel residues, oily sludges and oily bilges (see chapter 7.1). It consists mainly of mixtures of oil, water and solids. This type of waste is always present aboard a ship, so this type of waste has to be taken into account at all reception and treatment facilities. Compared to MARPOL Annex I cargo residues, the lot sizes of waste from engine rooms are relatively small. In table 6, possible situations at the port are mentioned, with the consequences for waste volumes and the cost recovery system which seems most appropriate in this case.

A typical example of case 1, where many similar ships are frequent callers, can be fishing vessels, which often call at the same port between fishing campaigns. Since the volumes of oily waste from these ships will be comparable, a system with standardized charges is appropriate. A tariff differentiation regarding the ship's type/size, boiler horsepower (BHP) or the ship's (estimated) fuel consumption and the type of fuel used can be considered.

11.3.2 Cargo residues (MARPOL Annex I)

Cargo residues may consist of tank washings and, in case the ship does not possess segregated ballast tanks, dirty ballast (see chapter 7.1). Often these types of waste are taken care of by the terminals where tankers are loaded and unloaded[17]. The volumes of this type of waste can be very large compared to e.g. waste from engine rooms, particularly in the case of dirty ballast. In table 7, possible situations at the port are mentioned, with the consequences for waste volumes and the optional cost recovery system which seems most appropriate in this case. Where a terminal has its own oil and water separating system, it may be practicable to receive oily ballast water and tank washings at little or no cost. This approach has been applied successfully in several countries.

Table 6 - Cases for oily waste from engine rooms and the possible cost recovery system

Case	Wastes	Cost recovery system
1. many frequent callers, many similar ships	predictable annual volumes, predictable lot sizes[18]	contract, costs of delivery included in port dues, fixed fee, combined
2. many frequent callers, not many similar ships	predictable annual volumes, variable lot sizes	contract, costs of delivery included in port dues, fixed fee, combined
3. many infrequent callers, many similar ships	less predictable annual volumes, predictable lot sizes	costs of delivery included in port dues, fixed fee, combined
4. many infrequent callers, not many similar ships	less predictable annual volumes, variable lot sizes	direct fee

For oily cargo residues, cases 1 and 2 are less likely to occur than cases 3 and 4. For the contract and combined system – and other systems with a standardized charge – a tariff differentiation regarding the ship's tonnage, the oil content in the washing waters and the presence of segregated ballast tanks can be considered for this type of waste.

11.3.3 Cargo residues (MARPOL Annex II)

Cargo residues covered by MARPOL Annex II concern tank washings and dirty ballast (see chapter 7.2). In general, most chemical ships have segregated ballast tanks. This means that ballast water contaminated with chemicals will be rare. The main contributor of MARPOL Annex II wastes to reception facilities is therefore wash water resulting from tank cleaning activities. The reception and treatment of wash water is in most cases considered to be the responsibility of the party that unloads the ship.

Unloaded tankers arrive at the loading port in ballast and must discharge this (dirty) ballast at the loading port. Therefore, reception and treatment of dirty ballast is in most cases considered to be the responsibility of the party that loads the ship. Chemical residues

[17] Ports other than oil terminals should not be designed to receive the large volumes of dirty ballast which are associated with oil terminals, since oil terminals are required to have reception facilities for these wastes.

[18] Lot sizes of waste from engine rooms are relatively small.

received may relatively easy be processed by the companies importing these chemicals, as they will often produce the same wastes from their own operations.

The possible situations at the port and the cost recovery system which seems most appropriate in these cases are the same as for MARPOL Annex I cargo residues (see table 7), though it must be noted that the kind of cargo often varies widely. Thus, cases 1 and 3, in which "many similar ships" call at the port, will not often occur as far as MARPOL Annex II cargo-related waste is concerned. For the contract and combined fee system – and other systems with a standardized charge - a tariff differentiation regarding the ship's tonnage and type of cargo can be considered for this type of waste.

Table 7 - Cases for MARPOL Annex I cargo residues and the possible cost recovery system

Case	**Wastes**	**Cost recovery system**
1. many frequent callers, many similar ships	predictable annual volumes, predictable lot sizes[19]	contract, combined
2. many frequent callers, not many similar ships	predictable annual volumes, variable lot sizes	contract, combined
3. many infrequent callers, many similar ships	less predictable annual volumes, predictable lot sizes	combined
4. many infrequent callers, not many similar ships	less predictable annual volumes, variable lot sizes	direct fee

11.3.4 Special waste (MARPOL Annex III)

Special waste, as covered by MARPOL Annex III, concerns harmful substances carried in packaged form. Although MARPOL Annex III does not explicitly address the need for reception facilities, these wastes can be generated, e.g. during loading and unloading (damaged packaging, etc.). However, these wastes are neither likely to occur frequently nor in large quantities. In addition, the wastes may consist of a variety of substances which may need specific treatment, and thus these cases are unpredictable. Therefore, it may be appropriate to determine the costs for reception and treatment of these types of waste on a case-by-case basis instead of designing a cost recovery mechanism that is generally applicable.

[19] Lot sizes of Annex I cargo residues can be medium to very large.

11.3.5 Sewage from cargo ships, including livestock carriers (MARPOL Annex IV)

Sewage from cargo ships is proportional to the number of the crew. Besides that, the quantity of this type of waste depends on the duration of the journey since the last port of call and the discharge permitted under MARPOL during the journey. Furthermore, ships may have their own sewage treatment plant on board, so they can discharge the treated sewage without problem into the sea. Also it should be considered that many smaller vessels do not have a sewage holding tank or treatment plant on board. Therefore, it should be taken into account that sewage will not often be delivered to a port reception facility.

In case sewage is delivered in port, it is important that there are facilities (e.g. a local sewage treatment plant) to take care of it. For reception of sewage a cost recovery system should be able to take into account the possible presence of a sewage treatment plant on board the ship or the fact that the ship does not have a sewage holding tank. If sewage is to be delivered, cost recovery systems with a standardized charge - the costs of disposal included in port dues system, fixed fee system and the combined system - can consider a tariff differentiation based on the number of the crew.

Table 8 - Cases for sewage from cargo ships and the possible cost recovery system

Case	**Wastes**	**Cost recovery system**
1. many frequent callers, many similar ships delivering sewage	predictable annual volumes, predictable lot sizes	contract, costs of delivery included in port dues, fixed fee, combined
2. many frequent callers, not many similar ships delivering sewage	predictable annual volumes, variable lot sizes	Contract
3. many infrequent callers, many similar ships delivering sewage	less predictable annual volumes, predictable lot sizes	costs of delivery included in port dues, fixed fee, combined
4. many infrequent callers, not many similar ships delivering sewage	less predictable annual volumes, variable lot sizes	costs of delivery included in port dues, fixed fee, combined

In table 8, possible situations at the port are mentioned with the consequences for waste volumes and the cost recovery system which seems most appropriate in this case.

11.3.6 Sewage from passenger/cruise ships (MARPOL Annex IV)

The volume of sewage from passenger/cruise ships is determined by the number of crew and passengers and can be very significant. Passenger/cruise ships usually travel along a defined and scheduled route. From the point of view of the passenger/cruise ships, therefore, a contract system with the port reception facilities along the route would be convenient and can be negotiated well beforehand. Nevertheless, the contracted port reception facilities will have to be able to receive the amount of sewage the passenger/cruise ship delivers. Most passenger/cruise ships, however, have sewage treatment systems on board and do not need to discharge sewage to shore reception facilities, unless these ships stay in the port for an extended period.

The possible situations at the port and the cost recovery system which seems most appropriate in these cases are the same as for sewage from cargo ships (see table 8). In case of cost recovery systems with a standardized charge, a tariff differentiation regarding the number of the passengers and crew present on the passenger/cruise ship can be considered.

11.3.7 Garbage (MARPOL Annex V)

Garbage covered by MARPOL Annex V is described in chapter 7.4. Garbage refers to a wide variety of wastes such as galley, domestic and operational waste. The quantities of garbage from cargo ships are relatively small, as the number of crew members is limited. Not all ships will have the facilities on board to segregate their garbage properly, so the composition of the garbage will also be very diverse. Garbage segregation on board is encouraged, but the reception facilities of the port should be taken into account. Most port reception facilities do not have segregated reception possibilities. Increased compliance with ISO standard 21070 on the management and handling of shipboard garbage, however, might lead to larger volumes of segregated garbage. Reception facilities should anticipate to this.

Generally, a system with a standardized charge - the costs of collection and disposal included in port dues system, fixed fee system and the combined system - can be considered for reception of garbage. A contract system can be considered in case of many frequent callers. A tariff differentiation can regard the number of the crew, the ship's tonnage, the types of garbage delivered, and the level of on-board segregation of these different waste types.

11.3.8 Garbage from passenger/cruise ships (MARPOL Annex V)

The garbage from passenger/cruise ships will predominantly consist of domestic waste and galley waste. The variety in the composition of the waste might be larger than that of cargo ships, and it will be delivered in large quantities. Passenger/cruise ships usually travel along a defined and scheduled route. Therefore, from the point of view of the passenger/cruise ships, a contract system with the port reception facilities along the route would be convenient and can be negotiated well beforehand. Many passenger/cruise ships nowadays have on-board incinerators to handle MARPOL Annex V wastes. Garbage delivery would in that case only be for the garbage generated while the ship stays in port and is unable to incinerate.

In table 9, the possible situations at the port are mentioned, with the consequences for the waste volumes and the cost recovery system which seems most appropriate in this case. For systems with a standardized charge like the costs of disposal included in port dues system, the fixed fee system and the combined system, a tariff differentiation regarding the number of people present on the ship, and the composition of the waste delivered (in case the garbage is segregated) can be considered. Garbage segregation on board is encouraged, but the reception facilities of the port should be taken into account. Most port reception facilities do not have segregated reception possibilities, but as more and more passenger/cruise ships take care of an improved on-board segregation of the garbage, reception facilities should anticipate.

11.3.9 MARPOL Annex VI waste from cargo and passenger/cruise ships

For MARPOL Annex VI waste, a distinction needs to be made between the delivery of ozone-depleting substances (ODS) and scrubber waste generated by the use of exhaust gas cleaning systems (EGCS). Both types of air emission related wastes can be generated on board cargo vessels as well as passenger/cruise ships.

As not all ships generate these types of wastes, it does not seem suitable to implement indirect fee systems: as most fee systems apply the "polluter pays" principle, it does not seem fair to require ships to pay for a type of waste they simply do not generate. Direct fee systems, where the ship directly pays the reception facility depending on the delivered amount of MARPOL Annex VI wastes, are therefore the most appropriate cost recovery solutions for these types of waste.

11.3.10 Other ship related wastes and residues

As wastes originating from the application of anti-fouling systems will be mainly generated at ship repair/conversion yards and/or ship recycling yards, a direct fee system will most likely be the most appropriate system.

