United States
Environmental Protection
Agency

Region 7
726 Minnesota Ave.
Kansas City, KS 66101

Emergency Response Team

EPA

Oil and Hazardous Substances Response Manual

HAZARDOUS MATERIALS ACCIDENT

1ST ON-SCENE CHECK LIST

1. REPORT THE INCIDENT AS A POSSIBLE H/M ACCIDENT. GIVE EXACT LOCATION AND REQUEST ASSISTANCE.
2. STAY UP-WIND AND UP-GRADE.
3. ISOLATE THE AREA OF NON ESSENTIAL PERSONNEL.
4. AVOID CONTACT WITH LIQUID OR FUMES.
5. ELIMINATE IGNITION SOURCES

   (Smoking flares combustible engines)
6. RESCUE INJURED ONLY IF PRUDENT.
7. IDENTIFY MATERIALS AND DETERMINE CONDITIONS (Spill fire leak solid - liquid - vapor; single or mixed load; waybills bills of lading. Shipper-owner manufacturer and carrier)
8. initiate evacuation Downwind first if necessary
9. ESTABLISH COMMAND POST LOCATION UPWIND A SAFE DISTANCE.

   REPORT EXACT LOCATION AND GIVE APPROACH ROUTE TO DISPATCHER.

	City	County
FIRE:		
POLICE:		
EMERGENCY MEDICAL SERVICE:		
HEALTH DEPT.:		
CIVIL PREPAREDNESS:		

REPORT

OIL OR HAZARDOUS MATERIALS SPILLS/RELEASES
TOLL FREE DAY OR NIGHT

1-800-424-8802

ASSISTANCE

OIL OR HAZARDOUS MATERIALS SPILL/RELEASES
DAY OR NIGHT

REGION VII EPA 913/236-3778

IOWA DEPT. OF ENVIRONMENTAL QUALITY	515/281-8694
KANSAS DEPT. OF HEALTH & ENVIRONMENT	913/296-1500
MISSOURI DEPT. OF NATURAL RESOURCES	314/634-2436
NEBRASKA DEPT. OF ENVIRONMENTAL CONTROL	402/471-4545
CHEMTREC	800/424-9300

A. Circumstances of Hazardous Materials (HM) incidents vary so widely, it is impossible to establish specific guidelines to cover all incidents.

B. The goal is to remove the threat to public health or welfare, safety, and property which may result from a hazardous materials incident.

C. Do not compound the existing problem by creating a disaster out of an emergency.

D. The senior fire ground commander of the jurisdiction is commonly the ON-SCENE Commander (OSC). As such he makes all the decisions and should be advised and consulted by all response personnel to promote a coordinated response official ON-SCENE Commander.

E. Until the fire ground commander is on-scene, you must take charge and set the scene for a coordinated response and recovery.

F. No one is an expert in all problems associated with hazardous materials Experts in specific fields provide needed pieces of information to the (OSC) to solve the overall problem.

G. You may have to delay attending to the injured in order to save the lives of many others.

H. Do not concern yourself with saving the H/M product or the carrier, it can be replaced.

I. Keep your dispatcher advised at all stages of your actions. He must advise other responding units and agencies.

J. Isolate the area of everyone not directly involved with the incident until on-scene commander arrives.

K. DO NOT BECOME PART OF THE PROBLEM YOURSELF BY ATTEMPTING IRRESPONSIBLE RESCUES OR HEROICS.

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1.0 INTRODUCTION

The Congress has declared that it is the policy of the United States that there should be no discharge of oil or hazardous substances into or upon the navigable waters of the United States, adjoining shorelines or into or upon waters of the contiguous zones (Sec. 311 (b) (1) of the Federal Water Pollution Control Act).

This policy is carried out through a coordinated effort by Federal, State, Local departments and agencies, as outlined in the "Region 7 Oil and Hazardous Substances Pollution Contingenty Plan" for the waters of Iowa, Kansas, Nebraska, and Missouri. This Response Manual is a sub-part of the overall Region 7 Contingency Plan. Its purpose is to give the responding Federal and State officials a convenient "quick" reference guide of duties, cleanup techniques, and resources that may be called upon to mitigate and control the effects of an oil or hazardous substance spill.

The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) significantly broadens the scope of spill reporting and response. Specially, the Act requires that the National Response Center be notified of any releases of a reportable quantity of a hazardous substance to the environment. Requirements for spill clean up and the responsibilities of the On-Scene Coordinator are similar to those under Section 311 of the FWPCA.

2.0 PREPAREDNESS/PREVENTION

Organization and operator of a hazardous materials response system requires more than a rapid delivery system for personnel to reach the scene of an incident. Careful planning, organization and training of personnel of diverse backgrounds are necessary to prepare for effective and safe on-scene operations at a hazardous materials release. Preparedness is the general term for these activities which result in an adequate state of awareness of the hazards involved combined with the capability to effectively respond to the emergency.

Preparedness ranks very high in the order of importance with other elements of oil/hazardous materials spill control. It is preventive in nature and from this viewpoint is regarded as most effective. It relates to both before and after-the-fact activities in that it can help avoid the spill/releases, or it can reduce the total impact of the spill on the environment.

The responsibility to develop a sound readiness lies with individual companies, agency, department, whether moral or legal obligations are involved, or simply appreciation of esthetic values. One step further each employee should be aware of his responsibilities to his company agency, department, and be willing to participate in maintaining and improving preparedness efforts.

There are many variables in developing an adequate preparedness plan, and there is no stereotyped checklist to follow. While it is true many good plans have been worked out, the fact is they are tailored to accomodate specific hazards, in specific geographic areas, using the available. manpower, organizational structures, equipment and supplies.

These things relate to planning and organization, whereas training of personnel, maintaining and improving the program must also be considered. Training of personnel, for example, might include:

1. How to deploy special equipment (booms and skimmers, etc.).

2. Improvising equipment in emergencies.

3. Arranging demonstrations by vendor/supplier of equipment.

4. Arranging conferences with local, state and federal environmentalists.

5. Discussing and studying new techniques and keeping current with developments in related subjects.

Maintaining readiness is extremely important, because changes in personnel, corporate organization, equipment availability, process changes and additions, product flow, etc., could render the plan ineffective or completely inadequate. Readiness is a never ending process and must be periodically reviewed to keep the system current.

Regardless of the best efforts that might have been made, certain improvements are always possible. All contingencies are not likely to be anticipated.

RESPONSE ACTIVITIES

Response activities associated with each specific incident are unique, however, there are criteria, principles, and operations that are common to all incidents. The incident must be evaluated to determine its hazard or potential hazard. Various types of environmental samples or measurements may be needed to initially determine the hazard or to provide additional or continual information for assessment. Personnel workers involved in the many activities will need to be protected appropriate to the hazards involved. Efforts will be needed to prevent or reduce potentially harmful substances from migrating from the site due to natural or man-made activities. Containment, cleanup, and disposal activities may be conducted.

DISPOSAL/RECOVERY

After cleanup operations have removed the spilled materials and contaminated debris from the water or ground, the OSC's responsibilities are not over. Improper shipping and disposal of spilled cleanup waste can cause serious safety problems, as well as result in secondary pollution as bad as, if not worse than, the original spill. Therefore, the OSC must be assured that all chemical disposal is carried out in a safe and proper manner.

Disposal/recovery operations may involve the shipping of the waste materials to a state approved land disposal site, treatment by a reliable disposal or recycling to the spiller's company or to a company that can use the material in its operation.

In all cases involving the disposal/recovery of oil and hazardous substances, contact and coordination should be made with all affected parties. EPA looks to the State pollution control agencies to obtain disposal sites and act as disposal sites, air pollution control agencies, sewage treatment plants, etc.

Extremely toxic materials may require special on-site treatment, or as in the case of PCB's either incineration or shipment to an EPA/State approved disposal site. EPA, Edison, New Jersey, has specialized equipment that may be available to treat these very toxic materials. Coordination of this activity will be contacted by the EPA Emergency Response Team.

Generators (spillers) and transporters of hazardous waste materials must obtain the appropriate EPA identification numbers as required by RCRA (See Section 4.4).

.0 FEDERAL LAWS/REGULATIONS

3.1 FEDERAL WATER POLLUTION CONTROL ACT

The Federal Water Pollution Control Act, as ammended (also called the Clean Water Act), represents the latest water pollution control legislation and contains several elements relative to pollution by oil and hazardous substances. The basic authority for spill prevention and response programs originates from Section 311 of the Act. Section 311 provides the overall framework for spills of oil and designated hazardous substances, including national policy and responsibilities. Section 311(b)(5) provides that "Any person in charge of a vessel or of an on-shore facility shall, as soon as he has knowledge of any discharge of oil or a hazardous substance from such vessel or facility ...immediately notify the appropriate agency of the United States Government of such discharge. Any such person who... fails to notify immediately such agency of such discharge shall, upon conviction, be fined not more than $10,000 or imprisoned for not more than one year or both." The appropriate "agency" is indicated in Section 6.1 of this manual.

It is the policy of the United States Environmental Protection Agency and the U.S. Coast Guard that the spiller assumes complete financial responsibility for removal actions. If the Federal On-Scene Coordinator (OSC) determines that timely and/or adequate removal actions are not being carried out, then the Federal Government will initiate cleanup. The Government may then bring action against the responsible party to recover all cleanup costs up to the liabilities set by Federal Law. A spill cleanup must be done to the satisfaction of the Federal OSC.

3.2 SPILL PREVENTION CONTROL AND COUNTERMEASURES PLAN (SPCC PLAN)

The Environmental Protection Agency Oil Pollution Prevention Regulation, published in the Federal Register on December 11, 1973, is addressed to non-transportation related facilities and is further identified as Title 40, Code of Federal Regulations, Part 112. The main requirement of facilities subject to the regulation is the preparation and implementation of a plan to prevent any discharge of oil into waters of the United States. The plan is referred to as a Spill Prevention Control and Countermeasure Plan (SPCC Plan).

The purpose of the plan is to prevent discharges of oil into waters of the United States. The main thrust of the regulation is "prevention" as opposed to "after-the-fact," or "reactive" measures commonly described in Spill Contingency Plans.

This plan applies to owners or operators of facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, or consuming oil and oil products, providing -

1. the facility is non-transportation related (see definition of non-transportation)

2. aboveground storage capacity of single container is in excess of 660 gallons, or an aggregrate storage capacity greater than 1320 gallons, or providing that total belowground storage capacity is greater than 42,000 gallons

3. facilities, which, due to their location could reasonably expect spilled oil to reach waters of the United States.

3.3 COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT OF 1980 (CERCLA)

This act significantly broadens the scope of spill reporting and response. Specifically, the Act requires that the National Response Center be notified of any releases of a reportable quantity of a hazardous substance to the environment.

