IPIECA REPORT SERIES

VOLUME TWELVE

GUIDELINES FOR OIL SPILL WASTE MINIMIZATION AND MANAGEMENT

IPIECA

International Petroleum Industry Environmental Conservation Association

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Centre of Documentation, Research and Experimentation on Accidental Water Pollution

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CONTENTS

PREFACE

This report is one of a series commissioned by the International Petroleum Industry Environmental Conservation Association (IPIECA). The full series of reports will represent the IPIECA member's collective contribution to the global discussion on oil spill preparedness and response.

In preparing these reports—which represent a consensus of membership views—IPIECA has been guided by a set of principles which every organization associated with the transportation of oil products at sea should consider when managing operations related to the transportation, handling and storage of petroleum and petroleum products:

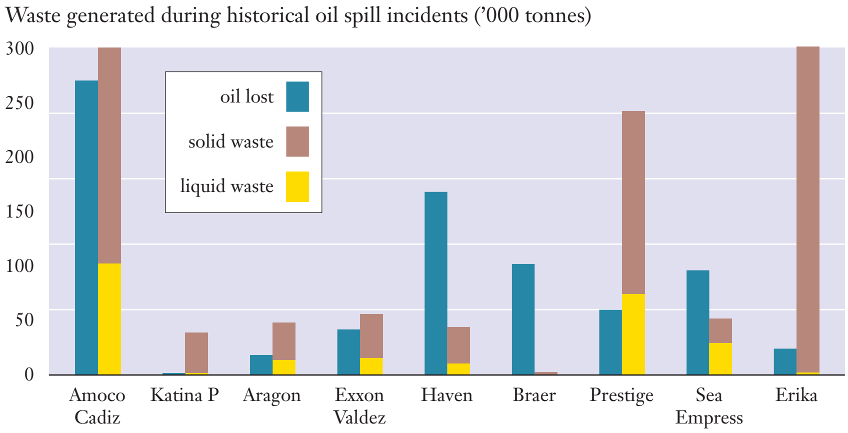
- it is of paramount importance to concentrate on preventing spills;
- safety of life is the highest priority in any incident;
- despite the best efforts of individual organizations, spills will continue to occur and will affect the local environment;
- response to spills should seek to minimize the severity of the environmental damage and to hasten the recovery of any damaged ecosystem;
- the response should always seek to complement and make use of natural forces to the fullest extent practicable.

In the aftermath of a spill, deciding how to deal with the waste oil and contaminated material is a critical and complex process. At the earliest stage a waste management plan should be developed and implemented to minimize serious economic consequences and environmental damage to the affected area. This is difficult to achieve successfully in the highly charged atmosphere of a spill control centre. To overcome this, a waste management plan should be drawn up during the contingency planning stage when there is time to consider all options. Research should be carried out locally and regionally to establish the best solutions to the potential challenges which include: determining final treatment/disposal methods; locating suitable long-term storage sites; and identifying qualified transport and storage companies. The most appropriate action can then be taken instantly during a crisis.

INTRODUCTION

The global transport of oil from production centres to the world market has been established through road, rail, pipeline and shipping infrastructures. As a consequence, there is a constant risk of oil spills in almost every environment worldwide.

Figure 1
Oil spills can produce greater volumes of waste than the oil originally spilled.



The bulk of the world's oil is at some stage transported by sea, thus putting the marine environment at risk. Although spills may occur in the open ocean, the action of currents, winds and tides will often result in the spilt oil impacting a shoreline. This has many implications, but one of the most difficult problems to deal with is the quantity of waste generated in a very short period. Historical data shows that oil spills impacting the shoreline can, in extreme cases, produce up to 30 times more waste than the volume of oil originally spilt (see Figure 1). Although there may be different reasons for the amount of waste generated, it is also evident that a significant number of smaller spills have created large amounts of waste. The management of all waste in any spill should be regarded as a high priority.

It is essential that oil spill contingency plans include adequate provision for the management of wastes produced. It is a fundamental requirement that, as soon as an incident occurs, the right decisions are made and contingency plans are set in motion. This will ensure a successful waste management operation and clean-up, and will minimize costs.