Also for the delivery of ballast water and sediments from ballast water tanks indirect fee systems might not be suitable because:

- the amounts of ballast water can differ significantly between various types and sizes of ships;
- the distinction can be made between ships that do short sea trips and sail in regional waters only, in which case the risk of transferring exotic/invasive species is lower;
- some ships might have on board ballast water management systems, so they are not discharging ballast water containing invasive species.

Therefore, in this case, direct fee systems, where the ship directly pays the reception facility (ship repair/recycling yards) depending on the delivered amounts of waste, are also the most appropriate cost recovery solution.

11.3.11 Waste from small vessels

The term "small vessels" applies to ships such as small fishing boats, leisure yachts and small ferries. The waste from small vessels consists of oily wastes (MARPOL Annex I), hazardous chemicals (MARPOL Annex II), garbage (MARPOL Annex V, including fishing nets and other discarded fishing gear) and sewage (MARPOL Annex IV).

For small vessels a system with a standard charge (fixed fee system, combined system, or a costs of disposal included in port dues system) might be a good system to stimulate the delivery of waste and to cover the costs of treatment. Considering the limited volumes of the waste from these small vessels, a port authority may decide to provide the disposal and treatment of waste free of charge.

11.3.12 Overview table of cost recovery systems

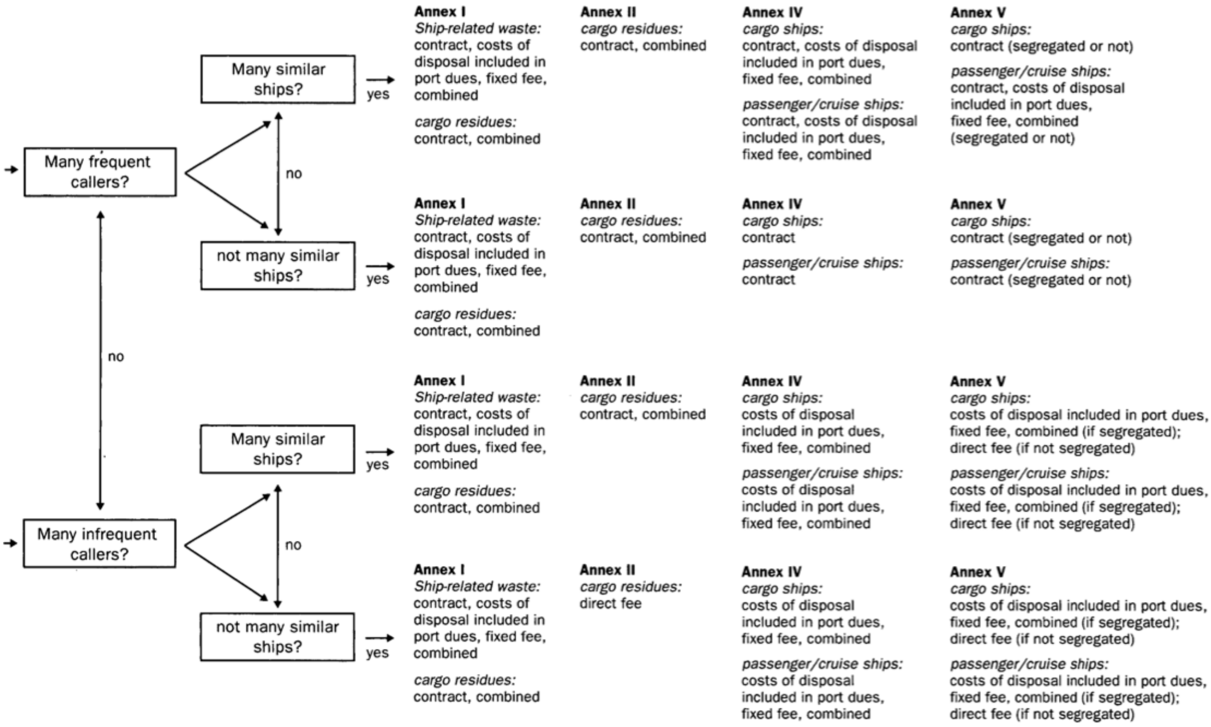
The table 10 in this section is meant to give an overview of the possible cost recovery systems that could be used by a port in certain situations (many frequent callers, many infrequent callers, many similar ships, and not many similar ships) for certain types of waste (MARPOL Annexes I, II, IV, V). As the fee systems for MARPOL Annex VI residues and the other ship generated waste streams are straightforward in almost all cases, they are not included in this table. As mentioned earlier, a port reception facility can use different cost recovery systems for different types of waste and different groups of ships at the same time. The table is intended to enable a port reception facility to choose the most appropriate combination of cost recovery systems for its particular situation (the type and calling frequency of the ships, type of waste).

A port reception facility can combine many different cost recovery systems at the same time. However, it should be recognized that a simple system might be a greater incentive for ships to deliver their waste. Furthermore, it must be emphasized that the word "many" in the table does not refer to a certain number of ships calling at a port. In the case of a small number of ships calling at a port – whether frequently or not – the regional approach as described in section 11.5 might be advisable. The choice for a cost recovery system can then be based on the kind of ships calling and the types of waste delivered at all ports in the region.

Table 9 - Cases for Annex V garbage from passenger/cruise ships and the possible cost recovery system

Case	**Wastes**	**Cost recovery system**
1. many frequent callers, many similar ships	predictable annual volumes, predictable lot sizes, variable composition	contract, costs of delivery included in port dues, fixed fee, combined (segregated or not)
2. many frequent callers, not many similar ships	predictable annual volumes, variable lot sizes, variable composition	contract (segregated or not)
3. many infrequent callers, many similar ships	less predictable annual volumes predictable lot sizes, variable composition	direct fee (if not segregated), costs of delivery included in port dues, fixed fee, combined (if segregated)
4. many infrequent callers, not many similar ships	less predictable annual volumes, variable lot sizes, variable composition	direct fee (if not segregated), costs of delivery included in port dues, fixed fee, combined (if segregated)

Table 10 – Overview of possible cost recovery systems for certain types of waste and certain situations



11.4 Funding the establishment of port reception facilities

In chapter 3, section 3.5, the responsibility for the establishment of a port reception facility is discussed. In many cases reception facilities might be provided by use of the existing infrastructure. However, depending on the situation and the facilities necessary, the establishment of a port reception facility can require a substantial investment, which must be financed by external sources when the available resources are insufficient.

Several resources can be recognized:

- private sector investors/contractors;
- commercial banks;
- government;
- regional/local authorities;
- multilateral donors (the World Bank, the United Nations, the European Union, the OESO, the EBRD, the European Investment Bank, the Asian Development Bank, the African Development Bank, etc.); and
- bilateral donors.

A port reception facility may be an initiative of the private sector or a governmental initiative (including ministries, etc.). In the case of a private sector initiative, funding may be secured though a private sector contractor/investor, commercial banks or the government. A private sector contractor can provide capital investment for facilities at ports as a part of his general investment programme. Such a contractor may finance a facility from loans or internally generated funds. In return, he may well seek exclusive rights or other security of tenure for his funding of the facility. Alternatively, he may want guarantees of a minimum level of income. These are consequences which need careful consideration when allowing such parties to shoulder the risk. The government securing funding will occur when it is willing to support the initiative, which otherwise may not get off the ground.

However, multilateral and bilateral donors generally do not lend directly to the private sector, but only to governments. Therefore, if funds from these donors are to be allocated to reception facilities, governmental involvement in the project is required.

Generally, two methods of financing can be distinguished:

- loans; and
- grant funding.

When an application for a loan is made, it will always be assessed by the lending organization against a number of criteria. Many of these criteria have to do with the feasibility of the project and this may require a detailed financial analysis which addresses amongst others things: sales revenues, operational costs, income statement, balance sheets, cash flow projections, net present value analysis and internal rate of return over a number of years. In general, it can be stated that the bigger the project, the more detailed the analysis to be carried out must be. Donors have their own requirements regarding the structure and the details of the financial information which must be submitted with the application for a loan. This must be discussed and checked before a formal application is made.

A potential donor may carry out its own financial analysis, but in any case it will assess the application against the applicable lending conditions. Again, these conditions may vary from one donor to the other. There are purely financial conditions such as applicable interest rates, grace period, repayment period, etc. However, other criteria may be applied as well. Especially when waste treatment processes are included, a project may be on such a scale that an environmental impact analysis must be carried out before a loan can be approved. It may also be necessary to include project components which are not directly related to the investment in equipment such as institutional capacity building, preparation of legislation, etc.

Another issue to be considered is that a port reception facility in itself can be a component of a larger port project, such as the construction of a new terminal. Since there is a clear connection between land-generated and ship-generated waste (in particular when treatment and final disposal are considered), a project on land-generated waste can incorporate a ship-generated waste component.

Grant funding may be obtained for relatively small projects, such as feasibility studies or (preliminary) designs, whereas loans are to be considered for bigger projects with (usually) a significant investment component (equipment, construction works).

11.4.1 Details on funding possibilities

More detailed information on institutions where one can apply for funding and the particular funding possibilities are listed below. Generally, four main groups of multilateral institutions can be distinguished:

- World Bank;
- regional development banks;
- institutions of the European Union; and
- institutions of the United Nations.

World Bank

The World Bank is the world's largest international financing institution, which aims at increasing the standard of living in developing countries. Over 170 countries are shareholders of this institution. The World Bank is located in Washington, D.C., United States of America.

The World Bank consists of four organizations:

- International Bank for Reconstruction and Development (IBRD);
- International Development Association (IDA);
- International Finance Corporation (IFC);

- Multilateral Investment Guarantee Agency (MIGA).

The IBRD and the IDA are the most commonly known divisions of the World Bank. They focus on the public sector. The IBRD supplies loans for governmental programmes and projects, with a maximum repayment period of 20 years. The interest can vary, depending on the average costs of the loan. The IDA supplies soft loans for the least-developed countries.

The IFC is oriented towards the promotion of private trade and industry in developing countries and is the only division of the World Bank to which the private sector can apply for funding. The MIGA insures political non-commercial risks for investments as mentioned above. Besides that, the MIGA offers promotional and advisory services to affiliated developing countries for their activities on raising and realization of national investments.

The protection of the environment is one of the World Bank's objectives. The World Bank offers grants for technical assistance and field survey. Loans are given for investment projects. For possible investments in port reception facilities the IBRD and the IDA are to be contacted.

Another resource for funding at the World Bank is the Port Railways Aviation and Logistics Thematic Group, which finances projects concerning the realization of the MARPOL agreement. The loans or grants are given to the government of the country in which the activity is undertaken.

Another fund which offers funding possibilities is the Global Environment Facility (GEF). The GEF is a fund that helps countries to translate global concerns into national action to help fight ozone depletion, global warming, loss of biodiversity and pollution of international waters by means of grant funding. The managing partners of the GEF are the World Bank, the United Nations Development Programme and the United Nations Environment Programme.