The Act defines the environment to include water, groundwater, land surface, and subsurface. The definition of hazardous substances has been expanded to include. those already designated under Section 311 of the Federal Water Pollution Control Act (FWPCA); hazardous wastes defined under Section 3001 of the Solid Waste Disposal Act; toxic pollutants listed under Section 307 of the FWPCA; hazardous air pollutants listed under Section 112 of the Clean Air Act; substances pursued under Section 7 of the Toxic Substances Control Act; and any substances subsequently designated pursuant to Section 102 of Superfund. The definition does not include petroleum. A listing of these substances can be compiled by obtaining copies of 40 CFR Part 116 and 49 CFR Part 172. The Act sets a reportable quantity of one pound, except for those substances for which reportable quantities were previously assigned under Section 311 of the FWPCA.

Petroleum spills to the navigable waters of the United States continue to be under the jurisdiction of the FWPCA.

Therefore, any substance designated as hazardous according to the laws cited above, when released to the environment in quantities of one pound or greater (unless a different quantity has been designated under Section 311 of the FWPCA) must be reported to the National Response Center. Failure to notify could result in a fine or not more than $10,000 or imprisonment for not more than one year, or both.

Requirements for spill cleanup and the responsibilities of the On-Scene Coordinator are similar to those under Section 311 of the FWPCA.

3.4 RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

This Act addresses problems related to the generation, disposal, and management of waste materials in the United States. In relation to his plan are those portions of the Act dealing with hazardous wastes. Regulations have been promulgated by EPA which will serve to identify hazardous waste both by characteristics and by sources; develop the cradle-to-grave manifest and tracking systems; and implement a permit system and facility standards for the treatment, storage, and disposal of hazardous wastes.

The regulations require that generators, transporters, and disposers of hazardous waste must obtain EPA identification numbers. During spill situations where hazardous waste is recovered and transported to a disposal site, the shipment must be accompanied by a manifest which includes the EPA characterization number of the generator and each transporter. These identification numbers are necessary prior to transporting the material off site. In order to avoid delay in obtaining these numbers, EPA has established a special procedure for rapid issuance of numbers. EPA Region Office will issue provisional numbers to generators and transporters during emergencies when necessary for rapid transportation of hazardous waste to an authorized waste management facility. These identification numbers and further information concerning the RCRA Act can be obtained by contacting: U.S. Environmental Protection Agency, Region VII, 25 Funston Road, Kansas City, Kansas 66115.

4.0 NATIONAL AND REGIONAL OIL AND HAZARDOUS SUBSTANCES POLLUTION CONTINGENCY PLANS

The National and Regional Oil and Hazardous Substances Pollution Contingency Plans have been developed in compliance with the Federal Water Pollution Control Act, Section 311 (c) (2) and CERCLA, Section 105. These Plans provide for a coordinated and integrated response by departments and agencies of the Federal and State governements to protect the public health and environment and minimize adverse impacts due to oil and hazardous substance discharges, including containment, dispersal and removal. The Plans also promote the coordination of the Federal and State response systems by developing local government and private capabilities in handling environmental incidents.

4.1 ON-SCENE COORDINATION

The On-Scene Coordinator (OSC) is the Federal official predesignated by the EPA or USCG to provide on-scene coordination and direction of all aspects of a spill and subsequent removal actions. The OSC is predesignated as part of the planning and preparation for response to pollution incidents. EPA normally provides OSC's for inland waters and USCG normally provides OCS's for coastal waters. However, this function may be delegated to other State and Federal officials where appropriate. The OSC maintains responsibility to insure that the proper initiation, containment, countermeasures, cleanup, and disposal actions take

place. An official from any agency with responsibility under the Regional Contingency Plan may assume the role of the OSC until the predesignated OSC arrives.

4.2 REGIONAL RESPONSE TEAM

The Regional Response Team (RRT) serves as the regional body for planning and preparedness actions prior to pollution discharges and for coordination and advice during a pollution discharge. The RRT is composed of regional representatives of participating Federal, State, and Local government agencies. Activation of the RRT will normally occur when a major or significant discharge of oil or hazardous substance occurs. During a pollution emergency the RRT members shall insure that the resources of their respective agencies are made available to the OSC. Both the National and Regional Plans contain the responsibilities and the functions of the OSC and RRT and are available for review at the EPA and USCG offices.

4.3 SPILL RESPONSE PHASES

The actions taken to respond to a pollution release can be separated into five relatively distinct classes or phases. For descriptive purposes, these are: Phase I Discovery and Notification; Phase II - Evaluation and Initiation of Action; Phase III - Containment and Countermeasures; Phase IV - Cleanup, Mitigation and Disposal; and Phase V - Documentation and Cost Recovery. It must be recognized that elements of any one phase may take place concurrently with one or more other phases. The OSC initiates and directs Phases II, III and IV.

4.3.1 Phase I Discovery and Notification

Identification is the first response action to an oil or hazardous substance spill. The notification and dissemination of information will be in accordance with the applicable regional and local plans, but should include the necessary steps to safeguard life and property and the notification of other agencies, i.e., fire departments, police departments, etc.

4.3.2 Phase II Evaluation and Initiation of Action

Identification of the material spilled is of utmost importance during spill incidents (see Section 7.0). If the identity of a spilled material is not known, it is recommended that the spill not be approached by the responder until the material can be properly identified and the hazards and safety precautions known. Otherwise, the spill should be treated as if it were a highly toxic substance and should be approached only with full protective gear employed.

In the case in which the nature of the potential hazard of a spill is unknown, but no imminent hazard to a populace is suspected, every effort should be made to determine the spill nature and extent prior to exposure of cleanup personnel. In the long run, time spent in making such a determination may be more than compensated for by making swift, concerted and appropriate action possible when the problem is properly defined.

Many, if not most, hazardous substances are soluble or miscible in water. Thus, evaluation of containment/clean up efforts will be much more difficult than with oil spills. In addition, the evaluation of the magnitude of the spill and the potential hazard and environmental impact will be more difficult and can be expected to require more on-scene response effort than previously required for oil alone.

4.3.3 Phase III - Containment and Countermeasures

This includes actions taken to recover the pollutant from the water and affected public and private shoreline areas, and monitoring activities to determine the scope and effectiveness of removal actions. Actions that could be taken include the use of sorbents, skimmers and other collection devices for sunken pollutants; the use of reaeration or other methods to minimize or mitigate damage resultant from dissolved, suspended or emulsified pollutants; or special treatment techniques to protect public water supplies or wildlife resources from continuing damage (see Section 8.0).

Pollutants and contaminated materials that are recovered in cleanup operations shall be disposed of in accordance with procedures agreed to at the State or local level (see Section 9.0).

4.3.5 Phase V - Documentation and Cost Recovery

This includes a variety of activities, depending on the location of and circumstances surrounding a particular release. Recovery of Federal removal costs and recovery for damage done to Federal, State or local government property is included, however, third party damages are not dealt with in this Plan. The collection of scientific and technical information of value to the scientific community as a basis for research and development activities and for the enhancement of understanding of the environment may also be considered in this phase. It must be recognized that the collection of samples and necessary data must be performed at the proper times during the case to fix liability and for other purposes (see Section 9).

5.0 SUMMARY OF ACTIONS TO BE TAKEN BY THE SPILLER

When a spill has occured which is in violation of the Act (see Section 11.0), the responsibile party must take certain actions which can be classified as follows.

5.1 REPORT IT

The Act requires that any person in charge of a facility responsible for discharging will notify the appropriate agency of the United States Government as soon as he has knowledge of any discharge of oil or hazardous substance. The appropriate agencies to notify are as follows:

Federal

National Response Center	800-424-8802
USEPA Region VII K.C.	816-374-3778
USCG 2nd District	314-425-4612

State

Iowa DEQ	515-281-8883
Kansas DHE	913-862-9360
Missouri DNR	314-634-2436
Nebraska DEC	402-423-7442

5.2 CONTAIN IT

Containment of the spilled material is of extreme importance since the effectiveness and cost of cleanup will usually be directly related to the effectiveness of containment. For this reason, containment must be undertaken immediately upon discovery of the spill. The first step is to locate the source and make an effort to stop the migration of material. Containment equipment should then be established well below the leading edge of the spilled material to insure ample time for installing the containment equipment. In many cases, a series of containment devices will be required. Whenever possible, containment should be accomplished before the material reaches water. Once oil or a hazardous substance release has reached water, recovery is much more difficult. Most other hazardous substances are nearly impossible to recover or treat when they have entered a water body.

5.3 CLEAN IT UP

The Act also requires that the responsible party remove the spilled material and conduct cleanup to the satisfaction of the OSC (see Section 4.1). Therefore, after the material has been adequately contained, resources should be assembled to accomplish a satisfactory cleanup. This may involve using company employees and equipment or it could require the assistance of a contractor who specializes in spill cleanup. (See Section 8.0 for specific techniques related to containment and cleanup).

6.0 IDENTIFICATION AND ASSESSMENT OF SPILLED MATERIALS

In the event of a discharge, the spiller should be able to provide information concerning the identification of the material. However, if the spiller is unknown or not available, then other clues may be useful in determining the type of material spilled. These include.

1. Characteristics of the container
   - o Container shapes
   - o Markings and colors
   - o Placards and labels

2. Characteristics of the spilled material
   - o Physical state
   - o Type of odor emitted

- o Color
- o Turbidity
- o Behavior in water
- o Irritability to eyes
- o Fuming
- o Flaming
- o Foaming
- o Gas emitting
- o Reactions

3. Shipping papers for transportation related spills

Every vehicle should be considered to be a hazard because of the material it may be carrying, even though it is not placarded. This is because the law does not require vehicles carrying certain materials be placarded, even though they may be extremely dangerous under certain circumstances. (For example, hair spray usually considered to be relatively harmless, is very flammable and explodes when subjected to heat). There are numberous other products which when packed under pressure in aerosol cans are potentially dangerous.

In case of an accident or spillage, the first person at the scene should ascertain from the driver of the vehicle, conductor of train or pilot of plane, the type of material being transported. If the driver, conductor or pilot is unconsicious or dead, an attempt should be made to retreive the shipping papers from the location indicated in Table 1 to determine the type of material aboard. If unable to locate shipping papers, or obtain the name of the commodity from the containers, contact the carrier or shipper involved to get this information. The attempt to retreive the shipping papers or name of commodity from containers, should ONLY be attempted it it can be accomplished without undue risk to emergency personnel.

TABLE 1 SHIPPING PAPER IDENTIFICATION CHART

Mode of Transportation	Title of Shipping Paper	Location of Shipping Papers	Responsible Person
Highway*	Bill of lading	Cab of vehicle	Driver
Rail**	Waybill Consist	With Conductor	Conductor
Water	Dangerous Cargo Manifest	Wheelhouse or pipelike container on barge	Captain Master
Air	Air Bill with Certification for Restricted Areas	Cockpit	Pilot

* Manufacturer's data sheets generally available from driver in addition to bills of lading.