The aim of this document is to highlight waste management issues related to oil spill clean-up. It outlines the sources of waste, how the waste should be collected, the storage considerations and the disposal options available. Case studies are used to demonstrate the importance of learning from past incidents. This document follows the progress of the waste through each stage as shown in the waste management model (Figure 2).

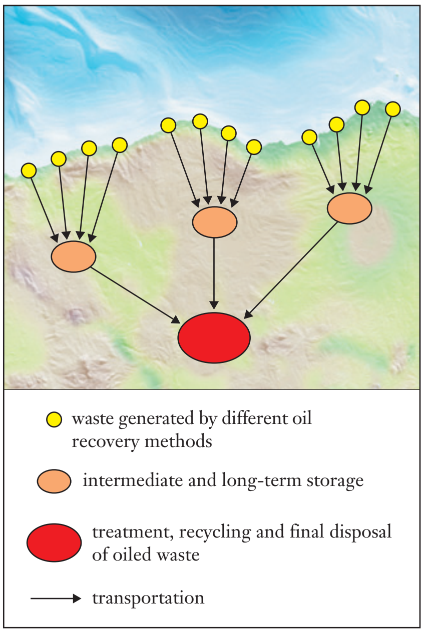


Figure 2
The waste management model—a flowchart showing the stages from waste generation to final disposal, as discussed in this document

WASTE MANAGEMENT CONSIDERATIONS

Before implementing any waste management plan, consideration should be given to the options available.

The waste hierarchy

A useful model when dealing with a waste stream originating from any source is the 'waste hierarchy' (Figure 3). This concept uses principles of waste reduction, reuse and recycling to minimize the amount of waste produced, thus reducing environmental and economic costs and ensuring that legislative requirements are met. It provides a tool for structuring a waste management strategy and can be used as a model for all operations.

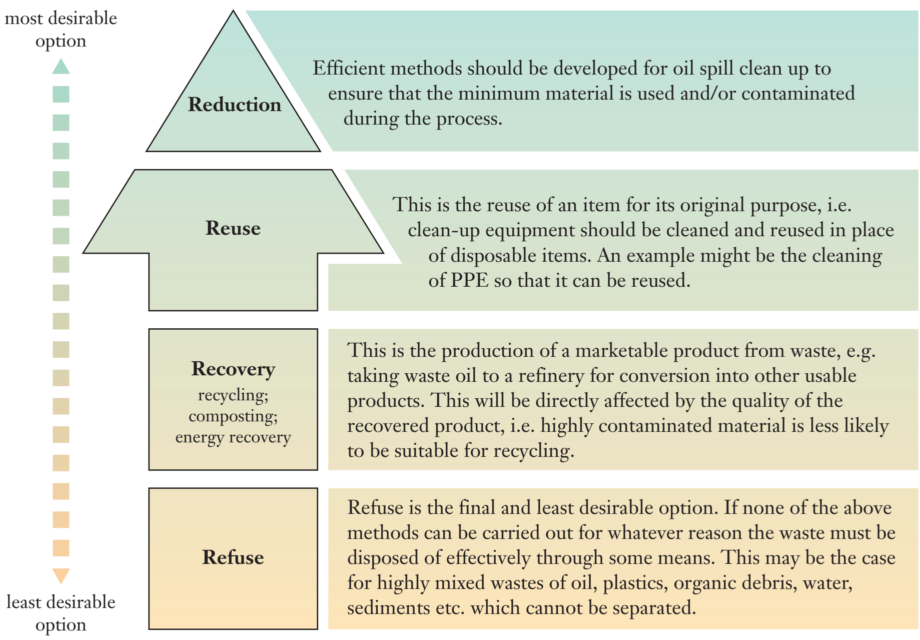


Figure 3
The 'waste hierarchy' provides a tool for structuring an efficient waste management strategy.
(Modified from Williams 2000)

Segregation

In the event of a spill and the subsequent clean-up operation, oil and oiled debris collected becomes a waste that should be segregated, stored, treated, recycled or disposed of. Assuming segregated disposal routes are available, an important process in the first stages of an oil spill response is to classify and segregate waste streams at source. Waste should be channelled into separate storage dependent upon type, taking into consideration the most suitable containment for that material.