World Bank co-ordinates:

World Bank/IFC
1818 H Street, NW
Washington, DC 20433
USA
telephone: + 1 202 473 1000
telefax: + 1 202 477 6391
Internet site: http://www.worldbank.org/

Regional development banks

The following regional development banks can be distinguished:

- African Development Bank (AFDC);
- Asian Development Bank (ADB);
- Inter-American Development Bank (IADB); and
- European Bank for Reconstruction and Development (EBRD).

These banks are organized in a way comparable to the World Bank. The difference is that the regional banks focus on a specific region. Most regional banks provide financial means to specific projects, but the banks also provide programmes and multi-project loans. Specific programmes on financing port reception facilities are not available. The regional development bank in question has to be contacted to investigate the funding possibilities.

African Development Bank (AFDC) co-ordinates

African Development Bank
01 P.O.B. 1387

7è étage, Immeuble CRRAE UMOA plateau
Abidjan 01
Côte d'Ivoire
telephone: + 225 20 20 48 22
telefax: + 225 20 21 31 00

Internet site: www.afdb.org

Asian Development Bank (ADB) co-ordinates

Asian Development Bank
6 ADB Avenue, Mandaluyong City 1550
Philippines
telephone: + 63 2 632 4444
telefax: +63 2 636 2444

Internet site: http://www.asiandevbank.org/

Inter-American Development Bank (IADB) co-ordinates

Inter-American Development Bank
1300 New York Avenue, NW
Washington, DC 20577
USA
telephone: + 1 202 623 1000
telefax: + 1 202 623 3096

Internet site: http://www.iadp.org/

European Bank for Reconstruction and Development (EBRD) co-ordinates

European Bank for Reconstruction and Development
1 Exchange Square
London EC1A ZEH
United Kingdom
telephone: + 44 20 73 38 63 61
telefax: +44 20 73 38 61 55

Internet site: http://www.ebrd.com/

European Union (EU)

The EU finances through various programmes several projects in Africa, Asia, Latin America, Central and Eastern Europe and the CIS (Commonwealth of Independent States) countries. Besides that, the EU also finances projects in its own community. Protection of the environment and sustainable development are important objectives of the EU programmes.

The duration of the programmes in which the EU finances a country is five years. Most of the programmes are grants given for technical assistance. Only the European Development Fund (EDF), which is the main instrument for providing Community development aid in the African, Caribbean and Pacific (ACP) countries and the overseas countries and territories

(OCTs), provides grants for investments. Loans for investments are given by the European Investment Bank (EIB). The EIB supports up to 50% of the investment costs.

European Development Fund (EDF)

Directorate-General VIII
Building G-12, Rue de Genève 12
Wetstraat 200
1049 Brussels
Belgium

Internet site: http://ec.europa.eu/europeaid/how/finance/edf_en.htm

European Investment Bank (EIB)

98-100 Boulevard Konrad Adenauer
2950 Luxembourg
telephone: + 352 43791
telefax: + 352 437704

Internet site: http://www.eib.org/

United Nations

The United Nations (UN) consists of a large number of institutions. The headquarters of the UN are situated in New York, USA. The central and also largest UN organization for development co-operation is the United Nations Development Programme (UNDP). Through a network of field offices and resident representatives in over 134 developing countries, the UNDP offers financial and technical support for projects in the field of agriculture, industry, trade, education, energy, transport, communication, healthcare and housing. As already mentioned, the UNDP is, together with the World Bank and the UN Environment Programme (UNEP), one of the managing partners of the Global Environmental Facility (GEF). A description of the aims of the GEF is mentioned above. The GEF offers funding possibilities for projects like the establishment of port reception facilities.

For further information on the UNDP and addresses of the country offices, refer to the website of the UNDP: http://www.undp.org/.

11.5 Financing schemes on a regional basis

In a region of various ports of different size or for ports in very remote areas, co-operation between these ports concerning port reception facilities is an option to reduce the effort and costs (inter-port strategy). In chapter 3 (section 3.6), the options for co-operation between ports for the various types of waste are described.

Financing of co-operating port reception facilities can be structured in several ways:

- centralized: one port reception facility manages all finances, or one co-ordinating organization manages the cost recovery systems for different port reception facilities; or
- decentralized: each port reception facility manages its own cost recovery.

To reduce the complexity of the co-operation, the cost recovery systems applied to the various types of waste should be the same in all ports within the co-operative venture. In the case where the financial management is centralized, the fees in all ports should be similar.

11.6 Managing the financing system

For a sound management of the financing system it is important to know the costs of operation of a port reception facility and which parameters influence these costs. Therefore, generally the following parameters have to be monitored:

- the types of waste delivered;
- the amount of waste delivered;
- properties of the waste relevant for treatment;
- chemical composition of the waste (by means of chemical analysis);
- certain data of the ship;
- the costs of reception, treatment, and final disposal of the waste;
- revenues from recycling or reusing certain types of waste; and
- the charge/fees paid by the shipowner for the reception of the waste.

The "cradle-to-grave" or "cradle-to-cradle" system of notification described in section 4.5, is an appropriate monitoring system, which follows the waste from the moment of reception until disposal or re-use.

For a well-functioning monitoring system, the following parties will have to have an up-to-date and accurate inventory of the waste delivered:

- the shipowner or operator;
- the port reception facility;
- the port authority or another competent organization, which collects the charges for the delivered waste;
- the organization or company which carries out the analysis of the delivered waste;
- the treatment facilities and landfills;
- the companies that take care of the transportation of the waste after disposal by the ship.

The cost recovery system determines:

- the data which have to be gathered; and
- the time period in which the data have to be gathered.

For instance, for the good financial management of a cost recovery system certain characteristics of the waste like the quantity and the composition, the costs of reception, treatment and final disposal, and revenues from recycling or reusing have to be determined for each load of waste delivered. For indirect systems (costs of reception included in port dues/charges or fixed fee system) the need to gather these data immediately is less great than for direct cost recovery systems (direct fee and combined system), but the data are essential if the system is to be managed effectively. The costs determine the level of the fees or charges. Also other data like the fuel consumption of the ship, the type of fuel the ship uses, the boiler horsepower (BHP), the volume of the ship and the crew and/or passenger number have to be known, for instance to be able to apply a correct tariff differentiation. These data can be requested when the ship calls at the port.

The data needed to determine a reasonable fee are also partly determined by the possible treatment facilities and the possible sale of recovered materials such as oil for re-refining or recyclables for sale (plastic and aluminium). For instance, if there is a waste incinerator to recover energy, the caloric value of the waste is an important parameter to know.

11.7 Incentives to encourage good practice

Good practice refers on the one hand to good practice on board the ship (waste minimization and waste separation) and proper delivery of waste by ships. On the other hand good practice refers also to proper reception and treatment of waste by the port reception facility.

This can be stimulated by:

- education of ship's officers, administration personnel of the port authority and personnel of the port reception facility (see section 3.4.2);
- requiring permits for port reception facilities to receive waste of ships (see section 4.4);
- rewards of port reception facilities for the delivery of specific types of waste and/or proper delivery;
- competition between port reception facilities, leading to competitive prices and high service levels;
- a quality management system linked to a reward system;
- establishment of a risk fund for port reception facilities, for cases in which the port reception facility cannot cover the costs for reception or treatment of the waste.

The first two incentives are already described in other sections of this manual and will not be discussed here. Port reception facilities can take measures to stimulate the delivery of specific types of waste, for instance waste that is possibly recyclable (e.g. MARPOL Annex I waste). They may give a discount on the fee when such waste is delivered or for the delivery of separated MARPOL Annex V into tin, plastics, glass, chemical waste like batteries, etc.

A quality management system can be applied to both the waste deliverer and the waste receiver. In the case of shipowners who utilize waste management systems on board (e.g. ISO standard 21070 on the management of shipboard garbage) or submit themselves to proper and/or regular delivery of (ship-generated) waste, they can apply for discounts on port dues, charges for pilots and/or towing services. For port reception facilities the quality management system can involve a bonus from a special quality guarantee fund in case the facility demonstrates excellence in the reception, recycling and treatment of the wastes, leading towards a circular economy with increased reuse of waste as a raw material. Awarding a quality guarantee mark to port reception facilities is another possibility for encouraging good practice and a way to recognize the efforts made.

The introduction of a security deposit may also be an incentive for good practice. It ensures there are sufficient funds to complete disposal of waste at the site if the operation fails financially. Of course measures (e.g. permits) must be taken to ensure that such a fund does not result in an inefficient operation of the port reception facility.

CHAPTER 12 - Co-ordination of port and ship-requirements

12.1 Introduction

Good co-ordination of port and ship requirements will be important in avoiding undue delay (see chapter 2). In this chapter measures are discussed which are helpful in co-ordination between ship and port, to enable both a fast and a safe waste disposal procedure.

12.2 Prior notification

In order to plan efficient waste disposal in ports, it is important that an advance notification is received as to which wastes a particular ship will want to discharge in the port. The IMO standard format for advance waste notification to port reception facilities can be used as a model for the notification form (MEPC.1/Circ.834, appendix 2).

For an individual ship, either the ship's agent or the port authorities will have to make arrangements for the delivery of wastes. At the same time the ship should draw attention to the disposal of wastes. As all ships generate oily waste and garbage, it should become a standard procedure for the agent or port authorities to ask what the ships wishes to discharge. If this is not done it may have a negative impact on the delivery procedure (delays and possible high costs).

On the other hand, if prior notification is correctly carried out by the ship, the port should guarantee the possibility to deliver waste in a certain period (e.g. within 24 hours after notification). Port authorities should provide both ships and agents with sufficient information on the waste delivery procedures in a port (e.g. pumping requirements, safety issues, specific requirements regarding segregation of garbage, piping connection standards for sewage, etc.).

It is essential that the means of delivery from ship to shore is co-ordinated. For example, ro-ro ferries require vehicles to drive into the vessel's car deck to collect wastes. Garbage and slops from oil/water separators are often discharged into a suction truck entering the vessel. For ships less than 400 gross tonnage, on-board pumping to shore from machinery spaces is not a MARPOL Annex I requirement. In this case a suction truck with a pumping facility would be necessary. For ships, which do not have on-board cranes or derricks for lifting skips or dumpsters, a telescopic chute could be provided, so that garbage could be directed to the shore, without the risk of spillage into the sea.

When ports take the initiative to organize the collection services, this may give them a greater bargaining power with waste disposal contractors than individual agents because they would be able to agree on a contract for a much larger number of ships. It should be made clear to the agent that encouraging a ship to deliver its wastes in port does not conflict with his loyalties towards the owner of the ship, but is indeed a matter of good service.

To monitor the delivery of ship-generated wastes and cargo residues to reception facilities, the IMO standard format for the waste delivery receipt following a ship's use of port reception facilities (MEPC.1/Circ.834, appendix 3) can be applied.