** STCC (Standard Transportation Commodity Code) Number is used extensively on rail transportation shipping papers.

When identifying hazardous substances, great care must be taken in copying names of materials since even minor spelling errors can have serious consequences in determining the hazardous properties of the spilled material.

Unidentified materials must be approached as though they are highly toxic and full protective gear should be used.

Table 2 provides a general classification of hazardous materials commonly transported.

The following format will be of assistance in establishing the identity of the material and the magnitude of the spill:

Establish the type of spill The first step is to determine what type of spill is involved by identifying the source of the spill. The following types of spills are possible:

1. Trains
   - o Tank car
   - o Box car
2. Trucks
   - o Tank
   - o Trailer
3. Bus
4. Aircraft
   - o Cargo
   - o Passenger
5. Ship
   - o Dry Cargo
   - o Tank Ship
   - o Com. Pass. Vessel
   - o Fishing Vessel
   - o CG Vessel
   - o Pleasure Craft
   - o Tugboat
   - o Unidentified
6. Barge
7. Pipeline
   - o Offshore
   - o On shore
8. Storage Tank
   - o Offshore
   - o On shore

Things to look for at spill site:

1. Are hazardous placards or labels visible on vehicle or container?
2. If so, what are contents identification or warnings relating to dangers (poisonous, explosives)?
3. Identification numbers on tank cars, trucks, etc.?
4. Is shipping paper available?

Record easily visible physical properties Observation of the following properties of the spilled material can confirm an identification or possible identify the specific chemical involved. However, the OSC must approach the spill cautiously and not endanger himself and others in determining the characteristics. If a certain physical property cannot be readily identified, gather other information that can safely be obtained.

1. What is the spill state?
   - o Solid (powder, pellet granular)
   - o Liquid
   - o Gas

2. Is there a noticeable odor from a safe distance? (pleasant, almond, ammonia benzene, fragrant, lysol, vinegar, sweet)

3. What color is it?

4. Is it turbid?
   - o Opaque
   - o Clear
   - o Cloudy
   - o Other

5. If it is in water, does it
   - o Float
   - o Sink
   - o Mix (soluble)

6. Does it cause your eyes to water?

7. Is it
   - o Fuming
   - o Flaming
   - o Foaming
   - o Is a gas being given off
   - o Is another noticeable reaction occurring?

Magnitude of Spill The OSC can establish the magnitude of the spill by considering the following.

1. What number, type and size of individual containers have spilled the material?

o Metal drums		approx. height	_____	
		diameter	_____	
o Fiber drums		approx. height	_____	
		diameter	_____	
o Carboys		approx. height	_____	
		diameter	_____	
o Bags				
Paper	Length _____	Width _____	Height _____	
Polyethlene	Length _____	Width _____	Height _____	
o Cylinders	Length _____	Width _____	Height _____	
o Boxes Type	Length _____	Width _____	Height _____	
o Other	Dimensions:			

2. If large tank trucks, cars, or barge and ship holds are involved, the approximate size can be estimated by pacing off a similar distance at a remote location.

size. _____ x _____ x _____

Often the tank cars and trains are labeled so the capacity should be recorded. _____ gallons.

6.1 CHEMICAL COMPATIBILITY

If two or more hazardous materials can remain in contact indefinitely without changing structure or resulting in a chemical reaction then they are compatible. Incompatibility does not necessarily indicate a hazard.

Many operations on waste or accident sites involve mixing or unavoidable contact between different hazardous materials. It is important to know ahead of time if such materials are compatible. If they are not, then any number of chemical reactions could occur. The results of a reaction could range from the formation of an innocuous gas to a violent explosion. Table 2 gives the results of incompatible mixtures.

The identity of the reactants and their nature must be determined in order to establish compatibility of the reactants are unknown, then it must be determined by chemical analysis.

Once the identity is known then a chemist should be able to determine the compatibility or the chemical reaction resulting from mixing the reactants. Judging the compatibility of more than two reactants is very difficult. If more than two reactants are to be combined, then compatibility is judged on a one to one basis.

For response personnel who are required to determine compatibilities there is an EPA R&D publication which can be utilized. It is called "A Method for Determining the Compatibility of Hazardous Wastes" EPA 600/2-80-076.

Sometimes the identity of a waste is impossible to ascertain due to money and time constraints. In this event, simple tests must be performed to determine the nature of the material or mixture. Tests such as pH, oxidation-reduction potential, and flash-point determinations are used to characterize the waste. Other tests such as combining very small amounts of the reactants may be carefully employed to determine compatibility.

Practical Considerations:

If materials are compatible they must be stored together in bulk tanks or transferred to tank trucks for ultimate disposal. Bulk containment of wastes for transport requires only one chemical analysis whereas one is required for each drum or container transported.

Compatibility information is also very important when evaluating a situation resulting from an accident involving several different hazardous materials. The ultimate handling and treatment of the materials may be partially based on such information.

TABLE 2

1. Generation heat e.g., acid and water
2. Fire e.g., hydrogen sulfide and calcium hypochlorite
3. Explosion e.g., picric acid and sodium hydroxide
4. Toxic gas or vapor production e.g., sulfuric acid and plastic
5. Flammable gas or vapor production e.g., acid and metal
6. Formation of a substance with a greater toxicity than the reactants e.g., chlorine and ammonia
7. Formation of shock or friction sensitive compounds
8. Pressurization of closed vessels fire extinguisher
9. Solubilization of toxic substances e.g., hydrochloric acid and chromium
10. Dispersal of toxic dusts and mists
11. Violent polymerization e.g., ammonia and acrylonitrile

Available technical data

A. CHRIS Manuals - U.S. Coast Guard

B. OHMTADS EPA

C. Chemtrec

D. NIOSH/OSHA Guide to Chemical Hazards

E. Merck Index

F. Sax, Irving Dangerous Properties of Industrial Materials

G. Fire Protection Guide or Hazardous Materials NFPA

H. Hazardous Materials - Emergency Action Guide
U.S. Department of Transportation

I. Bureau of Explosives
Association of American Railroads
Emergency Handling of Hazardous Materials
in Surface Transportation

3. Additional Notes:

TABLE 3
CLASSIFYING HAZARDOUS MATERIALS

General Category DOT Classifications	Examples	General Hazardous Properties
Explosives		
Class A Explosive	Dynamite, TNT, Black Powder	Sensitive to heat &
Class B Explosive	Propellant Powders, Rocket Motors	Contamination could cause explosion
Class C Explosive	Common Fireworks, Small Arms	Thermal and Mechanical impact
Blasting Agents	Nitro Carbo Nitrate	
Compressed Gases		
Flammable Gas	Acetylene, Butane, Hydrogen	BLEVE potential
Nonflammable Gas	Carbon Dioxide, Nitrogen Sulfur Dioxide	Flammability hazard Highly mobile vapors Toxicity, corrosivity potentials
Special Forms		
Liquified	Butane, LNG, Nitrogen, Propane	Liquified gases - cold temperatures - frostbite
Cryogenic	Ethylene, Hydrogen, Nitrogen	expansion ratio high
Gas in solution	Acetylene	
Flammable Liquids		
Pyrophoric Liquids	Aluminum Alkyls, Alkyl Boranes	Flammability
Flammable Liquids	Acetone, Gasoline, Methyl Alcohol	Explosion potential
Combustible Liquid	Fuel Oil, Stoddard Solvent	BLEVE Vapor/air Potentially corrosive, toxic thermally unstable
Flammable Solids		
Flammable Solid	Magnesium, Titanium	Readily ignite & burn explosively, some spontaneously
Water Reactive	Calcium Carbide, Sodium Hydride	
Spontaneously Combustible	Phosphorus, Sodium, Potassium	Water reactive potentials Toxic & corrosive potenti
Oxidizing Materials		
Oxidizer	Lithium Peroxide	Supply oxygen to support combustion of normally nonflammable materials
Organic Peroxide	Benzoyl Peroxide, Peracetic Acid	Explosively sensitive to heat, shock, friction Potentially toxic
Poisonous Materials		
Class A Poison	Arsine, Hydrocyanic Acid, Phosgene	Harm from inhalation, ingestion, absorption
Class B Poison	Aniline, Arsenic, Methyl Bromide	Effect on environment
Irritant	Tear Gas, Xylyl Bromide	Flammability potential
Etiologic Agent	Anthrax, Botulism, Rabies, Tetnus	
Radioactive Materials		
Radioactive I Radioactive II Radioactive III	Plutonium, Cobalt, Uranium Uranium Hexafluoride	Harm - internal & externa Contaminates - Immediate area Smoke, clothing, water
Corrosive Materials		
Corrosive	Acids - Hydrocyanic Acid, Sulfuric Acid Bases - Caustic Soda, Caustic Potash	Harm - disintegration of tissues, internal & external Oxidizing effect Splatter pottential
Other		
ORM A	Dry Ice, Carbon Tetrachloride	Noxious
ORM B	Quicklime, Metallic Mercury	Corrosive
ORM C	Battery Parts, Bleaching Powder	
ORM D	Disinfectants	

7.0 CONTAINMENT AND CLEANUP TECHNIQUES

Upon arriving at a spill scene the investigator should observe the physical situation and take appropriate safety precautions if necessary. It is preferable to know the materials spilled before leaving the office. This will allow time to check the hazards of the materials involved in the spill, and what precautions and actions would be required during the cleanup operations.

Once the identity and danger of the spilled material has been assessed, various methods of containment and/or cleanup may be appropriate. It is the policy of EPA that mechanical containment and removal methods be used whenever possible unless they would endanger life of property or another more effective and readily available method is more feasible.

While it is recognized that there are many adequate methods available to mitigate the effects of an oil or hazardous substance spill, the methods presented here are offered as a guide to assist the Federal and other responding personnel in carrying out their responsibilities. For purposes of discussion, the techniques are divided into three categories: 1) those for materials which float, such as oil; 2) those for materials which are soluble or miscible in water or which are heavier than water (most hazardous substances fall into this category), and; 3) those for spills on land or in air.

Field problems associated with hazardous substances can be very complex and may require assistance beyond the scope of this manual. Questions regarding hazardous substances should be referred to the EPA Regional Office, or other sources such as the chemical manufacturers, Chlorine Institute, etc.

Note: Whenever dealing with oil and hazardous materials, give proper attention to their fire and explosion hazards as well as the chemicals' toxic properties. Safety of the public and responding personnel shall be of utmost consideration for the Federal OSC.

7.1 CLEANUP TECHNIQUES FOR FLOATING MATERIALS

The cleanup techniques used for floating material can involve either the use of mechanical or chemical means to collect or remove spilled oil or floating hazardous substances (see Table 4). The use of mechanical means such as skimmers, booms and sorbents are the preferred methods. It should be kept in mind that early stoppage of the spill source and quick containment will greatly reduce the scope of the cleanup operations and most likely the environmental damages as a result there of.

