③ Oil-in-water dispersion

Waves and turbulence at the sea surface can cause some or all of a slick to break up into fragments and droplets of varying sizes. Some of the smaller droplets of oil will remain suspended (like solid particles floating in a liquid) in the sea water while the larger ones will tend to rise back to the surface and reform with any droplets which remained at the surface. This reformed slick will then spread out to form a very thin film. The smaller suspended droplets encourage other natural processes such as biodegradation (the breaking down of chemical compounds into inorganic compounds through the actions of bacteria, fungi and other life forms).

It is interesting to note that given enough time microplastics may also biodegrade, but the process is extremely slow and they remain undegraded for a very long time causing a marine pollution problem which has recently come under much scrutiny.

④ Water-in-oil emulsification

The term “emulsion” refers to a state in which two liquids, which normally don't mix (like oil and water), become combined. For example, oil and vinegar, which normally don't mix, can be temporarily combined after vigorous shaking. This state is referred to as “emulsion”.

As the oil slick spreads over the sea, the film transforms from thick to thin and during this time the various distilled fractions of petroleum gas and petrol (gasolene) evaporate. Finally, only the non-volatile compounds remain and these are buffeted by waves to form an “emulsion”. This emulsion consists of the following two types.

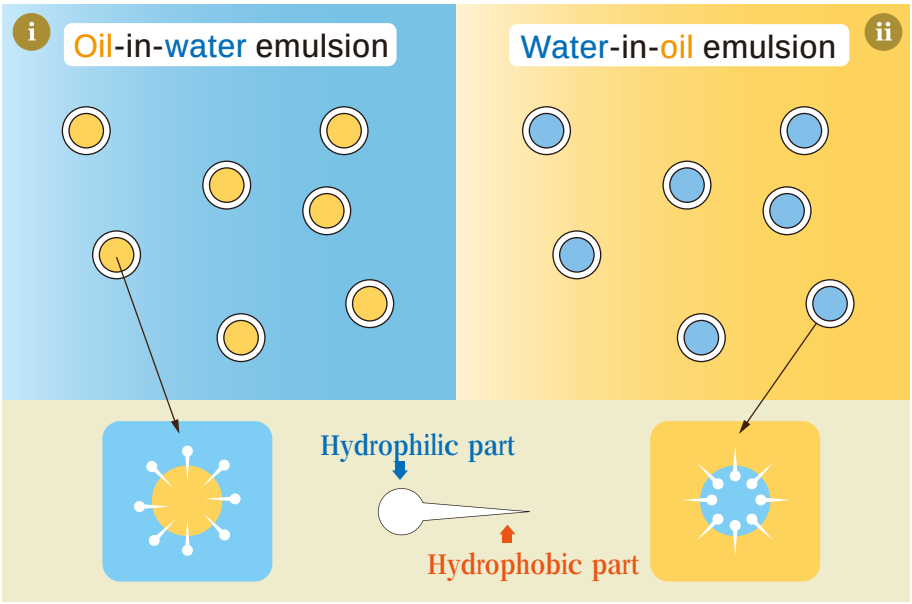


Figure 16: Emulsion Diagram

i Oil in Water

Oil particles in water. It is reduced to seawater by digestion and oxidative decomposition by bacteria.

ii Water in Oil

This is an oil containing water (seawater). When an emulsion is formed, the volume increases by a factor of three or four times and the viscosity increases by several stages. If the asphaltene content is especially high, it can lead to “Chocolate Mousse”, a stable tar-like oil mass that is extremely difficult to process, or “Tarballs”, which can take years or even decades to break down. Therefore, removal measures must be performed before the oil spill becomes an emulsion.

Photograph 17: Emulsion (Chocolate Mousse)

Photograph 18: Emulsion (Tarball)

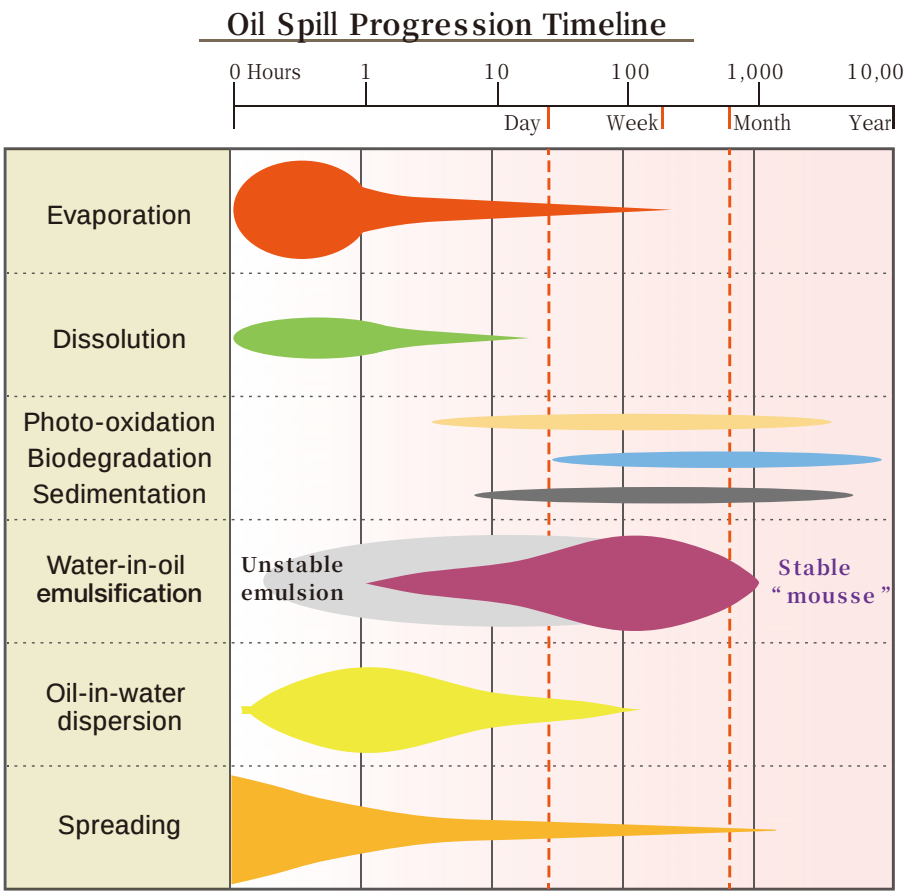


Figure 19: Oil Spill Progression Timeline (modified with data from the ITOPF)

4-2 Oil Spill Spreading Factor

Spilt oil is spread by gravity (the weight of the oil) acting on the oil in the initial stage and then by the surface tension of the oil. These spreads are short in duration and limited in extent. In fact, however, it is affected by the following external forces, which cause it to spread intermittently, forming long, narrow strips or masses of oil in an irregular shape rather than a circle.