Minimization

Minimization is a method of reducing the amount of waste entering the waste stream. This is essential to reduce the amount of waste for final disposal, thus limiting environmental and economic impacts. There are a number of methods to achieve this (see examples below).

Minimization tips

- Potential impact sites should be identified before the oil has beached. These sites should then be cleared of debris and rubbish to reduce the final amount of waste to be treated.
- Segregation at source of the different types of polluted wastes (liquid, solid, debris, PPE, etc.).
- Containment sites should, where possible, have a waterproof cover to prevent excessive rainwater infiltration which could cause overflow of the waste container and also lead to extra contaminated water.
- Recovery equipment should be cleaned and reused rather than discarded.
- *In-situ* handling of waste reduces the amount requiring further transport and treatment. Methods include surf washing, burning (if permitted), sand sieving and bioremediation.
- Reusable personal protective equipment (PPE) should be utilized where appropriate, for example products such as rubber boots that can be cleaned and reused.
- Sorbents should be used sparingly and effectively.

Secondary contamination

Secondary contamination is the spread of oil via people, transport and equipment to otherwise unpolluted areas. This should be avoided to control the overall impact of the spill, and can be achieved in a number of ways. For example:

- the designation of 'clean' and 'dirty' zones at the work site;
- regularly checking all pumps and hose connections for leaks;
- ensuring all storage is water- and oil-proof to prevent leakage;
- decontaminating personnel and equipment before leaving the work zone;
- lining and decontaminating all vehicles intended for waste transportation before leaving the site;
- establishing a traffic circulation plan for vehicles.

An example of secondary contamination of vehicles and the surrounding area

Health and safety

All hydrocarbons potentially pose some degree of health risk and it is therefore essential that a health and safety plan is drawn up before any activity commences. Risks from physical hazards, e.g. storage pits, should not be overlooked. Each stage of the management process should be assessed to establish any potential health and safety risks together with appropriate mitigating methods. Further information can be found in Volume 11 of this report series, entitled *Oil Spill Responder Safety Guide*.

WASTE GENERATED BY DIFFERENT OIL RECOVERY METHODS

The waste stream starts at the point of generation, i.e. the spill site. Different environments and different clean-up techniques generate different types of waste. Table 1 represents possible response strategies and the types of waste they can generate.

Table 1
Response strategies and their effect on waste generation

Clean-up technique		Effect on waste stream	Type of waste generated
Dispersant application 	Dispersant chemicals are used to break down the oil slick into small droplets so that the diluting effect of the ocean is better able to reduce hydrocarbon concentrations. This strategy will not work with all oils and is not appropriate for use in certain environments.	Waste concentrations are minimal as the oil is suspended in the water column and allowed to biodegrade naturally.	• No hydrocarbon waste is generated. • PPE • Empty dispersant drums/considerations
At sea response operations 	Recovery devices, e.g. booms and skimmers, are deployed from ships or small craft to recover oil from the sea surface. Suitably sized storage systems may be needed which, in the case of highly viscous or waxy oils, will require heating elements. Transfer systems and reception facilities will also be needed to sustain operations over the long term.	Recovery operations will potentially give rise to a large quantity of waste oil and water for treatment. The volume of the storage systems available must be consistent with the recovery capacity of the skimmers. The type of oil spilled will have an effect on the resultant waste; viscous and waxy oils in particular will entrain debris and can create large volumes of waste. They can also present severe handling difficulties.	• Oiled equipment/vessels • Oiled PPE and workforce • Recovered oil • Oily water • Oiled vegetation • Oiled sorbent materials • Oiled flotsam and jetsam • Animal carcasses