TABLE 4
CONTROL METHODS FOR SPILLS IN WATER
FLOATING SPILLS

METHOD	APPLICATION OR CONSTRUCTION MATERIALS	USE	ADVANTAGES	DISADVANTAGES
Booms	Varies, need deployment device	Not too much	Used on large area; many knotcurrent	1. Only in wave <2-4 feet 2. Current speed <0.7 varieties
Weirs	Weir & boat	Calm	Not easily clogged; collects & contains	Not used in rough water
Pneumatic Barriers	Air compressor diffuser deployment method	Only in shallow water	Do not create a physical barrier to vessels	1. Not in rough water 2. Only shallow water 3. Only thin layers of materials
Spill Herding Methods	Chemicals on water; spray or prop. wash	Protect shore & facilities	Useful in rough water	1. Not easilty obtainable 2. Not 100% effective

7.1.1. Booms

Booms are used to contain spills of floatable materials, and to facilitate cleanup operations. Booms can be used to keep the oil and hazardous materials in a small area or to keep these materials out of a particular area. This latter approach is used to protect vulnerable natural resources and private property such as a marina.

Generally, booms as a containment device are good in clam waters. However, they will loose their effectiveness in currents above 1 MPH. (See Figures 1 and 2). In situations where the current is above the 1 MPH figure, the boom should be used as a deflection device, moving the oil to a quiet collection area. This is done by placing the boom at an angle to the movement of the floating material, this angle being less than 90° and usually smaller than 45°. The faster the current, the smaller the angle and the longer length of boom is required.

Booms are usually susceptible to two kinds of failure while they are deployed. (1) entrainment and (2) splashover.

Entrainment is the loss of oil under the skirt, due normally to a combination of increased headwave thickness and water current. Figure 2 illustrates what happens to cause this undesirable effect.

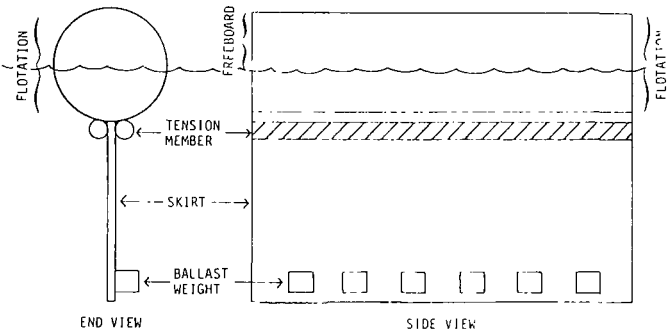


Figure 1. The basic components of an oil contaminant boom.

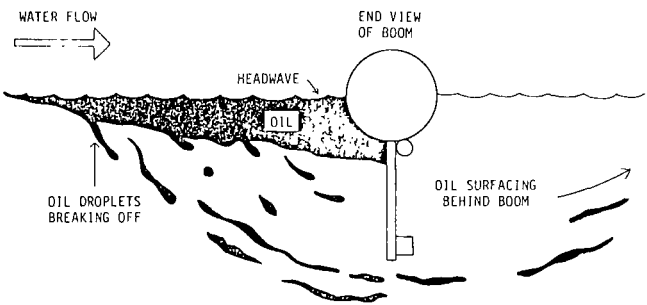


Figure 2. Heavy waves and currents may wash spilled oil under the booms; this type of failure is known as "entrainment."

Entrainment can be accelerated by either of two separate events or a combination of external inputs. One event is the increase of water current velocity. This event has a tendency to push the skirt off the vertical and to increase the amount of entrained oil (Figure 3). The second event is high winds, which can cause a similar loss of vertical integrity, if sufficient freeboard is present, by pushing the top of the boom toward the water surface. Sometimes, the boom may actually lie flat on the water with a subsequent loss of previously contained oil (Figure 4).

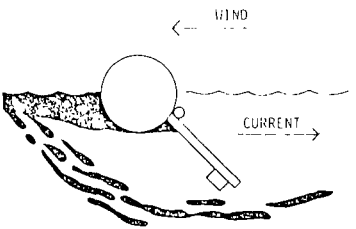


Figure 3. Entrainment increased due to fast current.

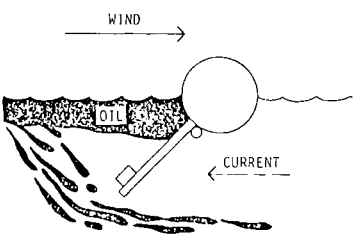


Figure 4. Entrainment increased due to high wind with normal current.

The problems associated with entrainment can be partially countered by decreasing the angle of the boom to the bank. Problems associated with the effect of wind on boom integrity are completely situational and require individual analysis and deployment of "trade-offs" to maximize containment of the spilled product.

The wind and the sea state are primary influences on the second type of failure, which stems from the splashover of the boom. Splashover is directly affected by boom design, freeboard height, angle of approach of waves to the boom, and the size and interval of the waves. Any combination of these factors causes the oil to go over the top of the boom. The solution, again, is site-specific, and the amount and direction of movement of the boom to minimize this splashover should be determined on a case-by-case basis. In choppy sea conditions, some oil will spill over, but there is no need for alarm unless large quantities are being lost.

Regardless of the type used, booms can be effective only if positioned or deployed in a manner consistent with local conditions.

The most valuable element in boom deployment is a sound working knowledge of local waterways. Knowledge of currents, tides, natural catch areas, water depth, etc., is invaluable in effecting a more rapid response. A second element necessary for timely, effective deployment is the availability of ready support equipment. If the water body is large enough to require a boat for boom deployment, it is important to have available some sort of towing bridle that will place the strain on the tension member.

The following examples demonstrate various techniques that are widely used to contain oil with booms under different stream conditions (Figures 5, 6, and 7). The illustrated solution is not always effective. In the case of most rivers, currents usually subside at or near the banks. Because of reduced flow in these areas, some containment can normally be expected nearshore. As can be seen, all of these deployment techniques require the securing of an anchor on the leading edge of the boom. A recommended method for anchoring the boom is shown in Figure 8.

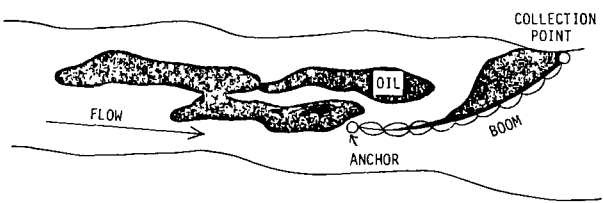


Figure 5. Small river with moderate depth of 15 to 20 ft (4.6 to 6.1 m) and slow current of 1.0 to 1.5 kn (1.8 to 2.8 km/h).

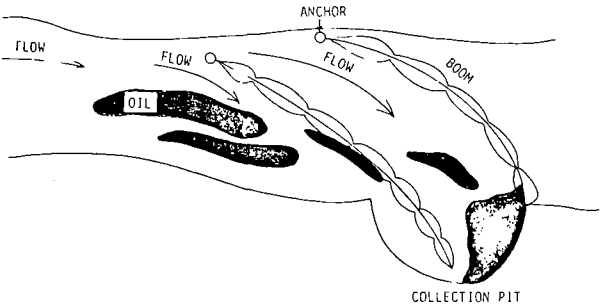


Figure 6. Small river with moderate depth of 15 to 20 ft. (4.6 to 6.1 m) and moderate to fast current of 3 to 4 kn (5.6 to 7.4 km/h).

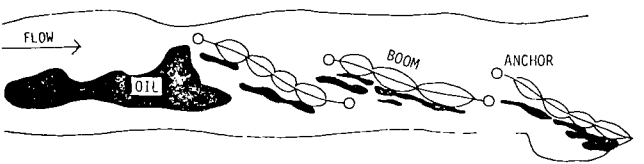


Figure 7. River of moderate to deep depth and fast current.

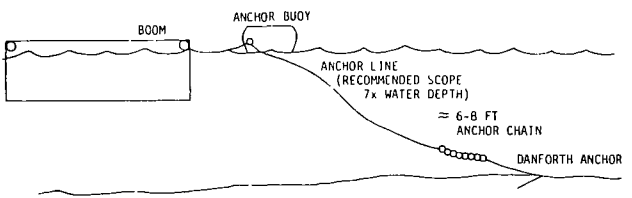


Figure 8. Normal configuration for anchoring booms.

7.1.2 Earthen Dams

Earthen dams are a second type of barrier. This measure is used most frequently on small creeks or tributaries, but could be effectively used on slightly larger water bodies if the flow rate is slow [<0.5 knots (kn)]. Earthen dams are very easy to construct, using a bulldozer, dragline, or backhoe. The primary objective is to allow the water to pass downstream while containing the oil. Water passes through an inverted siphon or inclined pipe, which is placed below the water surface (Figure 10-12).

Barriers of straw and/or peat can also be constructed easily. The type barriers or dams may be constructed in a variety of means. Typically chicken wire or something similar is strung across the stream/creek and the straw or peat is placed on the up stream side of the wire. It maybe desirable to use a second string of wire to contain the straw or peat should the stream or creek be prone to directional current changes. Natural debris such as a log jam may also be used to the responders advantage.

In summary, it should be remembered that physical barriers, whether booms or dams, are intended to restrict the spread of oil/hazardous materials and decrease contamination. In all oil spill situations, rapid response is the key to an effective operation, and containment must be accomplished as soon as possible, using the best available resources.

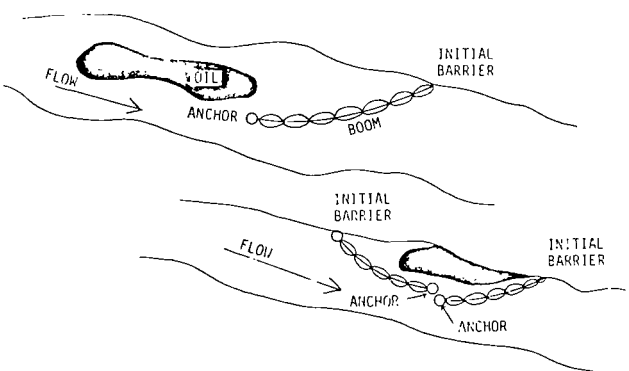


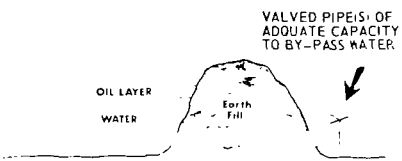
Figure 9. Back moored boom technique for containing spilled oil in tidal-influenced estuaries and bays.

DRY DITCH OR RAVINE
BLOCKED TO FORM HOLDING POND

• FILL SHOULD BE COMPACTED BY ANY AVAILABLE MEANS DURING CONSTRUCTION

FIGURE 10

WATER BY-PASS DAM
(VALVED PIPE)

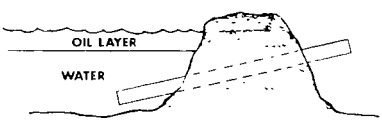


WATER FLOW OF STREAM OR SURFACE WATER DRAINAGE IS BY PASSED TO MAINTAIN RESERVOIR LEVEL. OIL IS SKIMMED OFF OR ADSORBED AS CONDITIONS DICTATE.