= External Forces: Spreading Factors =

① Wind

The floating oil spill is influenced by wind and leeway currents and is carried away by weathering at a speed of approximately 3% of the wind speed.

② Ocean current

The strength (speed) and direction of the ocean current will carry it away.

③ Tidal current

When considering ocean currents, it is also necessary to take into account tidal currents.

④ Waves and Undulations (Swells)

As for spreading, the effects of waves and undulations (swells) are difficult to calculate, but these facilitate the emulsification of oil.

= Direction of Spilled Oil Flow: Vector Calculation =

Figure 20 is a method of measuring the direction and speed of spilled oil flow by vector calculation.

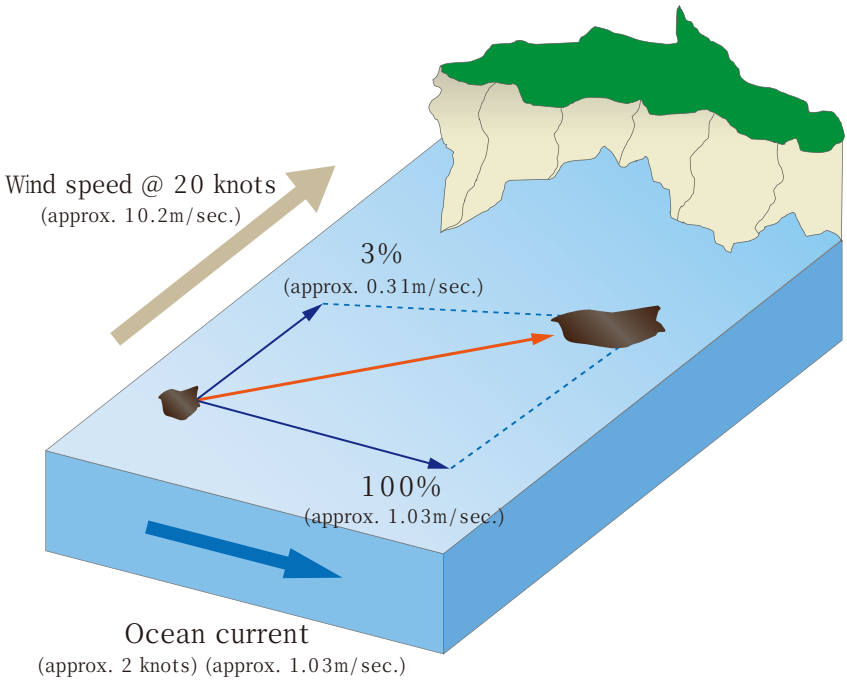


Figure 20: Direction and Speed of Spilled Oil Flow
(Document modified from the Marine Disaster Prevention Center (MDPC))

Using vectors, by calculating the data of the direction of flow of the ocean current (100%) and the wind speed of the prevailing wind (3%), the direction and speed of the oil spill can be determined.

4-3 Spreading Preventive Measures

The best way to minimise the damage caused by an oil spillage accident is to prevent the spread of the spilled oil. However, the Vessel has a limited supply of oil recovery materials, which are unlikely to be able to contain the spread of an oil spill. Therefore, the sooner oil recovery materials are made available, the less damage and loss is likely to occur. ITOPF has seven resource bases in Japan. (See Figure 21.)

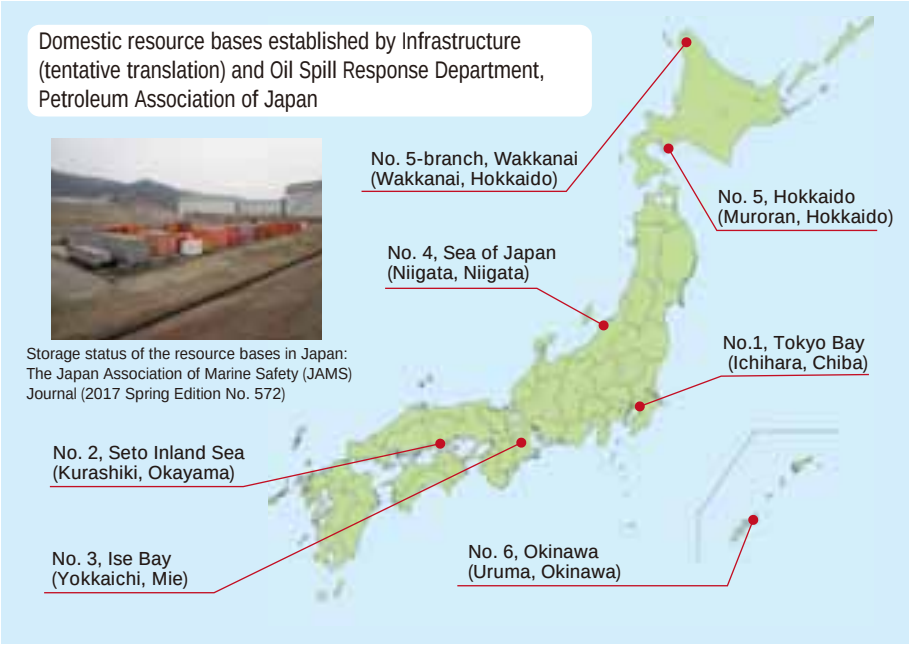


Figure 21: Bases of Petroleum Association of Japan (Partly Modified with Data from the ITOPF)

The MDPC has also set up resource bases in various parts of Japan. (See Figure 22.) The roles and activities of the MDPC are as follows: (Taken from the MDPC homepage.)

1. Purpose

In conjunction with the implementation of countermeasures to deal with the outbreak of maritime disasters and the containment of any escalation thereof (hereinafter collectively referred to as “maritime disaster prevention”), the MDPC also provides the necessary vessels, equipment and materials for such eventualities as well as the organisation of any necessary training programmes. Through international cooperation on maritime disaster prevention, the MDPC aims to contribute to the protection of human life and property.

2. Activities

(1) Implementation of measures to clean up any oil spills and recovery of any costs incurred therein, in accordance with directives from the Japan Coast Guard Commandant.

(2) Implementation of measures to clean up any oil spills, extinguish fires and/or prevent the spread of fire or any other maritime disaster, on behalf of shipowners or any other party.