12.3 Combining delivery of waste with other activities

Whenever possible, waste should be delivered while the ship does other gainful activities such as loading or unloading, as this will save considerable time. Another possibility is to combine port reception and treatment facilities with tank cleaning facilities (see also chapter 8). However, in all situations care should be taken that the combination of waste discharging and other activities does not lead to unsafe situations. See section 12.5.

12.4 Reporting alleged inadequacies

The management of the port reception facilities, as well as the port authority itself, should keep records of all the inadequacies occurring during operation of the facilities. Evaluation should not only include the occurrence of waste spills during discharge or other calamities, but also the adequacy of the waste reception procedure and operation has to be evaluated. This can be done by interviewing the regular users of the facility, who will be in contact with the facility.

Ships can also report alleged inadequacy of port reception facilities, by using the IMO standard format (MEPC.1/Circ.834, appendix 1). The master of a ship having encountered difficulties in discharging waste to reception facilities should forward the information in the format, together with any supporting documentation, to the Administration of the flag State and, if possible, to the competent Authorities in the port State. The flag State shall notify IMO and the port State of the occurrence. The port State should consider the report and respond appropriately informing IMO and the reporting flag State of the outcome of its investigation.

In some ports alleged inadequacies can also be reported directly to the port authority, and/or to local environmental authorities.

12.5 Safety regulations during discharge of wastes

Delivering waste to port reception facilities must not lead to unsafe situations. Oily and chemical wastes bring about special safety requirements due to their possible hazardous nature. The cleaning of ships' tanks is one of the most dangerous procedures in tanker handling, but can only be carried out in a safe way if certain safety regulations are observed on board the ships, and that safe berths can be provided for this purpose.

Occupational safety should be regarded as equally important as the safety against fire and explosion. Some ship-generated wastes constitute a health risk. People handling such waste should therefore be adequately trained and should have the right equipment to carry out the operations in a safe way. They should also be equipped with the right protective clothing and, whenever necessary, self-contained breathing apparatuses.

Safety regulations for the discharge of waste should be based on national legislation, international conventions and recommendations, accepted industry standards and guidelines and safe practices.

The International Maritime Organization has published, amongst others, the following safety guidelines and recommendations which are applicable when discharging and handling hazardous waste:

- Revised Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas;

- International Maritime Dangerous Goods Code;
- Crude Oil Washing Systems.

For further information reference is made to IMO. The following widely recognized industry safety guides are related to the subject:

- International Safety Guide for Oil Tankers and Terminals (ISGOTT), published by the International Chamber of Shipping, the Oil Companies International Marine Forum and the International Association of Ports and Harbours;
- Tanker Safety Guide (Chemicals), published by the International Chamber of Shipping;
- Safety Guide for Terminals Handling Ships Carrying Liquefied Gases in Bulk, published by the Oil Companies International Marine Forum;
- Ship to Ship Transfer Guide, published by the Oil Companies International Marine Forum;
- Guidelines on Port Safety and Environmental Control, published by the International Association of Ports and Harbours.

CHAPTER 13 - Options for enforcement and control

13.1 General

As mentioned in chapter 4, national legislation will have to be developed to regulate the processing of ship wastes which have been discharged and MARPOL requirements have to be incorporated into national legislation. Whereas MARPOL only requires the reception of ships' wastes (and subsequently the enforcement and control of discharge to these facilities), it is the responsibility of the government to regulate the treatment of these wastes. This is usually done by national legislation (see also chapter 4) and therefore enforcement and control of these regulations should be part of the national, regional or local legal framework.

The enforcement and control of the use of port reception facilities will be successful only if the States which have ratified MARPOL make a joint effort to do so. This should affect both ports and ships, as the availability of adequate reception facilities in ports will give a captain less reason to – illegally – dispose of his waste at sea.

Ships have a number of reasons for not complying with the regulations. The most important ones are:

- lack of adequate port reception facilities;
- bad planning: the use of the advance notification form (MEPC.1/Circ.834, appendix 2) can smoothen operations that need to be planned when the ship is in port (such as the waste delivery to a PRF);
- undue delay at port reception facilities;
- unreasonably high prices charged by some of these facilities;
- substandard services delivered by port reception facilities;
- malfunction of alarm systems or oil/water separators on board;
- rotting and smell problems caused by the long time on board storage of garbage;
- lack of information;
- lack of environmental awareness and responsibility by the ship's crew.

As national, regional or local legislation on port reception facilities will apply to both reception and treatment, enforcement and control actions can be categorized as follows:

- ships' compliance with the regulations on discharge and disposal; and
- reception facilities' and treatment facilities' compliance with applicable environmental regulations.

In the next sections both categories will be discussed in more detail.

13.2 Ships' compliance with the regulations on discharge and disposal

Ships from States which have ratified the MARPOL convention are required through their national legislation to comply with the MARPOL regulations. On the other hand, the MARPOL Convention does not make it obligatory for ships to deliver their waste to a specific port reception facility, with the exception of cargo hold prewashes (see also chapter 7.2.). Which port is used for waste disposal is always up to the captain or the shipowner or operator. Therefore, it is possible that a ship leaves the port with slop tanks which are too full to reach the next port without discharge en route, while the port authorities have no means to prevent this.

Some indirect measures are possible for preventing this, by addressing the personal responsibility of the captain. Ships leaving a port with slop tanks which are too full in relation to the trip to be undertaken, should be requested to empty the deposits at the port reception facility before leaving. The competent inspection authorities, such as port State control officers, can refer to the MARPOL Convention, which states that "*the Party carrying out the inspection shall take such steps as to ensure that the ship shall not sail until it can proceed to sea without presenting an unreasonable treat of harm to the marine environment".*

If the captain is not willing to cooperate the ship can either be detained and forced to deliver, or the destination port can be informed, depending on the judgement of the inspection authorities. For instance, port State control officers can, before departure of the ship, check whether or not there are adequate port reception facilities available at the intended port of delivery, e.g. using IMO's GISIS database (see also chapter 2.3.3) or by asking the next port of call. Again the mandatory use of the advance notification form is beneficiary for the authorities involved, as the master of a ship is then obliged to report the amount of waste retained on board, the available storage capacity and, when the ship does not discharge at the first port, the name of the intended port of delivery. Based on the information available, port State control officers can evaluate whether or not there is a risk that the waste will be discharged at sea. Port authorities might also put pressure on such a ship by indirect measures before it leaves the port, for instance by a stricter general control. If the ship is allowed to leave the port without delivery to a port reception facility, a second inspection can take place upon arrival at the destination port. The juridical action that can be taken depends on the local possibility for reverse burden of proof. This means that if the ship cannot prove to have disposed of its wastes at a reception facility, it will be taken guilty of non-compliance with the MARPOL treaty.

Figure 33 provides an overview of a possible inspection scheme at a MARPOL port State.

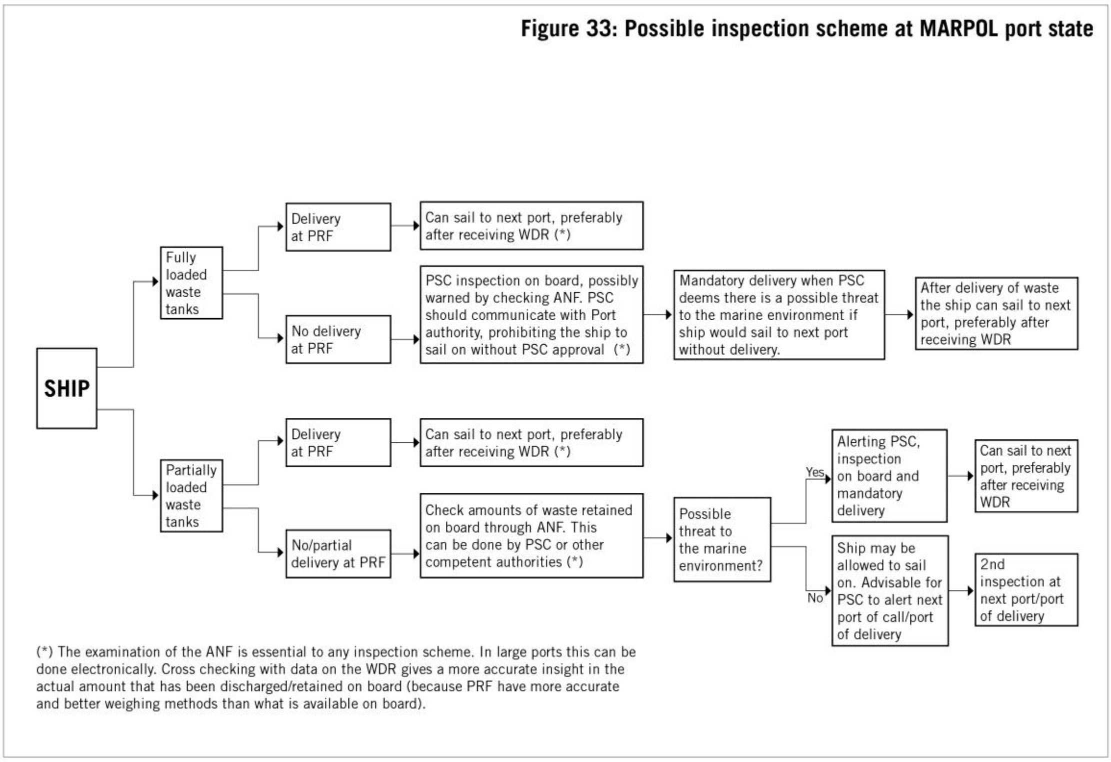


Figure 33 - Possible inspection scheme at a MARPOL port State

13.3 Reception facilities' compliance with local regulations

13.3.1 General information

It is important to note that the MARPOL convention does not state any requirements for the treatment and/or disposal of the wastes received in a port, but only for the delivery (and thus the actual reception of the waste). The further down-stream management of the wastes is the responsibility of the port State. The construction and operation of a treatment facility for ships' wastes therefore has to comply with national or regional legislation and local regulations. Especially important in this respect are the local standards for effluent concentrations, and waste management standards for solid wastes (e.g. preventing plastic waste to find its way into the sea).

It is important that national environmental acts should not allow the disposed waste to be discharged untreated into the sea again. Legal standards should at least be as strict as the discharge standards which MARPOL requires for ships. The same applies for other further treatment and/or disposal methods on shore such as landfill or incineration.

The national legislation developed for the implementation of MARPOL may not be appropriate for the control of discharges from land-based sources of marine pollution such as port reception and treatment/disposal facilities. Chapter 4 provides direction on legislative and regulatory development for both MARPOL ratification and port reception facility operation. However, legislation alone will not ensure that pollution is reduced or prevented: enforcement of the legislation is equally essential to compliance.

13.3.2 Compliance and Enforcement

The level of effort put towards achieving compliance with regulations for reception and treatment/disposal facilities should be equivalent to the number of facilities operating and the volume of waste received and processed by the facilities involved.