Shoreline clean-up 	Oils are recovered from shorelines either using mechanical or manual means. Manual recovery is the preferred method because it has the effect of minimizing the amount of waste generated. Machines can be used to transport the waste from the shoreline to the primary storage site. Portable tanks or lined pits can be used to consolidate recovered oil at the operating site. The shoreline type, and degree of access to it, will dictate the types of strategies used which, in turn, will determine the amount of waste recovered.	The type of spilled oil will often have a profound effect on the amount of oily waste generated. Waste segregation and minimization techniques are critical to ensure an efficient operation. These should be established at the initial recovery site and maintained right through to the final disposal site otherwise waste volumes will spiral out of control. Waste sites should be managed in such a way as to prevent secondary pollution.	• Oiled equipment/vessels
			• Oiled PPE and workforce
			• Recovered oil
			• Oiled vegetation
			• Oily water
			• Oiled sorbent materials
			• Oiled beach material:
			  • sand
			  • shingle
			  • cobbles
			• Oiled flotsam and jetsam
			• Animal carcasses
			• Oiled transport

In-situ burning 	This involves a strategy of burning spilled oil using fire booms to thicken the oil layer to sustain combustion. Weathering and emulsification of oil will inhibit the process. The strategy cannot be used on all oil types or in all environments. The resultant air pollution and the production of viscous residues can limit the application of the strategy.	*In-situ* burning can reduce the amount of oil in the environment. However, the remaining material may be more persistent.	• Burnt oil residues • Oiled/fire damaged boom • Oiled vessel • Oiled PPE

Summary

The nature of the environments in which spills occur and the clean-up techniques used all determine the waste type and quantity generated. The key is to ensure that each waste type is segregated at source and the amount of waste kept to a minimum. This will facilitate recycling as well as the environmental and economic efficiency of disposal.

Wastes must always be stored on site in suitable containment taking into account the local environment. It is good practice, and often compulsory by law, that quantities are noted and each type labelled. Monitoring of the waste will also be needed to support claims.

It is important to establish arrangements for the intermediate storage, transfer and final disposal of the waste at an early stage. Without this, it will remain on site preventing further clean-up operations. These arrangements should be agreed at the contingency planning stage to prevent hasty and uninformed decisions being made.

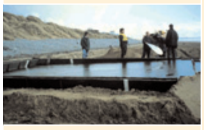
CASE STUDY: *Prestige*, Spain 2002

The oil tanker *Prestige* ran aground off the north-west Spanish coast in November 2002 spilling approximately 63,000 tonnes of heavy fuel oil. A massive clean-up operation was mounted with large numbers of military, volunteer and specialist contractors on each affected site. Systems were put in place and workers briefed to segregate the collected waste. Oil-tight containment was provided for each of these waste types but, ultimately, through haste and operational pressures, workers still mixed their wastes. The failure to rigorously implement a comprehensive waste management plan meant collected wastes were deposited together in lined pits with no segregation for recycling or final disposal; the disposal process for this mixed waste is ongoing and will be expensive and time consuming.

ON-SITE/NEAR SITE TEMPORARY STORAGE

Location of the storage site should be carefully planned and should, ideally, be above high-water, spring tide and storm wave limits to avoid being washed away. In regions subjected to extreme heat certain storage containers, especially plastic bags, should be protected from prolonged exposure to direct sunlight as this can cause breakdown of their material. Storage containers should be labelled with the contents, quantities and relevant hazard labels before transportation, and relevant documentation passed to the driver or waste manager. In some countries this is enforced by legislation.

Table 2
Examples of temporary on-site storage and relevant considerations

Storage type	Considerations
At sea  In-built vessel tanks  Inflatable barges/ bladders  Heated tanks	• Local legal regulations must be adhered to. • Wastes must be segregated. • Use of vessel-tanks can incur high costs and be difficult to empty and clean after the operation. • Deck-storage must be secured tightly. • Lids are required to prevent spillage with vessel movement. • Heated vessel tanks are strongly recommended.
Shoreline  Skips  Portable tanks  Sacks  Barrels  Lined pits	• Local legal regulations must be adhered to. • Wastes should be segregated. • Storage tanks must be located on firm, level ground. • Facilities should be within close proximity of the recovery equipment to limit secondary contamination. • Adequate access is required for heavy vehicles to remove the waste from site. • Storage facilities should be above the mean high-water spring tide limit. • Water-tight covering is required to prevent rainwater infiltration. • Pits must be lined to prevent ground contamination. • Storage areas should be marked clearly and cordoned off. • Security may be required to prevent unauthorized dumping.