(3) Ensuring that oil recovery vessels, oil recovery equipment, oil booms etc., or any other vessels or equipment deemed necessary to prevent a maritime disaster are made available to shipowners or any other party.

(4) Provision of the training required to implement maritime disaster prevention measures.

(5) Ensuring that the results of any research into the equipment, materials, and skills required for maritime disaster prevention are made available to shipowners or any other party.

(6) Gathering, collating and ensuring that any relevant information pertaining to maritime disaster prevention is made available.

(7) Provision of advice and guidance on maritime disaster prevention on behalf of shipowners or any other party.

(8) Provision of advice and guidance on maritime disaster prevention in overseas countries. Provision of maritime disaster prevention training to overseas trainees, and contribution to international cooperation on maritime disaster prevention.

(9) Manufacturing and retail of the materials and equipment necessary for maritime disaster prevention, publication and retail of printed material regarding maritime disaster prevention, and conduction of any other incidental business arising from the previously mentioned activities above.

(10) Any of the previously mentioned activities above apply in a similar fashion to rivers, lakes etc.

MDPC's Accident Response System and Base Map of Materials, Equipment and Experts for Maritime Disaster Prevention (2021 FY)

- In addition to the three bases such as the Headquarters (Yokohama), West Japan Branch (Kobe) and Kyushu Branch (Kitakyushu), five representative offices have been established in Tomakomai, Chiba, Yokkaichi, Mizushima and Iwakuni to ensure the efficient and effective implementation of standby operations during normal times, and to establish a rapid and accurate accident response system on a nationwide scale by utilizing the contractual disaster prevention system (tentative translation).

● Contractual disaster prevention measures (implemented by 166 companies)

● Base for materials, equipment and experts for maritime disaster prevention in designated areas (44 bases) (HNS (Hazardous Noxious Substance) response: 32 bases out of the above)

● Organization
- Headquarters (Yokohama)
- West Japan Branch (Kobe)
- Kyushu Branch (Kitakyushu)
- Representative offices in Tomakomai, Chiba, Yokkaichi, Mizushima and Iwakuni

● MDPC Training Department
Training Department in Yokosuka

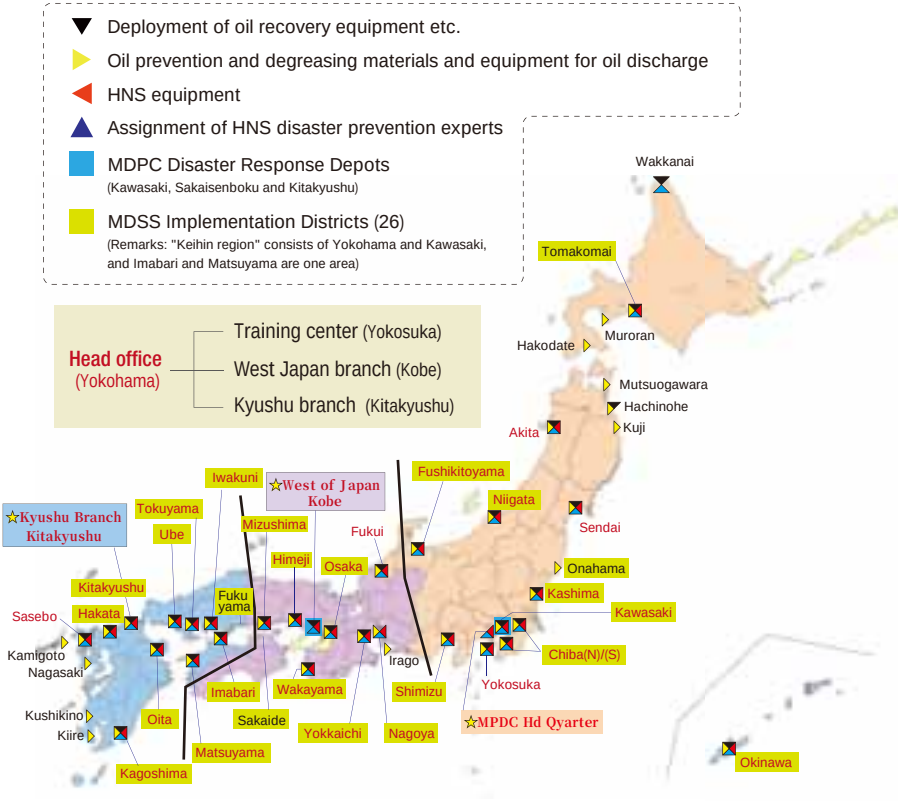


Figure 22: MDPC's Base Map (From MDPC Website)

Following an oil spill and on behalf of a Shipowner or any other party acting as the principal polluter, the Maritime Disaster Prevention Center (MDPC) will respond to any maritime accident.

Marine Pollution and Marine Disaster Prevention law requires that owners of tankers which have a gross tonnage in excess of 150 tonnes, which are navigating through applicable sea areas (*1), and are carrying specified oils such as crude oil or heavy oil, should have secured availability of specialised oil removal materials (oil booms, oil absorbents, oil dispersants etc.). The same law also requires that owners of specified oil tankers with a gross tonnage in excess of 5,000 tonnes which are navigating through specified sea areas (*2) have also secured the availability of oil recovery equipment. Furthermore, there are similar legal obligations for tankers with a gross tonnage in excess of 150 tonnes and which are carrying oil other than specified oil or hazardous and noxious substances (HNS), to similarly secure availability of oil removal equipment and personnel with the necessary expertise. On behalf of the shipowner, the MDPC issues certification (HNS Certificate and Specified Oil Certificate) to legally verify that vessels have secured availability of the proper oil removal equipment. The certification further guarantees that in the event of any oil or HNS spillage and upon request from the shipowner or ship's Master, the MDPC will provide an “Emergency Response Service” which will respond swiftly to clean up the contaminated area.
However, vessels without the proper certification or any other separate standby agreement with the MDPC, must first conclude a separate contract before any response can be made.

*1: Applicable sea area refers to specified sea areas, any port falling under the Act on Port Regulations, and Kagoshima Bay. (Pertaining to sections (6) and (9) of Article 33 of the ordinance for enforcement, and sections (3) and (4) of Article 39 of the Marine Pollution and Disaster Prevention Law.)

*2: Specified sea areas refers to Tokyo Bay, Ise Bay and the Seto Inland Sea. (Pertaining to sections (6) and (9) of Article 33 of the ordinance for enforcement, and sections (3) and (4) of Article 39 of the Marine Pollution and Disaster Prevention Law.)