The use of a manifest system for tracking of wastes received, transported and treated if utilized, should provide the necessary information on which to base a compliance and enforcement program. In addition, licences issued to reception, transportation, storage and treatment companies should include conditions for reporting, on a regular basis, the type and volume of wastes received. This type of information is necessary for determining the effort expended on enforcement. A single small reception facility receiving only MARPOL Annex V wastes will not require the same enforcement effort as a number of reception facilities operating in several ports and receiving all types of wastes and transporting the wastes to several treatment plants.

The legislation should include the power for the inspector to enter and inspect all aspects of the facility without prior notice. The regulatory agency should prepare annual inspection schedules which identify the frequency of inspection but not necessary the dates for inspection during the forthcoming year.

Probably the most important aspect of any compliance and enforcement program is a clear policy statement on how the legislation will be enforced. Many countries have such policies and they are available on request. The policy should describe how to handle minor offences. If all offences are taken to the judicial system, it will require a significant effort and time will be wasted. The primary purpose of enforcement is to achieve compliance and this objective may be best achieved when the judicial system is reserved for major violations or repeated offences.

Consideration should be given to a system of warnings prior to taking court action for offences of a minor nature. The environmental consequences of the offence should dictate the action taken. For example, delay of a day or two in reporting according to the conditions of a permit may be a minor offence and the regulatory authority could issue a verbal or written warning to the offender. However, discharge of untreated effluent from a treatment plant may result in significant environmental harm and a decision to take immediate judicial action immediately would be justified.

Ticketing/fine provisions, similar to parking tickets/fines, could also be considered in the legislation and thus the inspector could issue a ticket/fine for minor violations.

Each country should select an approach to enforcement and compliance that meets the country's need and resources and is consistent with national legislation. The approaches suggested here include warnings and a system of fines that should be large enough to discourage illegal activities.

13.3.3 Existing international networks on enforcement and compliance

In some regions of the world networks exist that deal with the implementation and enforcement of environmental law, such as the network for Implementation and Enforcement of Environmental Law (IMPEL) in the European Union. This network provides Member States with relevant information and guidance documents regarding environmental inspection and enforcement issues. Other existing networks are:

- the East African Network for Environmental Compliance & Enforcement – EANECE. This network, for instance, released a manual which provides technical and procedural guidance for environmental inspections and investigations within East Africa;

- the International Network for Environmental Compliance and Enforcement (INECE). They specifically aim at:
  - developing networks for enforcement and compliance cooperation, including on seaport security, environmental prosecutors, compliance training professionals, etc.;
  - strengthening capacity throughout the regulatory cycle to implement and secure compliance with environmental requirements, including training programs on principles of environmental compliance and enforcement, environmental inspections, performance measurement indicators, etc.;
  - raising awareness of the importance of environmental compliance and enforcement, including through conferences, publications, and the website and resource centre.

More information on these and other networks can also be found through the website of the Basel Convention (www.basel.int) or through the website of the INECE (www.inece.org).

CHAPTER 14 - Specific situations

14.1 Introduction

MARPOL applies to all ships unless expressly provided otherwise. Ocean-going commercial shipping is now highly specialized and as a result has docking facilities to match. Some situations, however, require special handling and/or monitoring methods, due to the size of ships that enter the port, or the regional geographical characteristics of the area. The following subchapter will therefore elaborate on possible solutions for small ships, often excluded from using facilities and/or landing places in big commercial ports. In the subsequent sub-chapter, possible regional arrangements for Small Islands Developing States (SIDS) will be highlighted.

14.2 Small ships

14.2.1 What is a small ship and its landing place?

Throughout the world small ships cover a vast range of sizes, type and activity. Nautical tourism is a popular activity and therefore leisure yachts represent a significant type of small ship. Fishing boats also represent a major form of small vessels. Regions comprising a collection of islands are usually connected by a network of small ferry boats transporting both general cargo and passengers, together with live animals. Such vessels range from highly sophisticated hydrofoils to sailing dhows. Landing places for small ships are equally diverse. Small boat harbours are likely to be the most significant shoreside landing facility used by small ships. However, small vessels using major ports will also require facilities consistent with their size and special needs. A small boat harbour may be specific to one type of vessel, a leisure yacht marina for example, or a fish dock with adjacent market. Other types may be small community harbours or a jetty which is used by a range of small ships. Some places used by small ships are simply the local beach or bank-side adjacent to swinging moorings, etc.

14.2.2 What will be small ships' wastes?

The MARPOL regulations, Annexes I, II, IV, V and VI cover wastes from oil, hazardous chemical residues, sewage, garbage and air pollution prevention.

Oily wastes from small ships are likely to arise from machinery spaces and dirty engine sump oil.

Hazardous chemicals may consist of certain spillages from cargoes but, in general, these are dealt with by the vessel itself. However, where toxic residues are brought ashore for disposal they should be handled by specialist agencies as needs demand. Therefore, the most likely toxic materials for which reception facilities are required ashore for small ships will consist of items such as unwanted lead, zinc/carbon and cadmium batteries, discarded antifouling paint cans, discarded receptacles for degreasing agents and other solvents.

By far the largest volumes of waste to arrive ashore from small ships will be garbage, mainly of a domestic type. Plastic, paper and cardboard wrapping materials, steel, tin and aluminium food and drink cans, glass and plastic bottles, etc. will all need to be accepted by a small ships' waste reception facility. In addition, items may arrive for which the local community has no experience.

Furthermore, where raw sewage discharges into the seas from land are prohibited, sewage collection facilities from small ships will need to be available. In addition, seafarers should be provided with lavatories ashore when they are precluded from using the facility on board their ship.

Other less obvious wastes may arise from small ships, particularly in the transportation of live animals. Urine, faeces and the carcasses of animals which have died on the voyage will need to be discharged ashore but will require specialist advice, especially from the local veterinary and quarantine service. Also information should be available where outdated marine distress flares/pyrotechnics can be deposited ashore for later safe disposal.

Although small ships might not frequently generate MARPOL Annex VI wastes, in some countries and ports these kinds of vessels also need to comply with the requirements regarding the delivery of ozone-depleting substances (ODS).

14.2.3 What are sufficient small ships' waste reception facilities?

Adequate waste reception facilities for small ships can also be described with the definition given in chapter 2 of this Manual. In assessing the prerequisites for planning purposes there is little difference to that required for the local domestic situation ashore. However, volumes and types of waste will arise for which no parallel may exist ashore and in these circumstances planning and execution of methods and systems will need to be related specifically to a marine context. This is particularly so in the case of nautical tourism and local ferries engaged in the holiday trade where there will be a surge in demand during the tourist season. Although in such circumstances it is relatively straightforward to increase the availability of port reception facilities, by placing more receptacles, ultimate disposal may be a different matter.

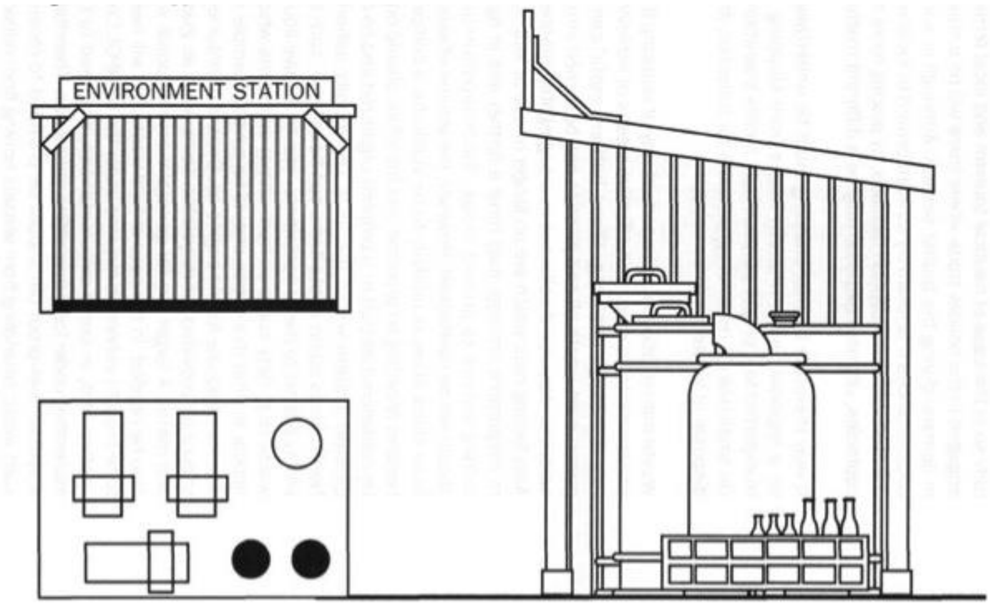


Figure 34 – Typical environment station

It may therefore be the case that planning must be undertaken on a regional basis, whereby waste from shipping is re-exported to a proper purpose-built facility elsewhere. However, when waste is collected ashore and exported afterwards, possible international requirements, such as those of the Basel Convention, have to be taken into account. For small islands specific regional agreements for collection and disposal of waste are possible and will be discussed in the subsequent sub-chapter.

Waste recycling is an important way of reducing the environmental burden of disposal, which requires controlled disposal sites and/or highly specialized incineration plants. Glass bottles, metal cans, paper, even waste oil and plastics can be turned into a saleable resource if collected in a segregated manner. Also, fishing nets, which are no longer of use at sea due to irreparable damage, may have a further use in agriculture ashore to protect crops, or the nylon material can be recycled and find a new use in the production of clothing. Such opportunities should not be overlooked. However, the volume of waste from ships alone is unlikely to be viable for a comprehensive recycling programme and therefore should only be considered as part of a properly organized and co-ordinated system within the local community ashore. Nonetheless some waste items can be re-used, such as empty plastic or metal containers, etc. to receive liquid waste (e.g. dirty sump oil from ships) and items which appear to offer this option should be saved. A simple oil drum is adequate for old engine oil. Separate containers should be provided for recyclable items such as glass and metal. A larger bin for general waste disposal will also be needed. In the case of food waste this will need to be brought ashore as required under MARPOL and, in some circumstances, will need to be incinerated under local quarantine regulations. Therefore, a special leak-proof bin should be provided to receive such waste emanating from vessels arriving from outside territorial waters. It is similarly advisable to provide a special receptacle for unwanted containers of toxic materials so they can be specially disposed of properly.