INTERMEDIATE/LONG-TERM STORAGE AND TRANSFER

Waste transfer

During clean-up operations both onshore and at sea, waste will have to be transported. The transportation of waste *within* any operational site will require the use of small vehicles such as dump trucks, front-end loaders and all-terrain vehicles; in inaccessible areas landing craft, or in extreme cases helicopters, may be required.

The transfer of waste from recovery sites to storage sites should also be carried out by suitable vehicles, e.g. tankers for liquid waste and sealed trucks for solid waste. In an emergency a variety of vehicles not normally used for oil transport may be utilized. This may include vacuum trucks, tipper trucks, skips or refuse trucks. Sources of transport should, ideally, be identified in the contingency plan, and agreements made in advance.

It is advisable that these vehicles do not leak and are carefully decontaminated before leaving the site in order to reduce secondary contamination of roads and access routes. Local legislative requirements should be given due consideration, and it should be noted that transport licences will often be required for the movement of hazardous wastes.

Far left: crane removing waste from site with limited access for vehicles

Near left: trucks containing waste from the Erika *spill.*

Intermediate and long-term storage

After the waste has been segregated and stored in appropriate containers on site it will usually be transported to storage sites where it remains pending final disposal. Figure 1 shows the geographical structure of the levels of waste storage. Efficient transfer and storage of recovered waste is an essential part of waste management. If waste is not removed from the recovery site then further operations could be hampered, both upstream and downstream. This was highlighted during the *Erika* spill in 1999.

Table 3 explains the criteria associated with intermediate and long-term storage if options for immediate disposal are not available.

Table 3
The need for intermediate storage, and associated considerations

Criteria	Intermediate Storage	Long-Term Storage
Purpose	● Permits efficient oil recovery, i.e. if oil is not removed from site then this can hinder further recovery. ● Prevents bottlenecking i.e. many vehicles from a large area trying to access one site. ● Gives responders time to organize final storage whilst continuing to recover oil. ● Allows efficient transfer of waste, combining small loads so that fewer journeys are made to the final destination, thus reducing fuel consumption, economic costs and the number of contaminated vehicles.	● Allows time for final disposal options to be identified. ● Allows segregation of mixed wastes to be carried out. ● Allows preparation for final disposal, negotiating contracts and time-scales, etc.
Management considerations	● All waste handlers should have proof of competence. ● Batches of waste should be marked according to the type of waste and source. ● All documentation should be retained. ● All legal requirements must be met. ● Sites should be well set up in areas with good access routes. ● Containers should be compatible with the types of waste. ● Where feasible, waste should be compressed to reduce transport volume. ● Containers should be leakproof to avoid secondary contamination. ● All contaminated water produced on site should be dealt with in a way that prevents environmental damage.	

CASE STUDY: *Erika*, France December 11 1999

The oil tanker *Erika* sank spilling approximately 20,000 tonnes of heavy fuel oil. More than 4000 people were involved in shoreline clean-up generating large volumes of waste very quickly. In total, from 20,000 tonnes of oil spilled, it is thought that more than 250,000 tonnes of oily waste was produced. Segregation at the recovery sites was reasonably successful, and the waste was then taken to storage before final disposal. Due to the rate of oil removal from the recovery sites, however, the storage site started receiving waste before it was fully operational and segregation could not be maintained. Consequently re-classification of the waste took six months; by the time a contractor had been appointed it was more than a year before final disposal facilities could commence operation. Final disposal of all waste took more than four years.

Front-end loader transporting waste on site in France after the Erika *spill.*

In the interests of best practice all storage sites chosen, whether they be intermediate or final storage sites, should be in a suitable geographic location; have suitable topography and geology to support a waste storage site; and avoid environmentally sensitive areas or areas near to dense population. Local legislation must always be adhered to. Table 4 sets out some guidelines for geographical and legal criteria that long-term storage sites should meet.