Whilst there are other private oil recovery services available, there have been reported cases of oil spill incidents where valuable time has been lost in making the decision about

which oil recovery operator to choose. Time which has led to the spreading of the spill and an escalation of the scale of the disaster. Costs are imperative in any recovery operation, and prompt decision making use of the nearest available recovery agency or operator can ultimately lead to a reduction of those costs.

4-4 Classification of Oil Spills

Oil spills from a vessel can be classified as shown in Figure 23. These are roughly categorized into two classifications: “cargo oil spills” from tankers and “fuel oil, lubricants and sludge spills” from all vessels including tankers.

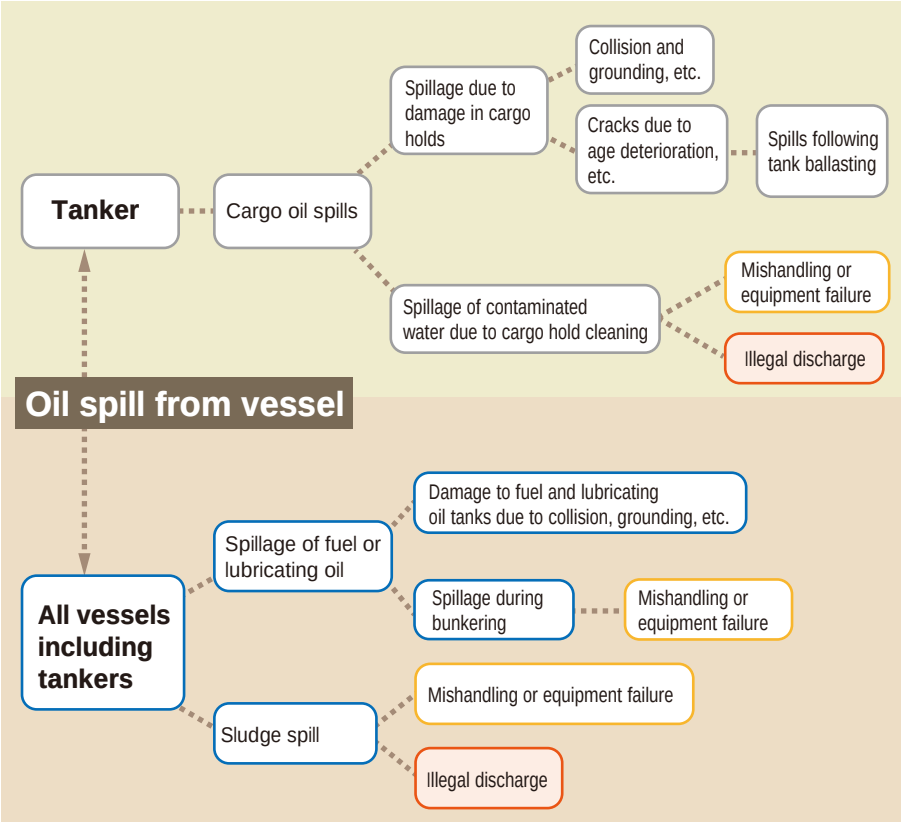


Figure 23: Classification of Oil Spills

Secondary disasters such as collisions and groundings can result in spills of fuel or cargo oil, but as the summarised statistical data in Chapter 1 shows, the majority of accidents involve spills of fuel or lubricating oil due to operational errors during bunkering.

4-5 Oil Types

Figure 24 illustrates oil types refined from crude oil.

Crude oil is divided by a method of separation and concentration of the mixture according to its components, using the difference in boiling point. Crude oil is heated and separated in a 50m high pressurised distillation column, where the lower boiling point substances (gas, naphtha etc.) are extracted from the top fraction and the higher boiling point substances (heavy oil etc.) are extracted from the bottom. It then undergoes a secondary treatment, including the removal of sulphur, to become a product. (Tentative translation.)

(Source: Official website of Idemitsu Kosan Co.,Ltd.)

https://www.idemitsu.com/jp/business/factory/profile/f_process.html

Liquid Petroleum Gas (LP Gas) is refined first, followed by petroleum, jet fuel and paraffin, light oil, and finally residual oil, heavy oil and asphalt. (Figure 24 and Table 25.)

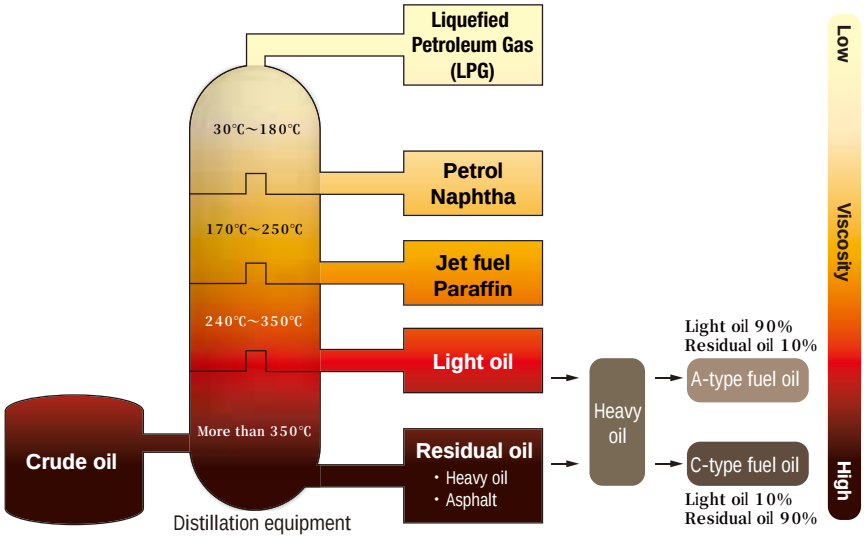


Figure 24: Oil Types

Purpose by Oil Type

(Modified from the management manual from "Umi" & "Nagisa" Foundation)

Oil type	Purpose	Points to note and response methods
A-type fuel oi	For vessels, factories, etc.	When a light petroleum oil is spilled at sea, it evaporates relatively quickly due to wind waves. However, in winter and/or in port, the speed of evaporation is slower and persistence is higher which requires early recovery.
Light oil	For vessels and vehicles	
Paraffin	Mainly for heating	
Lubricants	Engines, etc.	As this almost never evaporates, the basic principle is to surround it with string of flags-type oil absorbents which are then wrung to recover the oil.
Hydraulic oil	Oil hydraulic equipment	
C-type fuel oil	Large vessels, factories, thermal power plants, etc.	High viscosity index oil that hardly evaporates mixes with seawater to form an emulsion. This becomes hydrous and highly viscous, and expands to three times its volume whereby it can be physically recovered.
Petrol	For cars and sport fishing boats	Highly flammable, evacuate and escape on the leeward side.
Crude oil	Refined in an oil refinery	Carried by large tankers. Be cautious as it is flammable and toxic depending on the oil type.
	Crude oil-fired thermal power plants	

Table 25: Purpose by Oil Type

The method of recovery in the event of a spill varies greatly depending on the oil types and the location of the spill (in port or outside of port). These recovery methods are listed in the table (Table 26). For a full list please see Attachment 1.