CREST OF DAM SHOULD BE SUFFICIENT WIDTH TO ACCOMODATE COMPACTION VEHICLE. HEIGHT OF FILL 2 TO 3 FEET ABOVE FLUID LEVEL. NORMAL FALL ANGLE OF FILL WILL SUFFICE FOR SLOPING.

FIGURE 11

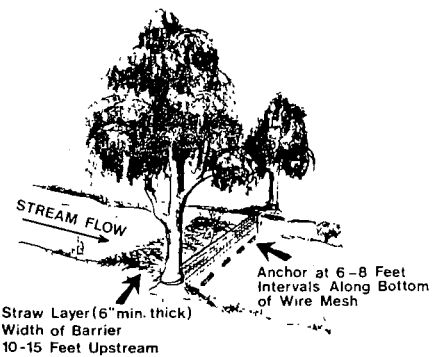
WATER BY-PASS DAM
(INCLINED TUBE)



ELEVATE DISCHARGE END OF TUBE(S) TO
DESIRED RESERVOIR LEVEL.

FIGURE 12

SUSPENDED BARRIER



- STAGE BARRIERS IN SERIES OF TWO OR MORE
- SELECT QUIESCENT AREA OF STREAM TO LOCATE BARRIERS

FIGURE 13

7.1.3 Skimmers

Assuming that efforts to contain the discharged oil have proved successful, recovery of the spilled oil is then begun. Removal is usually accomplished with the use of mechanical devices called "skimmers".

Skimmers, as the name implies, are designed to collect, or skim, the floating product from the surface of the water. Skimmers can be grouped into four basic categories: (1) vacuum or suction type, (2) weirs, (3) dynamic inclined plane, and (4) oleophilic belts, drums, and disks.

7.1.3.1 Vacuum or Suction-Type Skimmers

The suction-type skimmer is a simple device in terms of both design and operation. A suction head and pump are involved, and these devices simply vacuum the oil from the surface of the water. One sample of a suction-type skimmer head is called a "duck bill" (Figure 14). The primary advantages of using this device are its adaptability to most environmental situations, its ability to handle almost all types of oils, and the simplicity of operation in most water depth. Its disadvantages include a tendency to become clogged with debris and the need for continual maintenance during recovery operations to prevent clogging and allow efficient skimming.

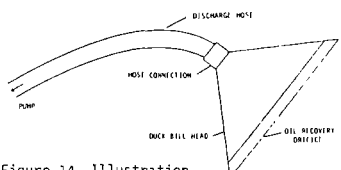


Figure 14. Illustration of a suction-type skimmer head for removing spilled oil.

7.1.3.2 Weir Skimmers

Weir skimmers are probably the most widely recognized type of recovery device available today. In addition, they are the most widely available type of skimmer for pollution recovery operations.

Weir skimmers consist of four primary components: (1) a flotation device to suspend the skimmer in water, (2) a reservoir to collect the oil, (3) a device to adjust the skimming level to minimize the quantity of water entering the reservoir, and (4) some method to empty the reservoir, either by positive displacement pumps or suction (Figure 15).

The idea behind this device is commonly referred to as the "waterfall" prinicple. The collecting reservoir is submerged to the level of the oil/water interface, at which point, gravity forces the oil into the reservoir, creating a "waterfall" effect. The advantages of this type of skimmer include its high mobility and good recovery efficiency in relatively calm water. The wier is susceptible to being clogged with debris, but a screen can be placed around the unit to minimize this problem.

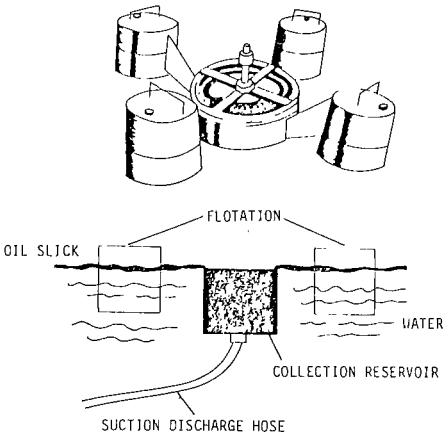


Figure 15. Vertical and lateral views of the components of the weir skimmer.

6.1.3.3 Dynamic Inclined Plane Skimmers

Dynamic inclined plane skimmers use an inverted, continuous belt; that is, a belt that runs from high to low, as opposed to normal conveyors which run from low to high (Figure 16). The belt takes the oil below the surface of the water. The oil leaves the belt and floats upward to a reservoir, where it is collected and pumped to a storage container. Like oleophilic skimmers, which are discussed later, dynamic inclined plane skimmers have good recovery efficiency and are available in a variety of sizes. Both types have restrictions on maneuverability and loss of efficiency when trash or debris is present.

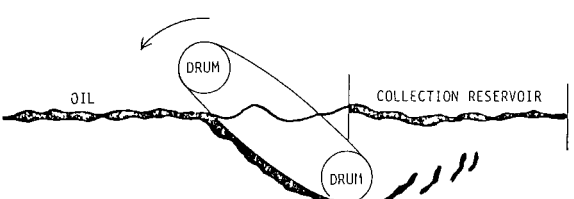


Figure 16. An illustration of the dynamic inclined plane skimmer in operation.

7.1.3.4 Oleophilic Skimmers

Oleophilic skimmers are operated on the principles of oil absorption. The term "oleophilic" means a strong affinity for oil. Almost all of the oleophilic components of this type of skimmer have the characteristic of being hydrophobic, or water-resistant. The common denominator of all oleophilic recovery devices is the passing of the "absorbing' material continuously through the spilled oil. The oil adheres to the surface and is removed from the water. At this point, the oleophilic member is wiped or squeezed by rollers or blades and the oil is deposited in a reservoir. the product in the reservoir is then pumped into some type of holding container.

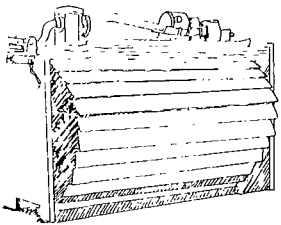
Oleophilic skimmers are the most sophisticated recovery devices available today, usually employing several different mechanical systems, which require varying levels of preventive maintenance and highly trained operators for use.

The rotating disk, or drum systems, as shown in Figure 17, are noted for very efficient recovery of oil in deeper water where little or no debris is present. Available in various sizes, the large models normally require extensive logistic support.

The most widely used oleophilic skimmers are of the belt and rope type. These devices operate very efficiently in both thick and thin slicks, and are usually capable of recovering sheens. Their ability to remove oil mixed with small amounts of debris remains almost as efficient as debris-free environments.

Because oleophilic belt skimmers require the use of some sort of vessel for staging and employment, they are difficult to operate in close quarters or in shallow water. Figure 18 shows a typical "continuous belt" installation.

The oleophilic rope employs the same basic principle as the "belt"; i.e., a continuous process of "absorption" by the oleophilic component, squeezing by a roller or wiper system, and re-entry into or upon the oil in the water.



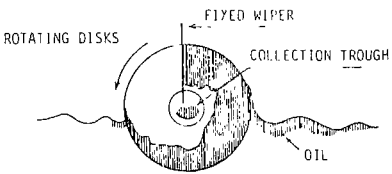


Figure 17. Oleophilic drum skimmer.

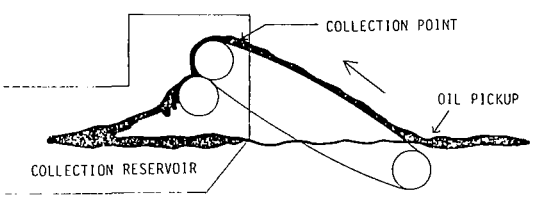


Figure 18. A continuous-belt oleophilic skimmer for recovering spilled oil on the surface of the water.

TABLE 5
EPA ACCEPTANCE LIST
DISPERSANTS, COLLECTING AGENTS, BIOLOGICAL ADDITIVES

Company	Product Name	Chemical Agent	Date of Acceptance
Shell Oil Company Two Shell Plaza P.O. Box 2105 Houston, TX	Oil Herder	Surface Collector	Sept. 16, 1976
Natural Hydrocarbon Elimination Co 5400 Memorial Drive Suite 812, Houston, TX	NOSCUM	Biological Additive	Sept. 16, 1976
Whale Chemical Co. 58 Winant St. State Is., N.Y.	Seamaster NS-555	Dispersant	June 6, 1977
Ara-Chem, Inc. 808 Gable Way El Cajon, CA	Gold Crew Dispersant	Dispersant	Aug. 31, 1977
GFC Chemical Co. 2539 Old Okeechobee Rd. West Palm Beach, FL	Atlantic-Pacific Oil Dispersant	Dispersant	Sept. 19, 1977
Adair Equipment Co. P.O. Box 19333 Houston, TX	Cold Clean	Dispersant	Oct. 7.1977
BP North America, Inc. 620 Fifth Ave. New York, N.Y.	BP-1100X	Dispersant	Oct. 20, 1977
Exxon Chemical Co. 1333 W. Loop South Houston, TX	Corexit 9527	Dispersant	March 10, 1978
Continental Chemical 270 Clifton Blvd. Clinton, N.J.	Conco Dispersant K	Dispersant	April 25, 1978
BP North America, Inc. 620 Fifth Ave. New York, N.Y.	CP-1100 WD	Dispersant	May 11, 1978
U.S. Navy Naval Ship Engin. Center, Washington, D.C.	Oil Spill Remover	Surface Collector	Aug. 31, 1978

Company	Product Name	Chemical Agent	Date of Acceptance
Exxon Chemical Co. 1333 W. Loop South Houston, TX	Corexit 8667	Dispersant	Nov. 1, 1978
Exxon Chemical Co. 1333 W. Loop South Houston, TX	Corexit OC-5	Surface	Nov. 1, 1978
Bioteknika Intl., Inc. 7835 Greeley Blvd. Springfield, VA	Petrodeg 100	Biological Additive	Dec. 15, 1978
Proform Products Corp. 230 California Ave. Palo Alto, CA	Proform-Pollution Control Agent	Dispersant	May 9, 1979
Drew Chemical Corp. One Drew Chemical Pl.	Ameroid Oil Spill Dispersant/LT	Dispersant	May 11, 1979
Polybac Corp. 1251 S. Cedar Crest Blvd., Suite 304A Allentown, PA	Petrobac R	Biological Additive	Aug. 4, 1979
Arco Chemical Co. P.O. Box 370 Sand Springs, OK	ArcoChem D-609	Dispersant	Aug. 20, 1979
Aspra, Inc. 4401 23rd Ave. Seattle, WA	EC.O Atlan'tol AT7	Dispersant	Nov. 13, 1979
American Petrofina P.O. Box 2159 Dallas, TX	Finasol Osr 8	Dispersant	May 21, 1980
Petrocon Marine & Industrial Chemical 243 44th St. Brooklyn, N.Y.	Oil Spill Eliminator N/T No. 4	Dispersant	May 21, 1980
Polybac Corp. 4 West 58th St. New York, N.Y.	Hydrobac	Biological	Dec. 3, 1980

7.1.4. Chemicals for Oil Spill Cleanup

The use of chemicals must be in accordance with Annex X of the National Oil and Hazardous Substances Contingency Plan. The list of accepted chemicals is shown in Table 5.