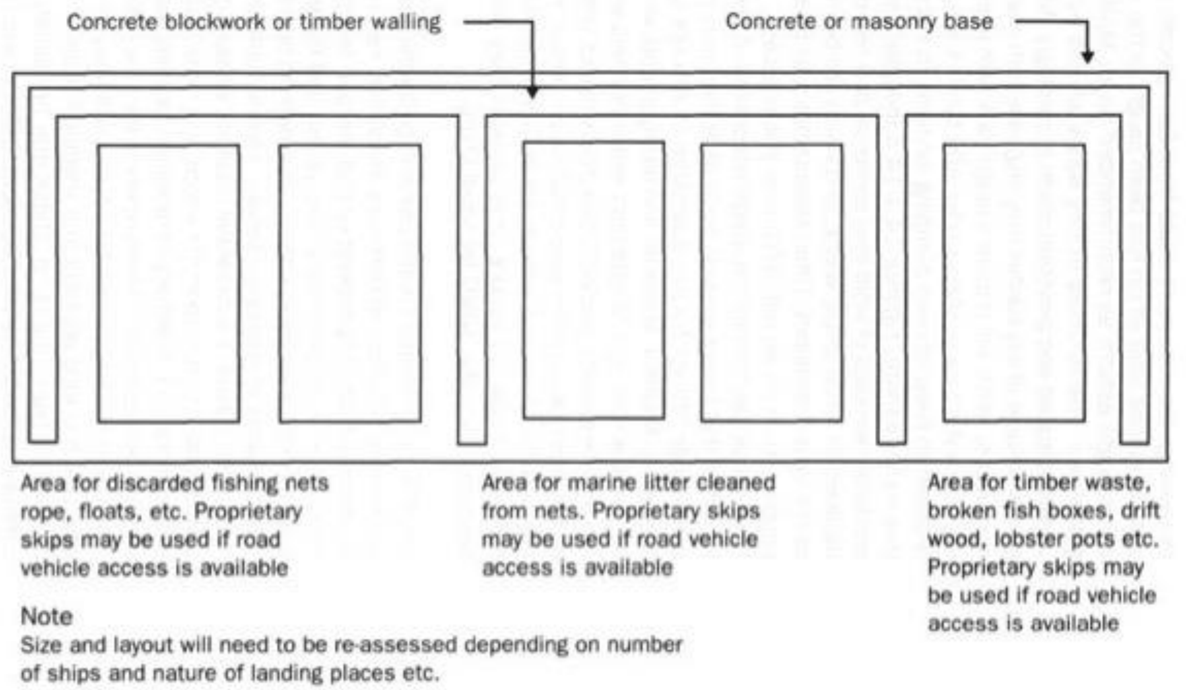


Figure 35 – Additional requirements for fish dock area of a small ship harbour

The volume of waste from fishing boats increasingly consists of marine litter which has been caught in the nets and brought ashore as recommended under the MARPOL guidelines. The volumes of this waste should not be underestimated and provisions should be made accordingly. Also, a greater volume of oily wastes may originate from machinery spaces, which will require a larger tank with a pumping out system as vessels under 400 gross tonnage are not required to have inboard pumping systems to transfer this waste ashore. Figures 34 – 36 indicate typical practical examples of what may comprise port reception facilities for small ships' waste, and which can the local community can provide. Other receptacles may be even simpler, such as a mobile tank truck, provided it can contain the waste adequately. It should be noted that larger vessels such as ferries may have pipe flange fittings for the discharge of sewage standardized to MARPOL Annex IV, and arrangements should be made accordingly. Waste bins and containers, which can also be co-ordinated with collection vehicles, provide an excellent facility to receive small ships' waste.

A further consideration is the use and positioning of an environment station. In harbours which may be somewhat spread out, it is imperative that any port reception facility is reasonably close to the vessel and therefore a number of environment stations may need to be established, placed at strategic intervals, clearly marked and lit at night. Where a substantial distance exists for the crew of a ship to transport the waste, it is more likely to end up in the sea. Adequacy of reception facilities ashore can also be described in terms of where they are needed. Traditional landing places for small ships may be the local beach or land adjacent to a sheltered creek or inlet or a simple launching ramp. These may not satisfy the criteria of a formal harbour but nonetheless have been adopted by local cultural tradition as a landing facility for small ships, and should therefore be provided with suitable waste collection systems. In the case of coastal maritime communities, where the local harbour is its focus, facilities for small ships can be combined with those required for normal domestic requirements ashore.

14.2.4 Who will provide and pay for reception facilities?

Where the MARPOL regulations have been transposed into national legislation, particularly with regard to MARPOL Annex V (garbage), the onus to provide the port reception facility is borne by the operator of the landing place. For privately owned and operated small boat harbours, the owner is usually responsible. However, at less formal places this may not be as clear and the local community should be prepared to accept responsibility for receiving small ships' waste, particularly in case of shoreside facilities which are integral to the community infrastructure. In some cases local fisherman and other seafarers have organized and managed their own requirements. However, the liability for ultimate disposal in most cases remains with the local community ashore. Nevertheless it is impractical to provide waste reception facilities at every landing place visited by small ships. Isolated places and remote communities where small ships land frequently cannot be expected to receive ships' waste, as the disposal burden ashore is too onerous. Here the waste should be retained on board the vessel until a suitable facility is encountered.

At informal landing places which are in continual use by seafarers but which are not necessarily associated with moorings or berthing, a minimum level of waste reception facility could be provided in the form of a garbage and food waste receptacle, which is emptied by the municipal waste services. For small boat harbours, jetties and landing places associated with moorings and berthing facilities, the full range of small ships' waste disposal options should be available. This may also include sewage pump-out systems, depending on national legislation. It is vital that the locations of port reception facilities are effectively disseminated to seafarers.

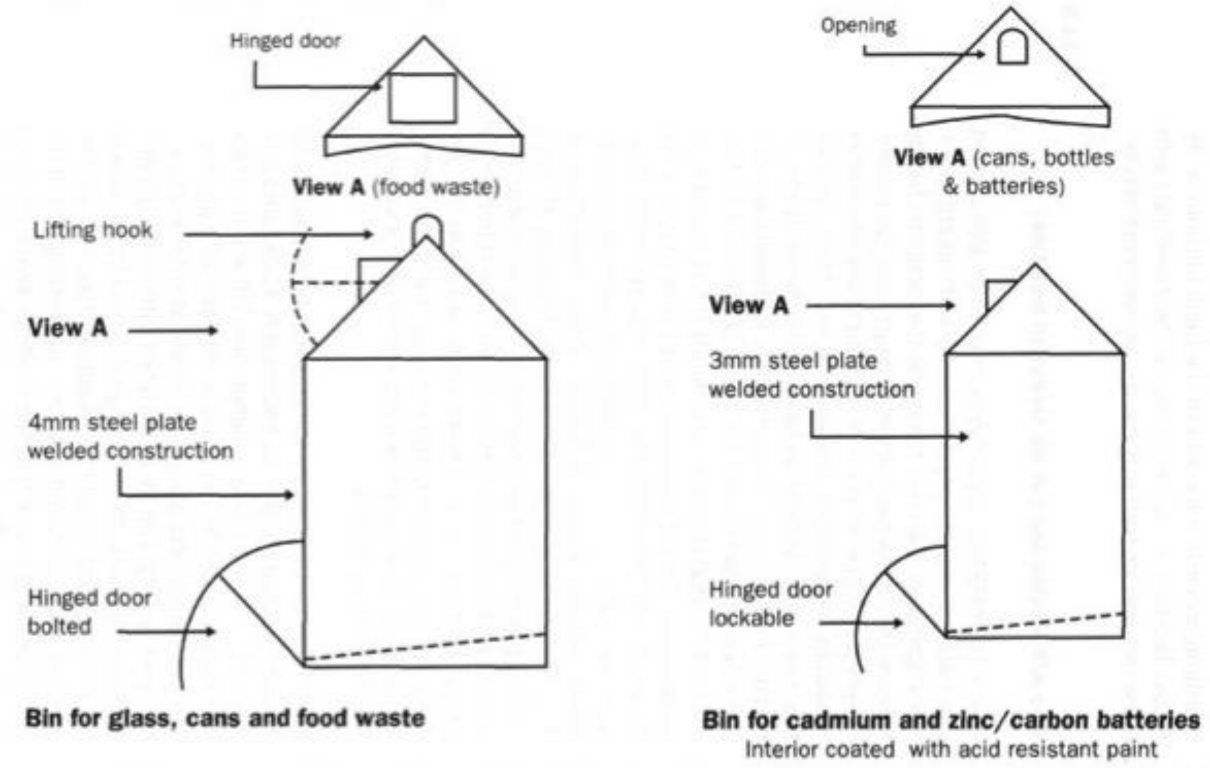


Figure 36 – Typical collecting bins

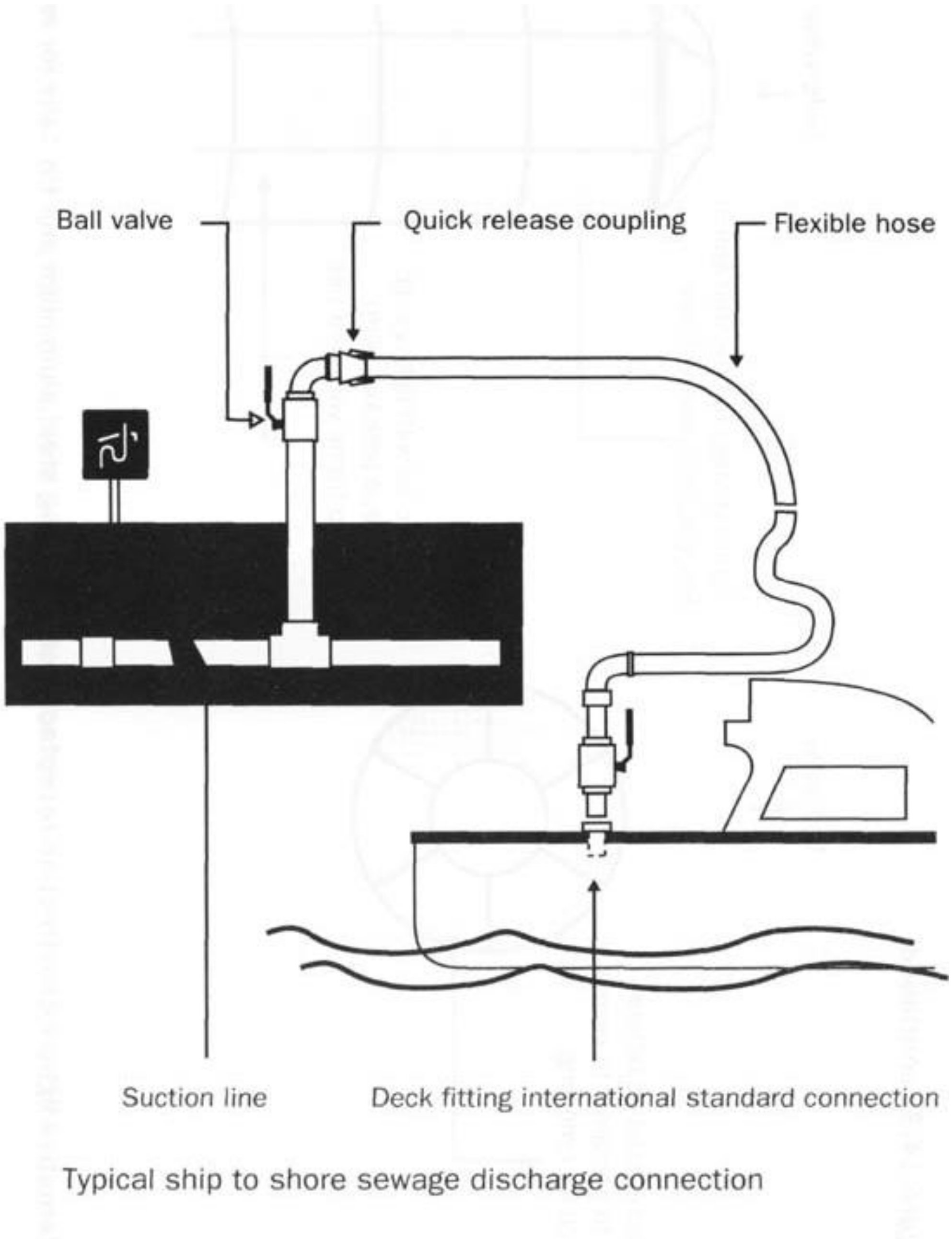


Figure 37 – Typical connections ship to shore for sewage discharges from small ships

This should be done by denoting their position on nautical charts, pilot books and sailing instructions, and on the port's websites. The adoption of information sources not commonly used by seafarers is unlikely to be effective.