Table 4
Storage considerations for oiled-waste sites

Criteria	Intermediate storage	Final (Major) storage
Occupancy	• Plan on occupying for 0–1 years (more in extreme cases)	• Plan on occupying for up to 5 years • There may be legal restrictions
Example of storage capacities	• 1,500–3,000 m^2 surface area • storage pits (100–200 m^3) • Storage for debris, bags etc.	• 20,000–100,000m^2 surface area • storage pits (1,000–10,000 m^3) • Sorting, pre-treatment, stabilization
Distance from recovery/ transfer sites	• Not more than 5 km	• Not more than 50–10 km; or • one hour by road from previous storage
Access and earthworks	• Access by heavy lorries necessary	• Access by heavy lorries necessary
Regulatory requirements	• Comply with local regulations	• Comply with local regulations
Land conditions	• Flat and graded to accommodate settling tanks • Rain runoff collection facilities may be required	• Flat and graded to accommodate settling tanks • Build appropriate rain runoff facilities
Hydrogeological conditions	• Load-bearing capacity must be adequate • Impermeable subsoil, either naturally or artificially • Avoid groundwater systems	• Load bearing capacity must be adequate • Impermeable subsoil, either naturally or artificially • Avoid groundwater systems
Environmental conditions	• At a safe distance from populated areas • Avoid cultural or archaeologically sensitive sites	• At a safe distance from populated areas • Beware of the impacts of lorries • Buffer for sensitive areas
Management and maintenance conditions	• Sort waste • Assess quantities • Organize final disposal contracts • Water management • Security to prevent unauthorized dumping • Site restoration	• Sort waste • Assess quantities • Organize final disposal contracts • Water management • Security to prevent unauthorized dumping

LEGISLATION ISSUES: Case Study of the UK

All hazardous waste in the European Community (EC) is strictly controlled by the European Council Directive 91/689/EEC on Hazardous Waste. The Special Waste Regulations 1996 implement this in the UK. Oil spill waste is considered a hazardous waste under these regulations. A system of consignment notes and licensing, administered by the Environment Agency, ensures that wastes are tracked from the point of generation to the point of disposal. Both temporary storage and transport of all oil spill waste must, therefore, be carefully documented and licensed. Although this legislation does not necessarily apply to the rest of the world it can be seen as a system of good practice in any spill situation.

When dealing with small, local or regional spills, these regulations should not present a problem as there should be enough licensed hazardous waste carriers and storage/disposal routes to deal with the waste. Problems with this legislation may arise when large regional and international spills occur. The normal disposal routes will become overrun and new carriers and temporary storage sites must be identified. Licenses will have to be issued before they become operational which will almost certainly hinder the clean-up operation. It is up to the relevant authorities (in the UK the Local Authority and the Environment Agency) to work together to resolve this issue. To aid this the Directive states that:

'In cases of emergency or grave danger, Member States shall take all necessary steps, including, where appropriate, temporary derogations … to ensure that hazardous waste is so dealt with as not to constitute a threat to population or the environment'

(EC Directive 91/689/EEC Article 7)

Summary

It is essential that all long-term storage sites be set up as soon as possible after a spill in order to facilitate efficient transfer of waste from the spill site. Storage sites should be strategically placed at locations which are suitable for the storage of contaminated waste. Effective management of these sites is also important in order to ensure that the waste is correctly handled, stored and prepared for final disposal.

If possible waste transfer, storage and disposal issues should be addressed at the contingency planning stage when different authorities can discuss the situation rationally without the pressure of an emergency situation. It is also essential that contingency plans be kept up to date with organizational or legislative changes.

TREATMENT, RECYCLING AND FINAL DISPOSAL OF OILED WASTE

The objective of any oil spill clean-up operation is ultimately to treat, recycle or dispose of the oily waste in the most efficient and environmentally sound manner. The disposal option chosen will depend upon the amount and type of oil and contaminated debris, the location of the spill, environmental and legal considerations and the likely costs involved.

Table 5 identifies the different options available for the disposal of waste with regard to the different categories of collected waste.