7.1.4.1 Dispersants

The Federal OSC, on a case-by-case basis, can approve the use of chemical dispersants on any spills if it is determined they will prevent or substantially reduce the hazard to human life or substantially reduce explosion or fire hazard to property. All other cases must be approved by the EPA RRT representative after consultation with appropriate Federal and State agencies. In all cases, appropriate application rates and methods must be used.

7.1.4.2 Collecting Agents

The OSC may authorize use of the surface collecting agents on minor, medium and major discharges on a case-by-case basis if their use will result in the least overall environmental damage or interference with water uses, and greatly enhance removal actions.

7.1.4.3 Burning Agents

The use of burning agents may be authorized on a case-by-case basis by the OSC with approval from the RRT, State, and local air pollution control agency. However, it must be recognized that burning off is potentially one of the most dangerous treatment operations. It should only be considered when it can be determined that the risks to people would be greater if burning were not attempted.

7.1.4.4 Biological Additives

Biological additives, such as bacteria cultures, have proven successful in degrading a variety of chemical wastes. The success of this method is dependent upon many factors, therefore, each case must be evaluated individually.

7.2 CLEANUP TECHNIQUES FOR HAZARDOUS SUBSTANCES

Methods for controlling spills of hazardous substances are shown in Tables 6 and 7. Techniques discussed in Section 8.1 may also be applicable for hazardous substances which float.

Candidate schemes for the treatment and disposal of hazardous substances include: 1) Carbon Adsorption, 2) Filtration, 3) Ion Exchange, 4) Gravity Separation, 5) Neutralization, 6) Coagulation Precipitation, 7) Reduction, 8) Oxidation and, 9) Dilution and Dispersion. These treatment schemes can be achieved either in a batch mode depending on the hazardous materials containment or in a flow through process. Consideration should also be given whether the material can be discharged to a municipal treatment plant without creating a major upset. This may be prior to or following treatment of hazardous materials on site. Also, due to the high solubility of most hazardous substances, success of any treatment scheme is dependent on quick containment of the spilled materials.

7.2.1 Carbon Adsorption

Carbon adsorption is a physical phenomena which removes organic matter and some inorganic chemicals from water. These chemicals are physically adsorbed on the large surface area of the carbon (500-1000 m^2 per gram). Activated carbon is produced from many materials including wood, coal, lignite, etc. The adsorption process and its effectiveness is dependent on the nature of the material being adsorbed and on the type of carbon used. In general, concentrations of greater than 1000 mg/l of a contaminant requires excessive detention times and excessive quantities of carbon. The amount of carbon needed to adsorb a given chemical must be established by field testing. When the capacity of the carbon has been exhausted the carbon must be replaced and the spent carbon disposed of. Table 7 gives general guidelines for the adsorbability of various organics on activated carbon. In situ use of carbon would generally consider the addition of powered activated carbon directly to the spill site. Effective mixing of the carbon with the contaminated water in question is essential for effective adsorption to occur. Off-site treatment would involve pumping the contaminated water through a granular carbon column (See Table 8).

7.2.2. Filtration

Filtration is designed to remove particulate matter by passing the contaminated water through a layer of porous media such as sand. The treatment may be employed as a pre-treatment prior to passing the water through a carbon column or ion exchange system or as a polishing step for removal of a particulate after a chemical reaction. While various types of media are used in

filtration a simplified mode for field application would generally consider a gravity or pressure flow dual media filter column. During a filter run, the head loss will gradually increase due to accumulation of solids within the filter media. When the head loss reaches the limit set by the hydraulic conditions of the filter design the filter run will stop and the filter is backwashed. In some cases the effluent quality from the filter may control the termination of the filter run. Filters may be backwashed with sorted filter effluent, in which case the backwash waste after removal of a suspended solid is retreated and refiltered. In situ filtration may involve permitting water to pass by gravity through a built-up sand or coal bed. Continuous filtration will usually involve bringing in a portable filter for direct application at the site.

7.2.3 Ion Exchange

Ion exchange is a process in which ions held by electrostatic forces to functional groups on the surface of a solid are exchanged for ions of a different species in solution. The process takes place on a resin which is usually made of synthetic material. Various kinds of resin are available including weakly acidic and strongly acidic ion exchange resins depending on the application involved. The ions are exchanged until the resin is exhausted and then the resin is regenerated with a concentrated solution of ions flowing in a reverse direction or replaced with new resin. The amount of resin required must be established by chemical tests done on the wastewater for the ion content of interest. The best type of resin is established mainly by the specific contaminant to be removed, the amount of wastewater involved and other ionic demands on the resin. Ion exchange treatment can be accomplished by off-site pumping of the wastewater in question through an ion exchange column with the ability to either regenerate or replace the resin when it becomes exhausted. In situ treatment in a manner similar to carbon would involve mixing the resin with the wastewater in question in a suitable containment area.

7.2.4 Gravity Separation

Gravity separation involves removal of suspended solids with a specific gravity greater than water by the process of sedimentation or particles with a specific gravity less than water by flotation. Sedimentation is removal of solid particles from a suspension through gravity settling. The process may be used as a pretreatment and concentration step to reduce the load subsequent to other processes, thereby utilizing a natural concentration procedure. Various factors affect the rate of settling including particle size and shape, density and viscosity of water, and the presence of other materials in the water. The rate of settling, while predictable using theoretical equations, should employ a field testing procedure. While sedimentation may involve the

removal of hazardous solid materials, it is most often associated with the coagulation process. Flotation is used to separate the materials with a specific gravity less than water. The contaminant rises to the top and is skimmed off periodically.

7.2.5 Neutralization

Neutralization is a process in which hydroxyl or hydrogen ions are added to a solution to produce an approximately equal concentration or pH 7. Acidic wastes can be neutralized using caustic soda (NaOH), lime ($Ca[OH]_2$), or soda ash ($NaCo_3$). Alkaline wastewaters are neutralized by the addition of hydrochloric acid (HCL) or sulfuric acid (H_2SO_4). Strongly basic NaOH, strongly acidic H_2SO_4 and HCl must be added very carefully to avoid creating a violent reaction. These chemicals may need to be diluted or mixed with sand prior to use in order to avoid a violent reaction. Complete mixing of the contents is especially important to avoid pockets of strong chemicals in the in the liquid. The other agents are considered weaker acids and bases and react slower than the strong acids and bases. The amount of neutralizing chemical required should be determined by a bench scale test.

7.2.6 Coagulation Precipitation

Coagulation precipitation is a process which removes pollutants by reacting these materials to form an insoluable product. This process results in a reaction rather than physical adsorbtion. There is a series of steps to allow effective precipitation; (1) chemical addition, (2) rapid mix, (3) addition of coagulant, (4) flocculation, (5) sedimentation and in some cases (6) filtration. Each precipitation reactions may not require all of these steps. Precipitation is used to remove many types of metal cations and some anions such as fluorides and sulfides. The agents involved in precipitation reaction include calcium, sodium hydroxide, sodium bicarbonate, sulfate and sulfide. These chemicals are added at a certain pH. The amount of chemicals required to precipitate a particular constituent are determined by running a bench scale test. Coagulation involves the addition of a coagulant such as ferric chloride, aluminum sulfate or organic polyelectrolytes in order to precipitate specific wastewater constituents.

Ferric Chloride As Coagulation Aid

This compound is effective in clarifying both organic and inorganic suspensions. The final pH should be above 6 for the best results or caustic soda may be needed to control pH. Large suspensions require dosages of approximately 50-500 mg/l, although larger doses may be needed for very high waste concentration or

alkaline materials needed to raise the pH to 6 or higher. Excessive dosages of ferric chloride will result in a brown colored effluent which should be avoided.

Alum As Coagulation Aid

Aluminum sulfate (Alum) is effective in clarifying both inorganic and organic suspensions. The pH can usually be controlled in a range of 6.5-7.5, and this control is generally crucial for good alum use. If a suspension is to be treated, alum dosages of 100-1000 mg/l should be effective. Huge dosages may be needed for concentrated or highly alkaline suspensions. As with ferric chloride, suspensions with low pH may require addition of lime or caustic soda to produce the final pH range of 6.5-7.5.

Organic Polyelectrolytes As Coagulation Aid

Polyelectrolytes are available in cationic, anionic or nonionic form, and may be effective alone when flocculating suspensions of inorganic materials. These polyelectrolytes are usually not effective alone for flocculating organic suspensions, but can be used in conjuction with alum or ferric chloride. Polyelectrolyte dosages vary with both the type of charge on the plymer and the type of suspension to be treated. Cationic polyelectrolytes are generally added in higher dosages, 1-10 mg/l in dilute suspensions, while anionic and nonionic dosages are added approximately at 0.5-5 mg/l. When the solution is concentrated and the suspension concentration is greater than 1000 mg/l add 1-300 mg/l of cationic polyelectrolyte or 1-100 mg/l of anionic or nonionic compound.

7.2.7 Reduction

Reduction reactions are only applicable to a small number of compounds. Sodium bisulfite has been recommended as the most suitable reducing agent. However, other chemicals including sodium sulfite, sodium metabisulfite, and sodium thiosulfate (photographers' hypo) can also be used. Reduction is used as a pretreatment for chrome compounds to change them to the chromous state for precipitation. This reaction must occur at low pH, so adjustment to pH 2 to 3 with acid is recommended. Reduction is also used for either sodium or calcium hypochlorite and other inorganic halides. A reducing agent can be added until an acceptable chlorine residual is measured. Excess reducing agent can be removed by addition of more wastewater or aeration. Determination of the amount of reducing agent, i.e., sodium bisulfite or its equivalent is determined by a small bench scale testing procedure.

7.2.8 Oxidation

Oxidation reactions are more common than reduction reactions and more agents can be used. Chlorination and aeration are two ways to oxidize materials. Chlorination reactions are the most

commonly used to oxidize cyanides to less toxic cyanate and then to carbon dioxide and nitrogen. These reactions are most effective at alkaline pH so both sodium hydroxide (caustic soda) and hypochlorite are commonly added. Chlorine is more safely added in the form of liquid hypochlorite in concentrations of 5-6%. This is the concentration found in common laundry bleach. Dosages are determined by a bench scale test. Aeration is another method for oxidation. Air can be used as an oxidizing agent and is more available, but not as strong as chlorine or chlorine compounds. In general, air is introduced in the form of bubbles which rise to the surface. As they travel through the water column the oxygen in the air is transferred through the bubble and into the water where it can oxidize the hazardous compound. This technique is only useful for easily oxidized materials. Hydrogen peroxide can also be used to oxidize organic materials under certain circumstances.