When assessing how small ships' reception facilities should be financed, great caution should be exercised as to how this is done. Fishermen, who collect large amounts of garbage in their nets, which is none of their making, cannot be expected to pay for depositing this ashore. A yearly waste fee may be included in the general port dues. In return, small ships can be allowed to deliver all waste, both ship-generated waste and litter caught in their nets, to a well-equipped port reception facility. Another option can be to include the cost of receiving and disposing of the waste from small ships in the overall budget for public cleansing ashore.

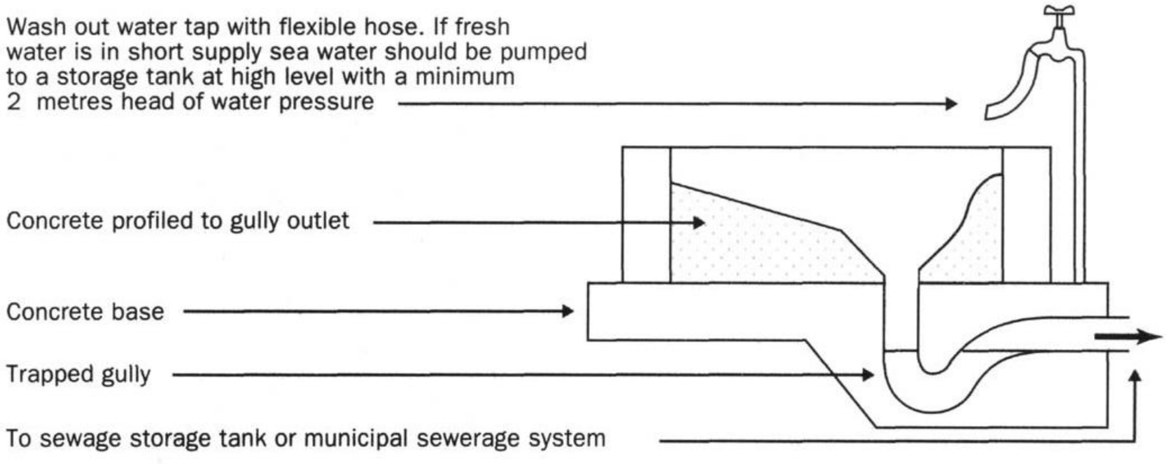


Figure 38 - Chemical lavatory emptying and washing out facility

14.3 Regional arrangements for Small Island Developing States (SIDS)

14.3.1 Legal background

Amendments to MARPOL have been made in such a way that Small Island Developing States (SIDS) may satisfy the requirements under MARPOL to provide adequate port reception facilities in their ports and terminals through regional arrangements.[20] However, only when, because of those States' unique circumstances, such arrangements are the only practical means to satisfy these requirements. Parties participating in a regional arrangement have to develop a Regional Reception Facilities Plan, taking into account the guidelines developed by the International Maritime Organization.

Moreover, the Government of each Party participating in the arrangement shall consult with the Organization, for circulation to the Parties of MARPOL:

.1 how the Regional Reception Facilities Plan (RRFP) takes into account the Guidelines;

.2 particulars of the identified Regional Ships Waste Reception Centres; and

.3 particulars of those ports with only limited facilities.

Extensive guidance can be found in the *2012 Guidelines for the Development of a Regional Reception Facilities Plan* (see resolution MEPC.221(63)).

As written in subchapter 2.3.5, port waste management planning in a regional arrangement can only provide a sustainable solution when undertaken in a way that vessels do not have an incentive to discharge the ship-generated waste at sea. This means that adequate facilities need to be provided, for a cost that does not create an incentive to illegally discharge at sea.

[20] Resolutions MEPC.216(63) and MEPC.217(63).

14.3.2 Providing adequate port reception facilities through a regional arrangement

Prior to the development of a regional arrangement facility plan, the geographical region should be well defined. The majority of States participating should be Small Island Developing States. Non-SIDS may participate, but they should do so only so far as their ports may be Regional Waste Reception Centres (RWRC).

Care should be taken that the RWRC are located in those ports and terminals frequently visited by ships. The RWRC should be able to receive all types of ship-generated wastes and cargo residues.

A ship should not need to deviate from its route for the sole purpose of accessing port reception facilities. Prior investigation of shipping patterns, voyage planning (e.g. does the ship sail in or outside a Special Area) and the need of ships in the ports concerned, together with the treatment possibilities a port or region may or may not be able to offer at a reasonable cost, form the basis of a good RRFP.

The distance between a port and a suitable waste treatment facility may result in unacceptable transport costs. On the other hand, providing basic collection bins in all ports and afterwards transporting these to specialized treatment facilities will not be as expensive as providing these treatment facilities in every port. It is clear that the need of ships, the geographical size and geomorphology of the region and/or State will determine the possible options for determining the RWRC and the ports with limited facilities (PLF).

It is suggested that a government agency or authority, rather than an individual person, is nominated as the central point of contact. For the development of the RRFP, external consultation can be sought, however, basic knowledge of the region and its characteristics is strongly recommendable.

CHAPTER 15 - Checklist

This checklist has been designed to give a short overview of the main aspects when following the different phases, which have been indicated in figure 1. The checklist poses questions, rather than giving answers. When using the checklist the reader can refer to the manual as an aid in answering the questions. Although made on a chapter-by-chapter basis, the checklist should not be seen as a short overview of the manual nor it is intended to be complete, as every situation will have its own specific problems.

CHAPTER 3: DEVELOPMENT OF A WASTE MANAGEMENT STRATEGY

1. What information do you have available, which describes the current situation regarding:

   - waste production, i.e. domestic garbage and sewage, industrial hazardous and non-hazardous wastes;
   - waste collection, treatment and disposal practices and facilities for the various types of waste; and
   - base line data describing the extent of pollution of air, water and soil?

2. What legislation do you have on the regulation of environmental pollution in general (air, water, soil) and how does monitoring and enforcement take place?

3. Has a governmental agency been assigned the responsibility to develop a waste management strategy and policy, and has it got the means of executing its tasks? If not, have the main obstacles been identified, in terms of:

   - staff;
   - budgets; and
   - required expertise and possible (external) assistance?

4. What are the main constraints that prohibit environmentally sound waste handling, in terms of:

   - administrative and legal matters;
   - technology requirements (equipment); and
   - infrastructure and support services?

5. What plans and actions have been identified to improve the situation in the respective fields listed under question 4 and have all environmental issues (air, water, soil) been addressed?

6. Has the role of all the parties that may participate in waste collection, treatment disposal and recycling been identified, such as:

   - public;
   - non-governmental organizations;
   - governmental organizations and public enterprises; private sector; and
   - governments of neighbouring countries, in case of a regional strategy?

7. How has the issue of ship-generated waste been integrated in the plans and policies for land-generated wastes?

CHAPTER 4: NATIONAL IMPLEMENTATION

1. Identification of environmental problems

- what environmental problems need to be resolved, at least in part, through legislation. Identify clearly the environmental media (i.e. air, land, sea, etc.) and the target organizations affected by such environmental problems;
- summarize those impacts that will need legislation to resolve; and
- if new legislation is needed, state clearly the purpose of it and check whether the regulations address practical problems.

2. What waste handling activities should be controlled with respect to:

- waste reception/collection;
- transport;
- treatment; and
- disposal?

3. Can you identify the appropriate legislative instruments to be applied for each waste handling operation? Which instruments have priority in implementation? Which of these instruments already exist?

4. Can you identify the (government) agencies which carry out environmental monitoring and control and those who would carry out possible new tasks?

5. Can you describe the licence system needed to control the different waste handling operations, with respect to:

- types of operations;
- issue of licences, including the requirements for obtaining licenses;
- applicable fees; and
- public review and industry appeal provisions?

CHAPTER 5: PLANNING

1. What responsibilities have been assigned to your port planning team and how is it constituted?

2. What is the budget for your project and which funds have you raised?

3. What parts of the project are to be carried out by consultants?

4. Have you formed an Advisory Panel and have you defined its task?

5. What is the time span of your project and how is it divided in phases?

6. What items have you included in contracts with your consultants?

7. How will you control the progress and budget of the project?

8. When and how often will you evaluate the project performance and what will you do with these evaluations?

9. How will the operation of the facilities be organized?

10. What reception systems have you considered for all ship-generated waste streams?

11. What criteria are important to you for selection of the location for reception facilities?

CHAPTER 6: PORT WASTE MANGEMENT PLANNING

1. Is it clear who should develop the port waste management plan and who should be consulted when doing so?

CHAPTER 7: TYPES AND QUANTITIES OF WASTES

1. What types of wastes can be expected?

2. What resources or methods can you use for quantifying the types and quantities of waste for each MARPOL Annex?

3. How flexible will your facility be with regard to types and quantities of waste?

CHAPTER 8: EQUIPMENT ALTERNATIVES FOR COLLECTION, STORAGE AND TREATMENT OF WASTES

1. What technologies have been considered for your reception/treatment facilities?

2. What criteria have been decisive when selecting the treatment technology for your facility?

3. Is your reception/treatment facility designed to receive peak loads, especially with respect to effluent discharge standards?

4. Would it be possible to make use of already available resources and installations in your port, in nearby industries or in the community where your port is situated?

5. Has co-operation with other ports in the region regarding the collection and/or treatment of ship-generated waste been considered?