It is difficult to recover petrol and liquefied gas, which has a low boiling point temperature and high volatility, because it takes a long time to evaporate, also, at the same time there is the possibility of fire, explosion and toxic gases being generated which means that evacuation measures must be taken to ensure that human life is not affected.

A-type fuel oil, which is used for marine fuel, has a low viscosity and therefore spreads to form a thin oil film. Therefore, the recovery operation must be completed before the oil spreads over a large area. On the other hand, the higher viscosity C-type fuel oil spreads more slowly than A-type fuel oil, but is more highly likely to emulsify, making recovery a longer process. To prevent this, the oil must be recovered before it has a chance to spread.

Oil Recovery Procedure by Oil Type

(Modified from the management manual from "Umi" & "Nagisa" Foundation)

Point oil spill occurs	Oil type	Preventive objective	Procedure	Necessary materials	Damage expected	Remarks
In port	A-type fuel oil	Recovery/ spreading	A, B	Oil fence boom and absorbent boom	Port closure, spoilage of water intakes, etc.	Spreads to form a thin oil film
	C-type fuel oil	Recovery	A, B, C	Oil fence boom, absorbent boom, and powerful suction trucks	Port closure, spoilage of water intakes, etc.	Use of absorbents for high viscous oils, emulsions
	Emulsion	Recovery	A, B	Oil fence boom and absorbent boom		Use of absorbents for high viscous oils, or snares (see photograph)
	Petrol	Monitoring and evacuation		Powder gelling agent	Fire, explosions and loss of life	Preventing the spread of secondary damage
	Chemicals	Investigation and confirmation	Instructions from expert	Powder gelling agent	Differ depending on type of chemical	Always consult an expert as treatment will vary depending on type
	Liquefied gas	Monitoring and evacuation			Fire, explosions and loss of life	LNG and LPG
Outside of port	A-type fuel oil	Recovery/ dispersion	A, B, D	Oil fence boom, absorbent boom, oil recovery vessels and oil treatment agents	Destruction of fisheries, tourism, and the natural environment	
	C-type fuel oil	Recovery/ dispersion	A, B, D	Oil fence boom, absorbent boom and oil treatment agents	Destruction of fisheries, tourism, and the natural environment	
	Emulsion	Recovery	A, B	Oil fence boom, absorbent boom and oil recovery system	Destruction of fisheries, tourism, and the natural environment	
	Petrol	Monitoring and evacuation			Fire, explosions and loss of life	Preventing the spread of secondary damage, natural evaporation
	Crude oil	Recovery/ dispersion	A, B, D	Oil fence boom, oil recovery vessels and oil recovery system	Destruction of fisheries, tourism, and the natural environment; fire, explosions and loss of life	Initially there is a crude gas hazard, then emulsions form
	Chemicals	Investigation and confirmation	Instructions from expert		Differ depending on type of chemical	Always consult an expert as treatment will vary depending on type
	Liquefied gas	Monitoring and evacuation			Fire, explosions and loss of life	LNG and LPG

Procedure A: In the case of large quantities, oil is to be recovered with oil fence booms and then recovered by an oil recovery vessel or powerful suction trucks, etc. Or, the oil can be absorbed using an oil absorbent. For small quantities, use oil absorbent.
B: For small quantities, the oil is to be surrounded by an absorbent boom (oil fence, string of flags-type, rolls, etc.) and then wrung and recovered by suction.
C: In the case of large quantities, oil is to be collected with oil fence booms and then recovered by powerful suction trucks.
D: Direct spraying and dispersal with oil treatment agents (for vessel and aircraft).

Table 26: Oil Recovery Procedure by Oil Type

4-6 Oil Recovery Materials

The Ministry of Land, Infrastructure, Transport and Tourism has deployed Water Surface Cleaning and Oil Recovery Vessels etc. to Regional Development Bureaus, and some private companies and organisations also have these oil recovery vessels. However, these vessels are usually engaged in dredging operations and it is difficult for them rush to the site immediately when an oil spill occurs.

Photograph 27: Water Surface Cleaning and Oil Recovery Vessel, Beikurin (Bay-clean) From the website of the Chiba Port Office, Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

Therefore, in the immediate aftermath of an oil spill, it is essential to control the spread of the spill as soon as possible and to begin recovery operations. However, this can only be done by human intervention.

Here are some of the materials that can be used for this purpose.

= Oil Snare =
From website of ANANDENKI CO., LTD.

The literal translation of Oil Snare is “Oil Trap”. The Oil Snare is an oil recovery material developed by Parker Systems in Virginia, USA specifically for high viscosity oil. Due to the unique shape of the oil adsorbent, oil gets trapped inside its thin looped tassels, which can capture the high viscosity of C-type fuel oil that cannot be recovered by other conventional oil adsorbents. For the past 25 years, it has been utilized in major tanker spills around the world and is highly regarded as an essential oil recovery material for the recovery of high-viscosity oil. An oil Snare is also used by the Japan Coast Guard in their “Oil Removal Contingency Programme”. (Tentative translation). A 15m long rope with 30 oil snares, shipped in a plastic bag, each oil snare weighs 230 grams and can trap up to 14kg of oil. It is made of polypropylene and can be incinerated after use.

Photograph 28: Oil Snare (From ANANDENKI CO., LTD. Website)

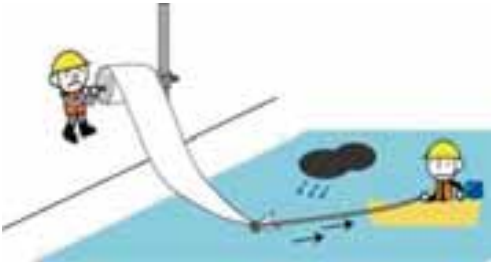
= Oil Absorbent Pad =

In the field, it is necessary to choose the oil removal equipment appropriate for the oil spill. For less viscous oils such as A-type fuel, the use of oil absorbents such as oil absorbent pads (hereinafter referred to as mats) can be effective. These mats are manufactured from polypropylene and vegetable fibres, the performance of which is defined by type approval, but the use of materials without type approval is not an issue and the use of non-approved materials is permitted. It absorbs more oil than water.