7.2.9 Dilution and Dispersal

Only after all other possible alternatives have been investigated and found not to be feasible is the method of handling by dilution and disperal to be considered. This method must be used only as a last resort to minimize local hazards such as permanent contamination of drinking water supplies or damage to wildlife. Care must be taken to determine if this method is feasible because mixing the hazardous chemical with water may cause undesirable side reactions or by-products. Once it has been determined that dilution and dispersal is the only action available, then additional water sources must be brought to the spill site. Water should be added to the stream at a turbulent spot to allow complete mixing with the hazardous material. Care should be taken not to exceed the capacity of the waterbody and extend the hazard past its natural boundary. Dispersion can also be induced by creating mixing zones in the waterway and reducing the pockets of concentrated contaminant which may exist.

Tables 8 and 9 provide information relative to treatment chemicals and chemical reactions. Table 10 lists general sources for treatment chemicals.

In addition to the treatment methods and cleanup techniques described, vacuum trucks should also be considered as an effective means for the removal of oil or hazardous materials spills.

It should also be kept in mind that it may be necessary to remove contaminated soil and vegetation on certain spills in order to completely cleanup certain types of spills depending on toxic effects, reactivity, persistence, etc.

TABLE 6: CONTROL METHODS FOR SPILLS IN WATER - SOLUBLE OR MISCIBLE SPILLS

METHOD	APPLICATION OR CONSTRUCTION MATERIALS	USE	ADVANTAGES	DISADVANTAGES
Sealed Booms	Boom, Device to anchor	Contain depth limited volumes leaking containers	Contain entire depth of water	1. Deployment difficult 2. Not used for large bodies 3. Difficult to get good seal
Diversion of Uncontaminated Flow	Earthmoving Equipment	Special area where topography is right	1. Can put cleaned water into diverted stream 2. Used for flowing water	1. Difficult to move large amounts of earth 2. Clear area needed 3. Impermeability of ground
Diversion of Contaminated Flow	Block entrance with sandbags, sealed booms or dikes	Special area where topography is right	1. Can put clean water back into stream 2. Used for flowing water	1. Difficult to move large amounts of earth 2. Clear area needed 3. Impermeability of ground 4. Adverse environmental impact
Gelling Agent	Gels, Dispersion Devices; experienced personnel needed	If small volumes	1. Stop flowing contaminant 2. Stop permeation	1. Hard to obtain 2. Can't use in large area 3. Must haul to dispose
Containment of Entire Waterbody	Diking Materials, Earthmoving Equipment, Sandbags, etc., Lining	For entirely contaminated area	1. Can allow containment of large waterbody 2. Materials on site 3. Easily constructed	1. Not all waterbodies have containable overflow 2. Permeability 3. May be an unstable condition

TABLE 6: CONTROL METHODS FOR SPILLS IN WATER - HEAVIER THAN WATER SPILLS

Natural Excavations & Dikes	none	Where a natural barrier exists	No construction needed	Can't control area which contains the spill
Construction of excavations & dikes	Dredges, hydraulic or vacuum pumps Divers with pumps place concrete/sandbags around to form dike if bottom material is not sufficient.	If bottom can be moved	Material is on site	1. Hard to construct 2. Stirred up bottom may cause dispersion and increased turbidity

TABLE 7
INFLUENCE OF MOLECULAR STRUCTURE
AND OTHER FACTORS ON ADSORBABILITY

1. An increasing solubility of the solute in the liquid carrier decreases its adsorbability.

2. Branched chains are usually more adsorbable than straight chains. An increasing length of the chain decreases solubility.

3. Substituent groups affect adsorbability:

Substituent Group	Nature of Influence
Hydroxyl	Generally reduces adsorbability; extent of decrease depends on structure of host molecule.
Amino	Effect similar to that of hydroxyl but somewhat greater. Many amino acids are not adsorbed to any appreciable extent.
Carbonyl	Effect varies according to host molecule; glyoxylic is more adsorbable than acetic but similar increase does not occur when introduced into higher fatty acids.
Double Bonds	Variable effect as with carbonyl.
Halogens	Variable effect.
Sulfonic	Usually decreases adsorbability.
Nitro	Often increases adsorbability.

4. Generally, strong ionized solutions are not as adsorbable as weakly ionized ones; i.e., undissociated molecules are in general preferentially adsorbed.

5. The amount of hydrolytic adsorbtion depends on the ability of the hydrolysis to form an adsorbable acid or base.

6. Unless the screening action of the carbon pores intervene, large molecules are more sorbable than small molecules of similar chemical nature. This is attributed to more solute carbon chemical bonds being formed, making desorption more difficult.

TABLE 8
CARBON ADSORPTION

PRIORITY POLLUTANTS EFFECTIVELY REMOVED BY ACTIVITATED CARBON	ORGANICS OF DIFFERENT TYPES EFFECITVELY REMOVED BY ACTIVIATED CARBON
Acrolein	Acetic acid
Aldrin	Acetone
Aroclor 1254	Aniline
Arochlor 1260	Benzoic acid
Benzene	P-Cresol
Chlorobenzene	O-Cresol
1,3 Dichlorobenzene	Diethyl Ether
1,4 Dichlorobenzene	Dimethyl Malonic acid
Hexachlorobenzene	Heptanoic acid
Nitrobenzene	Hydroquinone
Bis(2 chloroethyl) ether	Isopropyl alcohol
Carbon Tetrachloride	Methylene blue
Chlordane	Methyl Parathion
DDD	B-Naphthol
DDE	Parathion
DDT	PEG[1]-400
Dichloromethane	PEG[1]-1000
Dieldrin	O'O-Biphenol
n-Dibutyl Phthalate	2-6 Dimethylphenol
1,2 Dichloroethane	Phenylacetic acid
Endrin	Propylamine
Heptachlor	Resorcinol
Hexachlorobutadiene	
Hexachlorocyclopentadiene	
Lindane	
Naphthalene	
Phenol	
O-Chlorophenol	
2,4 Dichlorophenol	
2,4,6 Trichlorophenol	
4, Nitrophenol	
1,1,2,2 Tetrachloroethane	
Tetrachloroethylene	
Toluene	
2,6 Dinitrotoluene	
Trichloroethylene	

TABLE 9

CHEMICAL REACTION OPERATING PARAMETERS

Process	Type	Mixing Time (min)	Endpoint	Chemicals
Chemical Sedimentation	Rapid Flocculation	1-5 5-15 depends on rate and process height	Clarified water and good settling	Ferric Chloride Aluminum Sulfate Polyelectrolytes
Neutralization	Rapid	10-30, Use 30 min for lime addition	Add to pH 7, use pH paper or meter to check	Calcium Hydroxide Calcium Oxide, Sodium Hydroxide, Sodium Carbonate, Sulfuric Acid, Acetic Acid, Hydrochloric Acid
Precipitation	Rapid Flocculation None	1-5 5-10 30-60 depends on rate and process height	Varies to a pH or until residual of reactant or until clarified	Calcium Hydroxide, Sodium Hydroxide, Sodium Carbonate, Sodium Bicarbonate, Sodium Sulfate, Sodium Sulfide, Potassium Chloride
Oxidation	Rapid	10-30	to a HOCl residual of 1 mg/l	Sodium Hypochlorite
Aeration	Air mix	Depends on test	D.O. measure to 70% of saturation or other	Air
Reduction	Rapid	10-30	Large ORP change/ Cr+6 ---Cr+6 is yellow to green HOCl reduction, no	Sodium Bisulfite Sodium Sulfide

TABLE 10

GENERAL SOURCES FOR VARIOUS TREATMENT CHEMICALS

Chemical	Sources
Acetic acid	Plastic or electronic industries, grocery distributors (vinegar)
Alum	Water treatment plants
Ammonium salts	Hospitals, dye manufacturers
Anion exchangers	(must specify pollutant) water softener suppliers
Bottom pumps	Fire departments, EPA Regional offices, Coast Guard
Calcium carbonate (limestone, practically insoluble in water)	Cement plants
Carbon	Water treatment plants, sugar refineries
Cation exchangers	(must specify pollutant) water softener suppliers
Charcoal	Hardware stores, grocery distributors
CO_2	Soft drink dealers, compressed gas dealers
Epsom salts	Drug stores, groceries
Ferric (or iron) salt ($FeCl_3$)	Water treatment plants, photography shops
Lime	Cement plants
Peat moss	Nurseries, florists
Sodium bicarbonate (baking soda)	Grocery distributors, bakeries
Sodium carbonate (soda ash)	Grocery distributors, bakeries
Sodium chloride (table salt)	Grocery distributors
Sodium sulfate	Dye manufactures
Sodium thiosulfate	Photography shops, tanneries, pulp mills

TABLE 11

CONTROL METHODS FOR SPILLS ON LAND

TYPE	APPLICATION OR CONSTRUCTION METHOD	USE	ADVANTAGES	DISADVANTAGES
Dikes:				
Earthen	Created with bulldozer or earthmoving equipment to compact earth (height depends on earth type)	Flat or sloped surface	1. Material on site 2. Construct with common equipment	1. Natural permeability of soil 2. Seepage through ground 3. Surface composition of soil not suitable in all cases
Foamed Polyurethane	Use trained personnel to construct	Hard, dry surfaces	1. Hold up to several feet of water	1. Leaks on wet ground 2. Hard to obtain dispersion device
Foamed Concrete	Use trained personnel to construct	Flat ground Slow moving spill	1. Better adhesion to substrates (clay/shale/grass)	1. Hard to obtain foam and dispersion device 2. Must set for a time period 3. Will not hold high hydraulic heads
Excavation	Bulldozer or earthmoving equipment - line if possible	Soft ground Natural cavitation	1. Material on site 2. Construct with common equipment	1. Move large amounts of materi 2. Natural permeability of soil 3. Surface of soil not suitable in all cases
Excavation & Dikes	Bulldozer or earthmoving equipment - line if possible	Soft ground	1. Need less space than separate 2. Material on site 3. Construct with common equipment	1. Move large amounts of materi 2. Natural permeability of soil 3. Surface of soil not suitable in all cases

TABLE 12

CONTROL METHODS FOR SPILLS IN AIR

TECHNIQUE	METHOD	USE	ADVANTAGES	DISADVANTAGES
Mist Knock Down	Spray fine mist into air	Water soluble or low lying vapors	Removes hazard from air	Create water pollution problem must be contained in solution
Fans or Blowers	Disperse air by directing blower toward it	Very calm and sheltered areas	Can direct air away from populated areas	1 Not effective if any wind 2. Need large capacity blowers 3. Hard to control

7.3 CONTROL OF LAND AND AIR SPILLS

7.3.1 Land Spills

Whenever possible, spills should be contained on land as long as a greater risk to life and property is not created by doing so. Successful cleanup and treatment is much more likely and considerably less expensive when the material is contained before it reaches water. Table 11 presents several methods for controlling spills on land.