6. Would it be advantageous to upgrade some environmental protection systems in your port at the same time as treatment facilities for ship-generated wastes are

installed (e.g. treatment plants for oily ballast water could also handle the oil contaminated storm water in oil terminals)?

7. Would it be advantageous to upgrade the waste collection and treatment in the community where your port is situated at the same time as reception and treatment facilities for the ship-generated wastes are installed?

CHAPTER 9: RECYCLING OF WASTES

1. What organization will co-ordinate the recycling program?

2. What recycling regulations are already in existence, on the different authority levels?

3. What equipment will you use for recycling and how will the operation be organized?

4. Have you identified a market for recyclable materials?

5. How will you inform possible users of the recycling system?

CHAPTER 10: OPTIONS FOR FINAL DISPOSAL

1. How is your waste disposal plan set up?

2. Which final disposal options were considered when making your waste disposal plan?

3. Which criteria were decisive when choosing disposal options for the different waste streams?

CHAPTER 11: FINANCING AND COST RECOVERY

1. What information do you have available on experience of other ports, especially in your region, on possible cost recovery mechanisms?

2. What is your estimate of the operational costs of your facilities?

3. Will your cost recovery mechanism stimulate or deter the delivery of wastes to the port?

4. Does your cost recovery mechanism reflect the "polluter pays"-principle?

5. Does your cost recovery mechanism stimulate waste-reducing measures on-board?

6. Does your cost recovery mechanism require involvement of the government and port authorities concerning:

- monitoring of compliance with regulations and enforcement;
- financial and administrative matters;
- operational matters (collecting and treating matters)?

CHAPTER 12: CO-ORDINATION OF PORT AND SHIP REQUIREMENTS

1. How is your waste disposal procedure organized?

2. Have you implemented the necessary safety requirements and developed safety regulations?

3. Are these safety regulations known to all parties involved in waste disposal?

CHAPTER 13: OPTIONS FOR ENFORCEMENT AND CONTROL

1. Have you investigated your legal possibilities to enforce the compliance of ships with the MARPOL regulations?

2. Are there reasons for ships not to discharge their wastes in your port and what actions can you take to minimize these objections?

3. Are there procedures or (automated) mechanisms in place to check the correctness of the information on the advance notification form in order to facilitate enforcement?

3. How will you control the compliance of treatment facilities with the governing effluent discharge standards?

4. Which types of juridical action are possible in case the treatment facility does not comply with the regulations?

CHAPTER 14 SPECIFIC SITUATIONS

1. Are there adequate port reception facilities available for small ships? Is their need for reception facilities known? What is the optimal cost recovery system so that there is no incentive to (illegally) discharge waste at sea?

2. Are regional arrangements possible and what is the best structure for them to work?

***

ANNEX 3

ALTERNATIVE DRAFT TEXT FOR SECTIONS 8.1.2 to 8.1.5 (SHORTER VERSION)

8.1.2 Overview of collection and separation equipment and processes

The collection of oily wastes can be carried out in different ways (see sub-chapter 5.2.6.). Barges are a good option for floating facilities, as they have limited draught requirements and large collection capacity. These barges can either be motor barges, towed barges or other types. In any case, it is not advisable to use collection barges with oil/water separators on-board, since the time on the vessel will not be long enough for efficient separation. Furthermore, barges usually do not have sufficient space for installation of a separation unit. Additionally, in many ports, the discharge of effluent from a barge into the water would be prohibited.

On-shore collection can be carried out by tank trucks or at a central collection facility. In all cases, storage tanks with pumping facilities for the oily wastes will be needed, to which the ships, collection barges or collection vehicles (depending on which system is used for collection) can discharge their (collected) waste. Section 8.1.7 describes an example in which vehicles are used for collection.

While the collection of oily waste from ships is relatively straightforward, there are many different techniques for the pre-treatment and treatment of oil/water mixtures. In this section a structured overview is provided of different options, without wanting to give detailed descriptions.

8.1.3 Primary treatment techniques

Buffering and equalizing:

As the discharge of wastes to port reception facilities is a batch process and the composition of the batches can differ considerably, separation techniques will be more efficient if their inflow is relatively constant. This can be achieved by the use of buffering/equalizing tanks. The use of buffering/equalization tanks can increase the efficiency of a treatment plant considerably, at relatively low costs. The equipment is limited to a tank with a mixer. The size of the tank is determined by the average inflow of waste and by the capacity of the treatment plant.

Settling tanks:

The simplest form of gravity separation is to retain the oil/water mixture in a settling tank for a sufficient length of time to allow the oil, water and sediments to separate. During the separation it is important to maintain a stable oil/water interface. Turbulence in the tank will reduce the efficiency of the separation. Therefore, settling tanks either have to be operated batch-wise, or relatively large tanks are required. The addition of plate separators allow for continuous operation, with a relatively small tank. The oil layer can be removed either by skimming or by overflow, and is suitable for re-use and recycling (see chapter 9A). The water layer can be removed by simple draining, and collected for further treatment (biological and physicochemical). Regular tank cleaning is required to remove sediments that accumulate on the bottom of the tank, and that can be incinerated.

Plate separators:

Plate separators work on the principle of increasing the surface area for separation, resulting in a better separation. By using inclined plates, which are installed at an angle, the oil droplets move along the underside of the plate, sediments settle on the upper side of a down plate.

There are several types of plate separators available on the market. Another technique to promote coalescence is the use of corrugated plates. Holes in the upper parts of the plates allow the coalesced oil droplets to float to the surface.

Skimmers:

Usually a skimmer is an integral part of a separation installation. Basically there are two skimming mechanisms. The first mechanism scrapes the oil layer from the water surface using rotating scrapers or pipe skimmers. The second mechanism moves an oil adsorbing belt vertically through the water. At the other side of the belt, oil is removed from the belt by a scraper.

Evaluation of primary treatment techniques:

Gravity separation with settling tanks or with plate separators is very effective for removing the main part of free oil from an oil/water mixture. Sometimes, the oily waste stream is slightly warmed up because this enhances the separation. However, emulsions cannot be treated effectively with these methods, and emulsions frequently occur because of additives to the oil and the use of degreasers. In order to decrease the oil content in the water phase to values lower than those reached with gravity separation other techniques are required.

8.1.4 Secondary treatment

Chemical emulsion breaking/flocculation:

Oil/water emulsions cannot be treated by gravity separation. In order to break emulsions, chemicals (so called "de-emulsifiers") have to be added. A large variety of chemicals are available for emulsion breaking (or coagulation), each of which has specific applications. Most frequently, iron or aluminium salts and charged polymers (poly-electrolytes) are used for emulsion breaking. These chemicals are added under rapid mixing with the oil/water in the tank. Heating of the reaction mixture will accelerate the emulsion breaking process, but will also increase operating costs.

The waste water with the coagulated particles are then fed into a second tank, where flocculating chemicals are added. These "flocculants" react with certain components in the wastewater stream creating "flocs". These flocs agglomerate the destabilized emulsion particles to larger flocs, which makes it easier to separate them from water. This process is called flocculation.

The equipment needed for coagulation/flocculation is rather simple: a reaction vessel with mixer and injection pumps for the needed chemicals.

Flotation:

Coagulation/flocculation processes are usually combined with a flotation unit, where air bubbles are used to separate solid or liquid particles from the liquid phase. The combined particles and gas bubbles will rise to the surface. A skimmer can then collect the floating particles.

The efficiency of flotation systems can be increased by installing plates in the flotation tank. This will promote the separation, because of the coalescence occurring between the plates.

The separated oil phase, however, contains a lot of water and has to be treated with a centrifuge, prior to reuse as e.g. fuel.

Filtration:

Solids and emulsified oil can be efficiently removed by the use of filters. For oil/water separation there are two basic types of filters:

- coalescence filters; and
- precoat filters.

A number of processes take place in the filter, resulting in separation of oil from the water stream. The main processes are adsorption and coalescence.

Precoat filters consist of a thin support, on which a "precoat" is brought before filtration, thereby building up a filter cake. The material used for precoat is usually sawdust or diatomaceous earth.

In coalescence filters the filter material causes the oil particles in the waste stream to coalesce, after which oil will be separated by gravity. In coalescence filters the separation may be promoted by the addition of flocculation chemicals. Frequently used filter media are sand and other granulated material, wire mesh and even crushed walnut shells have been successfully utilised. Combinations of these materials are also used (dual-media or multi-media filters).

During operation fouling of the filters will occur, resulting in an increasing pressure drop over the filters. Therefore filters have to be backwashed. In a backwash clean water and air is fed through the filter in reverse flow, thereby cleaning the filter. The filter bed will eventually have to be replaced and the used bed will have to be recycled or disposed of as waste (see chapters 9 and 10).

However, emulsions cannot be treated well with a coalescence filter.

Hydrocyclones:

Hydrocyclones use the density difference between oil and water for separation. However, separation is achieved by centrifugal force rather than by gravitational force.

The wastewater stream is fed, under pressure, into the hydrocyclone through a tangential inlet at the large diameter end of the tube. Due to the geometry of the hydrocyclone, the waste water stream will swirl through the tube and the centrifugal forces will cause the denser liquid (water) to concentrate at the outer diameter of the tube. The less dense liquid (oil) will collect at the core of the tube.

Large advantages of the hydrocyclone over flotation and coalescing filter units are:

- the limited weight and volume of the equipment;
- the absence of moving parts other than pumps (thereby requiring little or no maintenance or operator attention); and
- the relatively constant efficiency (the effluent quality is relatively independent of the influent concentration).

The disadvantages of hydrocyclones are:

- problems handling stable emulsions;
- problems separating very small particles (this disadvantage is shared with many treatment systems); and
- a high wear on pumps.

Up until now hydrocyclones have been expensive compared to the other mentioned systems and have usually only been applied in off-shore oil production applications because of their low weight and low space requirements.

Centrifuges:

Centrifuges work on the same separation principle as hydrocyclones: separation by centrifugal forces. However, centrifuges are not static, as the equipment is mechanically rotated. Furthermore, centrifuges can be used for three-phase separation: oil, water and solids.

Molecular coalescence oil/water separator:

The main principle of the coalescence oil/water separator is the molecular coagulation of like molecules. This coagulation is achieved by changing the energy pattern in the liquid from a tranquil phase to a rapid phase and back.

Membrane separation:

The principle of membrane separation is simple: the structure of the membrane and its physical/chemical characteristics allow certain components to pass through and blocks the passage of other components.

Only a small volume of water permeates through the membranes with each pass, the wastewater has to be fed back into the filtration system several times to achieve the effluent quality stated below.

8.1.5 Tertiary treatment:

Biological treatment:

The use of micro-organisms for degrading dissolved organic components in wastewater streams is a well-developed technology. Different processes are available, depending on the waste to be treated. Biological treatment of oily wastes is especially important if the waste contains additives such as chemicals, as the treatment steps described previously cannot effectively treat them. It needs to be taken into account that effective biological treatment requires relatively constant influent conditions.

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