Oil Absorbent Mat

Oil Absorbent Mat Usage Example
(From Mitsui Chemicals, Inc. Website)

Oil Absorbent Roll
(Mitsui Chemicals Inc., BL-6500)



Oil Absorbent Roll
(Modified from Documents Created by
"Umi" & "Nagisa" Foundation)

Photograph 29: Oil Absorbent Mats

= Oil Fence Boom =

An oil fence is a floating structure, also known as a boom, which is stretched over a body of water to prevent oil from spreading in the event of a spillage. Except for special types such as “floating” oil fence booms, they are standardised so that they can be connected to oil fence booms of different manufacturers; there are two types in the Japanese standard: Type A and Type B. This material is used to control the spread of spilled oil and their main purpose is to collect, attract, enclose and prevent oil spread. It is not used as a stand-alone product, but in conjunction with materials and machinery to recover the oil. This is possible when the sea is calm, but if the wind, ocean current or waves exceed a certain limit, the oil can leak from the bottom or spill over the top and become uncontrollable.

Photograph 30: Oil Fence Boom Extension in Use
(From a Manual Created by “Umi” & “Nagisa” Foundation)

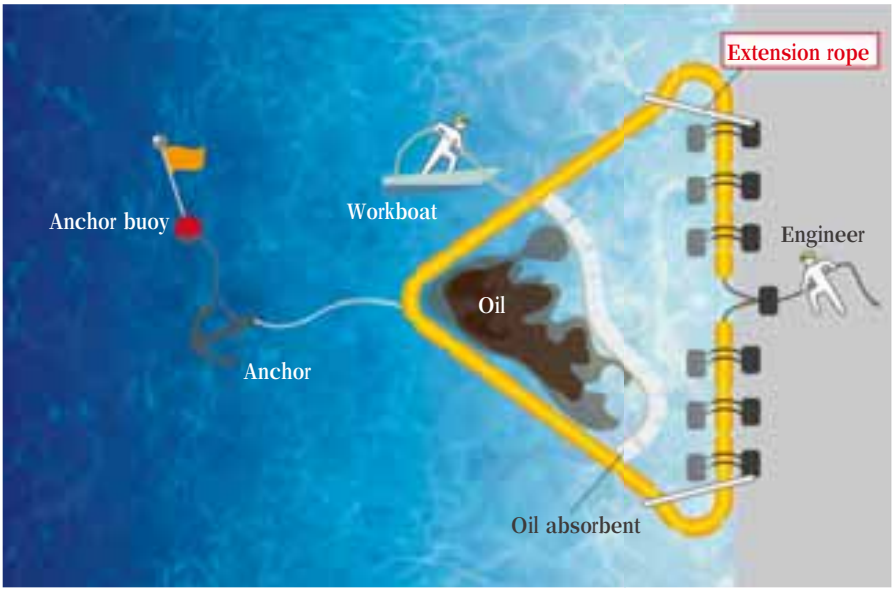


Figure 31: Oil Fence Boom Extension in Use

4-7 Oil Treatment Agents

An oil treatment agent is defined as a substance which when sprayed onto and mixed into floating oil at the sea surface, will cause the oil to rapidly emulsify and disperse into fine particles. This ultimately results in preventing the oil from sinking to the seabed, and enables the sea to naturally attenuate more easily. Furthermore, such agents also have a low toxicity towards marine life.

Previously, such agents were mistakenly referred to as “neutralizing agents” which wrongly suggested that they somehow chemically transformed the oil into a different substance.

However, as the opening definition states, oil treatment agents are rather chemical agents which atomize the oil, dispersing it over the nearby sea surface. This increases the surface area and encourages natural attenuation through the actions of microorganisms and oxygen. The effect of this atomization also means that the oil does not sink, and both the

level of toxicity to which coastal and marine life is exposed and the amount of oiling damage to seabirds can be contained. (Taken from the Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications homepage.) Oil treatment agents do not make the oil disappear, nor do they neutralize and chemically transform the oil into a different substance.

= Types of Oil Treatment Agents =

The two types of solvent are shown below. These solvents are further classified according to their percentage content of surfactant. Thus, 10-15% content is referred to as low concentrate, 15-20% as medium concentrate, and 35-60% as high concentrate.

1) Hydrocarbon type

This includes both 1st and 2nd generation types. The 1st generation type is an aromatic solvent of high toxicity. The 2nd generation type (Type 1) is paraffin-based. In terms of surfactant content, the 2nd generation type ranges from a low to medium concentrate. It is this 2nd generation type which is currently in commercial use in Japan.

2) Concentrated type (concentrate)

The concentrated type (Type 2) and self-mixing type (Type 3) are known as 3rd generation oil treatment agents. They are either alcohol or glycol based. As their name suggests, these types contain a high ratio of surfactant.

= Efficacy and Application Methods of Oil Treatment Agents =

When the viscosity of the oil slick is high, oil treatment agents have little effect since they slip off the surface of the oil before the solvents can disperse within. As a general rule, the agents remain effective on oils with a relative viscosity of less than 2,000cSt. However, this effectiveness drastically reduces when that viscosity is exceeded, and within viscosity levels of 5,000 - 10,000cSt all efficacy is lost. In short, oil treatment agents are not suitable for use with high viscosity emulsion oils or those oils with a pouring point in

excess of the ambient temperature. Furthermore, it may at first seem that the oil can be dispersed at the outset of the spill, however the volatile compounds quickly begin to evaporate and due to the effects of natural weathering, viscosity increases making any dispersion impossible within a short period of time.

Therefore, whilst the efficacy of any oil treatment agent also depends on the prevailing weather and sea conditions, wherever possible it is best to apply these agents one or two days before viscosity becomes high. The main methods of application are by a workboat or aerial spraying by plane.

= Toxicity =

Compared to the 1st generation oil treatment agents, the toxicity of recent agents has decreased. However, there still remains much debate as to their method of use. Furthermore, there is variation in local and national attitudes towards the use of oil treatment agents. In particular, the use of oil treatment agents runs the risk of introducing new marine pollutants into the sea, leading to an increase of localised hydrocarbon concentrations. The effect of this on marine life is a cause for concern. It is therefore vital that there is a consensus of opinion between local authorities, fishery officials etc., regarding the use of any oil treatment agents.