Table 5
Waste types and disposal methods

Waste Type	Treatment methods								
	Re-processing	Oil water separation	Emulsion breaking	Stabilization	Bio-remediation	Sediment washing	Landfill	Thermal treatment	Heavy fuel use
Pure oil	✓	✗	✗	✗	✗	✗	✗	✗	✓
Oil and water	✓	✓	✓	✗	✗	✗	✗	✗	✓
Oil and sediment	✓	✗	✗	✓	✓	✓	✓	✓	✗
Oil and organic debris	✗	✗	✗	✓	✓	✗	✓	✓	✗
Oil and PPE/equipment	✗	✗	✗	✗	✗	✗	✓	✓	✗

Summary

There are a number of possible disposal options for waste generated during a spill response (summarized in Table 6). Each waste will require a different treatment method. This will be determined by a number of factors including cost, local resources, legislation and environmental considerations.

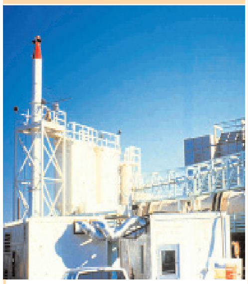
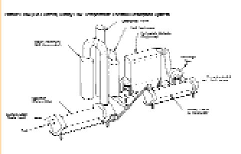
There may be conflict between the quickest, cheapest disposal option and sustainable waste management. This problem is now being recognized internationally and is being addressed by industry and governments through education and contingency planning.

Table 6 Disposal options and relevant considerations

Treatment method	Techniques	Considerations
Re-processing 	● Oil is recovered with a low water and debris content and is then reprocessed through an oil refinery or recycling plant. ● Oil can then be reused—the preferred option as identified in the waste hierarchy (see Figure 3).	● Refineries cannot accept oil with a high salt content because it can cause irreversible corrosion damage to the pipe-work. ● Oil that is heavily contaminated with water, sediment and debris is also unacceptable.
Oil/water separation 	● Separation generally occurs by gravity i.e. oily water is put into a lined pit and allowed to separate out. A skimmer is then used to remove the oil from the surface. ● Special separation equipment, found at oil processing installations, is also often used.	● Oily water residue from separation techniques may then have to undergo further treatment through a system of weir separators, as the hydrocarbon content will still be too high for release into the environment.
Emulsion breaking 	● Heating of emulsions can be used to break them down to oil and water phases. ● In some cases specialized emulsion breaking chemicals will have to be used. ● Once separated the recovered oil can be blended into refinery feedstock or reprocessed.	● Any chemicals used will remain in the water after separation so care will be needed when disposing of the water.
Stabilization 	● The oil can be stabilized using inorganic substances such as quicklime (calcium oxide), fly ash or cement. ● Stabilization forms an inert mixture that reduces the risk of the oil leaching out and thus can be sent to landfill with fewer restrictions than free oil.	● Contact with quicklime can cause irritation to eyes, skin, respiratory system, and gastrointestinal tract. The material reacts with water, releasing sufficient heat to ignite combustible materials.
Bioremediation 	● Bioremediation is used to accelerate the natural, microbial break-down of oil. ● One example of bioremediation is landfarming. Oily debris, with relatively low oil content, is spread evenly over the land and thoroughly mixed into the soil promoting natural breakdown of oil by micro-organisms.	● Bioremediated material may need mixing at intervals to encourage aeration; fertilizer may be added if necessary and consideration should be given to the suitability of location e.g. adequate distance from ground water supplies. ● Landfarms suitable for bioremediation are becoming difficult to find.
Beach washing 	● Involves the cleaning of pebbles and cobbles, either *in-situ* or at a separate treatment site. ● For boulders and rocks coated in oil, cleaning may be carried out through washing on a grill allowing the oily water to drain off for treatment. ● For light oiling, boulders and pebbles can be moved into the surf zone for natural cleaning. The wave energy will move them back into their original position over time.	● This technique should only be considered when the sediments hold a large quantity of oil because it is time consuming, costly, produces a lot of oily water waste requiring treatment, and there is often difficulty in defining when material is oil free and can be returned to the beach.
Sand washing 	● For sandy sediments, specialist sand cleaning equipment can be used. ● A suitable solvent may also be added to aid the process.	● This method is time consuming; costly; produces a lot of oily water waste requiring treatment; and it is often difficult to define when sediment is oil- or solvent-free and so can be returned to the beach.