4-8 Oil Spill Response

Figure 32 is a flowchart of an oil spill response. (Please see Attached 2 for details)

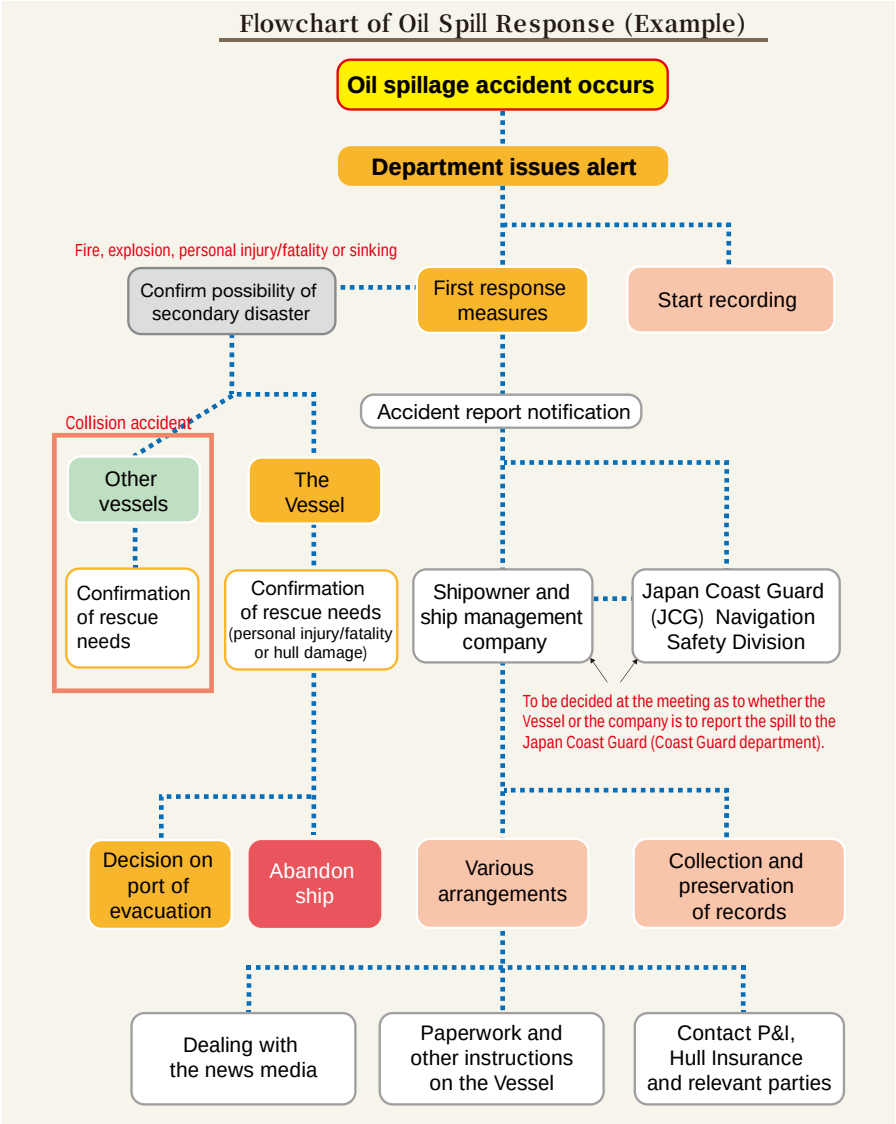


Figure 32: Flowchart of Oil Spill Response (Example)

1 In the event of an overflow during bunkering, first of all, immediately stop pumping oil from the supply vessel. Then, the Oil Removal Emergency Department issues an alert. (Tentative translation.)

2 In accordance with the sharing roles of the Emergency Department, the crew will start operation according to the Master's orders. Naturally, the first priority is to check that there has been no injury to persons.

3 Start first response measures to stop overboard discharge. Looking at the oil spill incidents reported to this Club, in some cases the scupper plugs were not set and the oil spilled overboard from there. In other cases, there was a failure to close or a loss of the spill combing plug in the vent pipe, which led to an oil spill on deck and overboard via a scupper.

= Spill Prevention, Mitigation and Leak Closure Measures =

To follow are some of the initial emergency measures which aim to prevent and reduce spills.

- **Decompression of the leaking tank and pipe**
- **Closing of the relevant valves (and in some cases those for gas biting), if necessary**
- **In case of tank damage, transfer the remaining oil in the leaking tank to another tank**
- **Maintaining ship directional control by Ballast control**

4 At the same time as the first response measures are taken, report the accident to the Shipowner (or ship management company) and confirm with the Shipowner (or ship management company) as to whether the incident is to be reported to the authorities (the Regional Coast Guard

Headquarters in Japan) by the Vessel or by the Shipowner (or ship management company). Please note that it is important to remember that the reporting of an accident is a battle with time so as to minimise the spread.

5 Moreover, the possibility of secondary disaster (fire, explosion, personal injury/fatality or sinking) is to be confirmed. In the case of a collision, after checking the status of the Vessel, the status of other ships should be checked.

6 As mentioned in section 3-1 Countermeasures for Maritime Accidents (For Each Maritime Accident Including Those Between Ship and Shore), it is important to make an appointment with the local Shipowner's agency, although the Shipowner (or ship-management company) is responsible for arranging the recovery personnel.

Figure 33 shows the response framework of major oil pollution incidents in Japan (organisation chart). (Modified with technical data from ITOPF: Please see Attached 3 for a full list.)