continued …

Table 6 (continued) Disposal options and relevant considerations

Treatment method	Techniques	Considerations
Landfill 	● Oily waste typically containing less than approximately 5 per cent oil can be co-disposed with non-hazardous, domestic waste and taken to designated landfill sites. ● Established landfill sites are usually lined which suits oily waste as it prevents the oil leaching out into surface water and aquifers. ● They are also usually covered daily which prevents infiltration of rainwater thus reducing the potential for an increase in contaminated water.	● The sites will need special permission from the local regulatory authority to receive this type of waste and volumes are often limited. ● Chemical testing should be conducted to determine the hazardous content of the oil at this stage. ● Facilities able to receive this waste are becoming more difficult to find.
Incineration 	● A treatment technology involving the destruction of waste by controlled burning at high temperatures. In the instance of oiled waste, the hydrocarbons are broken down by the high temperatures which also reduces the remaining solids to a safe, non-burnable ash. ● Cement factories and kilns are an effective method and will keep costs down, as treated waste can sometimes be used as a raw material or for power generation.	● The use of portable incinerators is often prohibited by legislation which stipulates that the location must be licensed and an environmental impact assessment carried out because of atmospheric pollution. ● Permanent incinerators used for the disposal of domestic waste can be considered, although the highly corrosive nature of the salt in the oil may render these unsuitable. ● High temperature industrial incinerators are able to deal with the waste, although they are limited in supply, making them unable to deal with large quantities, and are often costly.
Pyrolysis and thermal desorption  	● Pyrolysis is an example of high temperature thermal treatment. The method converts organic oily waste into gas and solid residues through indirect heating without oxygen. The process historically was used for distilling coal but is now used for dealing with industrial oil-polluted waste materials. ● Thermal desorption aims to separate contaminants from sediments. This is achieved by heating the waste to vaporize the contaminants, without oxidizing them. ● It can be carried out either as high temperature thermal desorption (320–560 °C) or low temperature thermal desorption (90–320 °C). The latter is most often used for remediating soils containing hydrocarbons as it enables treated soil to retain the ability to support biological activity.	● Due to the specialized nature and sophistication of the plant, high costs may be incurred. ● High organic or moisture content may increase cost and increases the difficulty of treating the gas emissions. ● High sediment content can potentially damage the processor unit. Anything greater than 60 mm in diameter typically must be removed prior to processing.

CONCLUSION

An oil spill inevitably leads to numerous difficult decisions having to be made with regard to the supply of resources, prioritizing of resources, best practice clean-up techniques, and the safety of those involved, to name just a few. The issue of waste management can be one of the most significant aspects, in terms of both the operational impact, and the environmental and financial burdens. For successful management of these problems it is essential that the issues are well understood in advance so that they can be planned for, and ultimately mitigated. This should be possible through the use of the best practice techniques described in this document and the implementation of an effective contingency plan that includes waste management.

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Jim Thornborough (BP)
Dave Salt (OSRL)
Thomas Liebert (OSRL, and Coordinator, ITAC)

All photographs were provided by OSRL and Cedre.

Further Reading

Cedre (2002) *A practical guide on how to manage and treat waste from a major oil spill.*

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The International Petroleum Industry Environmental Conservation Association (IPIECA) is comprised of oil and gas companies and associations from around the world. Founded in 1974 following the establishment of the United Nations Environment Programme (UNEP), IPIECA provides one of the industry's principal channels of communication with the United Nations. IPIECA is the single global association representing both the upstream and downstream oil and gas industry on key global social and environmental issues including oil spill preparedness and response; global climate change; health; fuel quality; biodiversity; and social responsibility.

Through a Strategic Issues Assessment Forum, IPIECA also helps its members identify new global environmental issues and evaluates their potential impact on the oil and gas industry. IPIECA's programme takes full account of international developments in these global issues, serving as a forum for discussion and cooperation involving industry and international organizations.

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International Association of Oil & Gas Producers (OGP)

Petroleum Association of Japan (PAJ)

Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (ARPEL)

Regional Clean Sea Organisation (RECSO)

South African Petroleum Industry Association (SAPIA)

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