Response Framework to Major Oil Pollution Incidents in Japan (Organisation Chart)

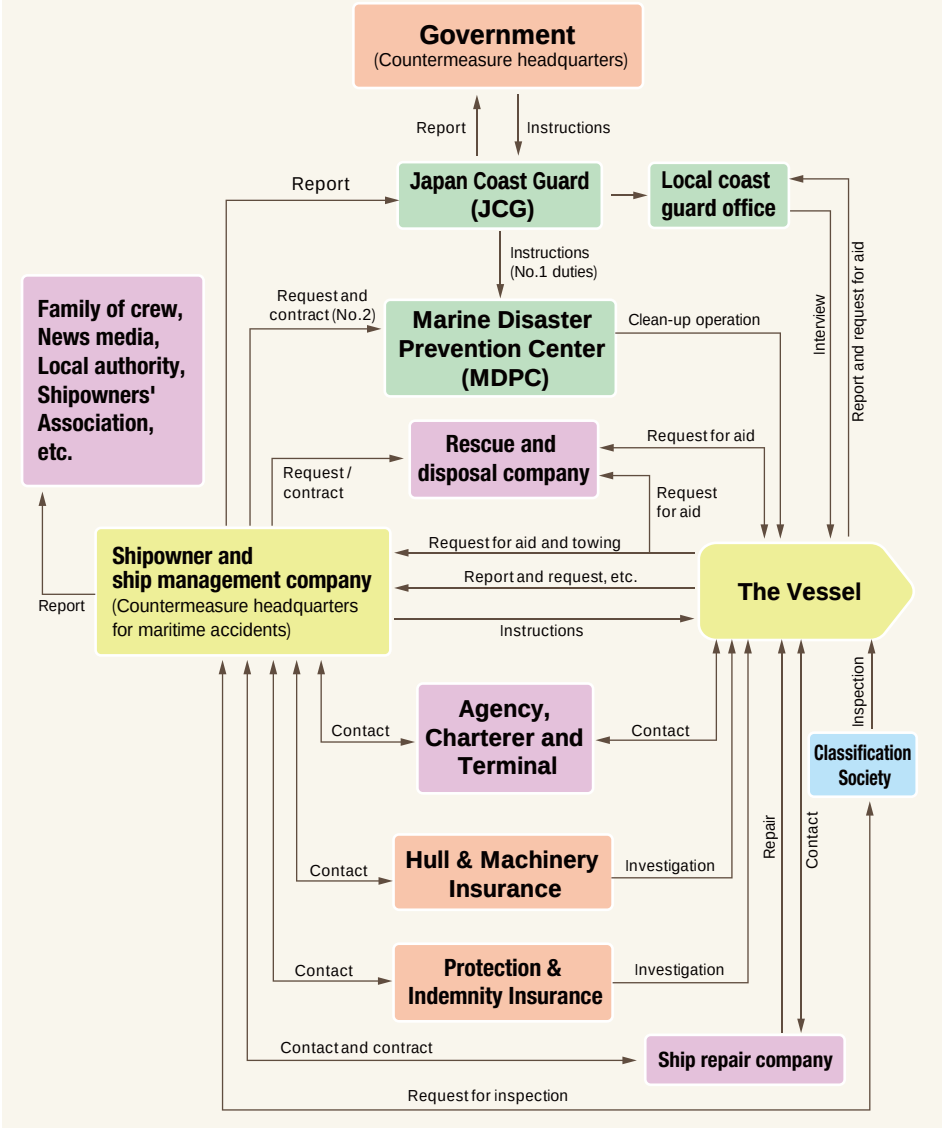


Figure 33: Response Framework to Major Oil Pollution Incidents in Japan (Chart)

4-9 Oil Spill from a Vessel with a Hole Rupture

Pop quiz !

Q In the case of a collision accident etc., as shown in Figure 34, and in the event of a hole rupture in any one part from ① to ④, predict how much oil will be spilled. This is assuming no change in hull angle inclination, trim or draft, and no effects from currents or waves. It is also assumed that no fuel oil tank is actually connected to the double bottom and tanks in the port and starboard sides.

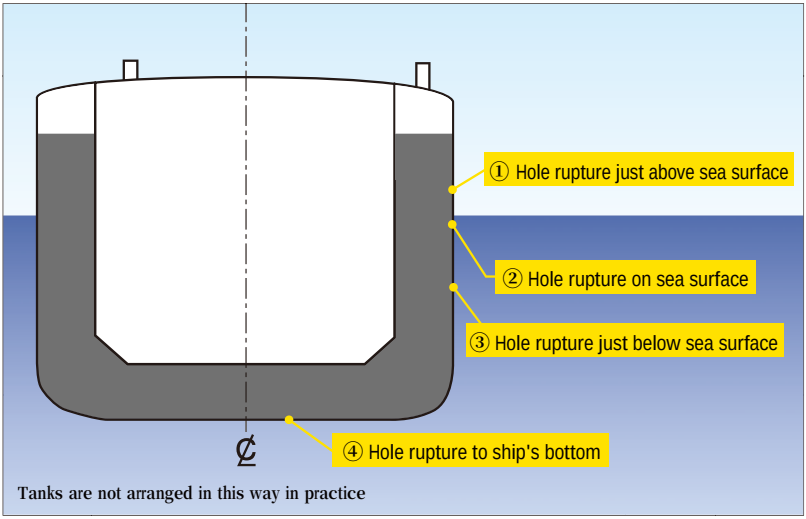


Figure 34: Oil Spillage Differs According to Hole Rupture Location

As a hint of how to approach this, it may be helpful to distinguish between "instantaneous oil spill", where the spilled oil flows out the moment the hole rupture occurs, and "continuous oil spill", where the spilled oil flows out slowly afterwards. Answer can be found on Page 86 .

§5 Case Study of Oil Spillage Accidents

Accident cases involving both oceangoing vessels and coastal vessels will be examined.

5-1 Oceangoing Vessel Case

= Date, Time and Point Accident Occurs =

Date and time accident occurs:
DD/MM/20YY
Point oil spill occurs: Unspecified repair wet dock quay in China
Ship type: General cargo ship approx. 19,000 G/T

Photograph 35: Hull Spoilage of Vessel After Accident

5-1-1 Accident Overview

The Vessel was in the process of bunkering when C-type fuel oil (HFO) spewed onto the deck from the air ventilation of the Vessel's No.2 fuel tank, of which approximately 61 KL spilled into the sea. Some of the oil spilled over the oil fence extended around the Vessel and spread to the surroundings after the accident, causing damage to nearby bay and fishing facilities.

Photograph 36: Oil Slick Drifting in Coastal Areas

Photograph 37: Damage to Fishing Facilities

5-1-2 Accident Treatment Expense

The following expenses have been incurred for accident treatment.

Oil spill recovery and clean-up expenses	Approx. 129 million yen
Compensation for fisheries	Approx. 46 million yen
Penalty（fine）	Approx. 13 million yen
Attorney fee	Approx. 20 million yen
Condition survey costs and others	Approx. 7 million yen
	Total approx. 215 million yen

Photograph 38: Fuel Oil Recovered from the Deck

Photograph 39:
Recovery via Oil Adsorbent

Photograph 40:
Recovery Work Using Oil Adsorbent