In cases where the soil is particularly porous, materials spilled on land may migrate down to the water table. If this occurs, recovery is very difficult and may require the digging of wells for purposes of monitoring movement or recovery of the material. In such cases the technical assistance of a groundwater hydrologist or other appropriately trained individuals will be required.

7.3.2 Air Spills

Air spills (vapors, mists, etc.) are extremely difficult to control. Evacuation of the affected area is often the only practical choice. However, Table 12 shows several methods which may be considered in specific cases. When using a spray mist, consideration must be given to the possible creation of a water pollution problem.

8.0 DISPOSAL/RECOVERY PROCEDURES

After cleanup operations have removed the spilled material(s) and contaminated debris from the water or ground, the OSC's responsibilities are not over. Improper shipping and disposal of spilled cleanup waste can cause serious safety problems, as well as result in secondary pollution as bad as, if not worse than, the original spill. Therefore, the OSC must be assured that all chemical disposal is carried out in a safe and proper manner.

Disposal/recovery operations may involve the shipping of the waste materials to a state approved land disposal site, treatment by a reliable disposal or recycling company, or sending the material to a sewage treatment plant, etc. The preferred method of disposal would be to recycle to the spiller's company or to a company that can use the material in its operation.

In all cases involving the disposal/recovery of oil and hazardous substances, contact and coordination should be made with all affected parties. EPA looks to the State pollution control agencies to obtain disposal sites and act as liaison between the Federal government and local agencies such as disposal sites, air pollution control agencies, sewage treatment plants, etc.

Extremely toxic materials may require special on-site treatment, or as in the case of PCB's either incineration or shipment to an EPA/State approved disposal site. EPA, Edison, New Jersey, has specialized equipment that may be available to treat these very toxic materials. Coordination of this activity will be conducted by the EPA Emergency Response Team.

Generators (spillers) and transporters of hazardous waste materials must obtain the appropriate EPA identification numbers as required by RCRA (see Section 4.4).

9.0 SPECIAL CONSIDERATIONS

9.1 SAFETY/DECONTAMINATION

9.1.1 General Considerations

The safety of the people who arrive on the scene of an oil or hazardous material spill is critical to consider before any action is taken. All spills are considered extremely dangerous.

Safety considerations should receive priority during the decision-making process. Persons responding to spills are not expected to risk personal injury or contamination through intimate physical contact with spilled materials, vapors, etc. Team members should assess the situation and coordinate activities from outside the high risk area and should enter such areas only in the

event of imminent hazard to life and then only if proper equipment is available, the individual has been thoroughly trained in its use, and two additional trained and properly equipped persons are standing by to provide assistance.

Although the response organization utilized for responding to the discharge of a hazardous chemical incident is similar to that for responding to an oil discharge, the state-of-the-art in physically dealing with discharges of hazardous chemicals is limited. The inherent risk of life or limb involved in dealing with certain hazardous chemicals will make available response actions unfeasible on occasion. Extreme care should be excercised when responding to spills of this nature, especially in initial stages. The following general precautions should be taken:

1. Always approach a spill from upwind
2. Avoid direct or indirect contact with spilled material
3. Remove all ignition sources
4. Restrict access to area
5. Obtain assistance

If a vehicle carrying flammable liquids or compressed gas is wrecked, do not drive your car near the wreckage as it may cause the material to ignite.

Keep fires, open flames, lanterns or flares, lighted cigarettes, cigars and pipes away from the scene.

Warning signals should be set up to prevent further accidents. It is recommended that flame producing signals (flares, fuses, or open flame lanterns) not be used when an accident involves dangerous material of any type. The use of flame producing signals is specifically prohibited by the Department of Transportation for any cargo tank vehicle used for transporting flammable liquids or flammable compressed gas and for any vehicle transporting explosives, Class A or B.

Prevent leaking liquids from draining onto the highways or into sewers and streams by damming up the liquid or by digging a drainage trench, etc. Tipped containers that might be leaking should be set upright, if possible. Powdered materials should be covered with a blanket, dirt or other material to prevent blowing about.

Should any of the material being transported get on your skin or clothing, you should remove it as soon as possible by washing. You should then try to identify the material as soon as possible and contact Chemtrec, EPA, and the local or State Health Department to see if there is a potential danger and if so, how to handle the situation. Something that may not seem dangerous could

have serious side effects. For example, materials which come into contact with your pants leg may not cause illness or discomfort to an adult, but later in the home, a small child coming into contact with the contaminated clothing could be made seriously ill or killed. For this reason, it is IMPERATAIVE that you find out how the material should be treated. You may have to remove your clothing outside so that your vehicle, home or office does not become contaminated and cause unnecessary illness or death. If in doubt, remove contaminated clothing before entering a building and shower as quickly as possible to remove any contamination that may be on the skin or in the hair.

Even though many spilled materials will be in a solid or liquid form, the greatest danger to personnel is from inhalation or exposure to airborne gases, dusts, vapors, or fumes. The dangers from vaporization, sublimation, or secondary reactions which produce toxic airborne materials cannot be overemphasized.

Common sense and alertness will prevent most accidents; conversely, overconfidence and ignorance are the leading causes of injury.

9.1.2 Site Control

Traffic and spectators should be kept away from the accident. Do not let vehicles stop in, or pass through, the area of the spilled materials.

If hazardous or toxic vapors are escaping from a spill, it is best to take action to evacuate people from the area downwind from the spill until the spill has been cleaned up.

In the event that the evacuation of civilian personnel becomes necessary, the procedure should be coordinated through local officials. Although the OSC may determine that evacuation may be advisable in any given situation, the responsibility to make such a decision rests with local civilian officials. Close liaison with local police and fire officials is a necessity.

Access to the control site is limited to essential personnel. The designated control site consists of the command post (upwind and outside the contamination control site), contamination reduction area, and exclusion area.

The complexity and size of the controlled site is dependent upon the actual site conditions and decontamination requirements. Figure 18 illustrates a controlled site situation.

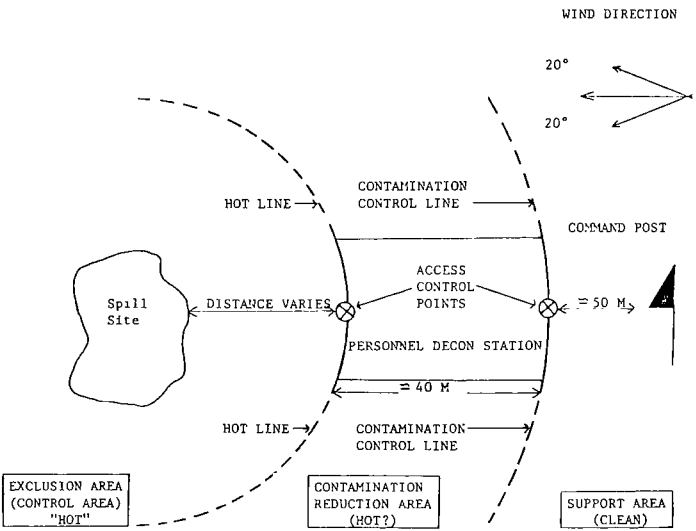


FIGURE 19 FIELD CONTROL SITE

9.1.3 Equipment and Clothing

Spills of toxic materials can drastically alter the ambient environment. Consequently, an accurate assessment of hidden dangers is an integral part of safety considerations. Field monitoring equipment for oxygen deficiency, combustible gases and vapors, and radiation are necessary in atmospheres where these problems could be found.

It is important that personnel protective equipment and safety requirements be appropriate to protect against the potential or known hazards at an incident. Protective equipment should be selected based on the type(s), concentration(s), possibilities, and route(s) of personnel exposure from the substance(s) at a site. In situations where the type of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the personnel protection equipment required for initial safety.

The appropriate level of protection should be determined prior to the initial entry on-site based on best available information. Subsequent information may suggest changes in the original level selected.

Levels of Protection

When response activities are conducted where atmospheric contamination is known or suspected to exist; there is a potential for the generation of vapors or gases; or direct contact with toxic substances may occur, equipment to protect personnel must be worn. Personnel protective equipment is designed to prevent or reduce skin and eye contact as well as inhalation or ingestion of the chemical substance. Respirators can protect the lungs, gastro-intestinal tract, and eyes against atmospheric hazards. The surfaces of the body can be protected against contact with and possible adsorption of chemicals by chemical-resistant clothing. Good personal hygiene practices prevents ingestion of toxic materials.

Personnel equipment to protect the body against contact with known or anticipated chemical hazards has been divided into four categories commensurate with the degree of protection afforded.

LEVEL A - protection should be worn when the highest level of respiratory, skin, eye and mucous membrane proteciton is needed.

LEVEL B protection should be selected when the highest level of respiratory protection is needed, but a lesser level of skin and eye protection. Level B protection is the minimum level recommended on initial site entries until the hazards have been further identified and defined by monitoring, sampling, and other reliable methods of analysis, and personnel protection corresponding with those findings utilized.

LEVEL C - protection should be selected when the type(s) of airborne substance(s) is known, the concentration(s) is measured, the criteria for using air-purifying respirators are met, and skin and eye exposure is unlikely. Periodic monitoring of the air must occur.

LEVEL D is primarily a work uniform. It should not be worn on any site where respiratory or skin hazards exit.

The appropriate Level of Protection to be selected should be based on two major parameters:

1. Types and measured concentration(s) of the chemical substance(s) in the atmosphere with its (their) associated toxicity.

2. Potential for exposure to high air concentrations of volatile substances splashes of liquids, or other types of direct contact with material due to work functions being performed.

In situations where the type(s) of chemical(s), concentration(s) and possibilities of contact are not known, a more subjective determination based on professional experience and judgement must be made for selecting the appropriate Level of Protection.

While personnel protective equipment reduces the potential for personnel contact with harmful chemical substances, insuring the health and safety of response personnel requires that in addition to protective clothing and respiratory protection, safe work practices, standard operating procedures, decontamination, site entry protocols, and other safety considerations be developed and implemented. Together these protocols establish a comprehensive approach for reducing potential harm to response workers.

LEVEL A PERSONAL PROTECTIVE EQUIPMENT

Pressure-Demand, Self-Contained Breathing Apparatus (OSHA/NIOSH approved)
Fully-Encapsulating Chemical Resistant Suit
Gloves, inner, chemical resistant
Boots, chemical resistant, steel toe and shank. (Depending on suit boot construction, worn over or under suit boot.)
Gloves, outer, chemical resistant
Underwear, cotton, long-john type.*
Hard Hat* (under suit)
Disposable protective suit, gloves, and boots*
(Worn over fully-encapsulating suit).
Coveralls* (under suit)
2-way radio communications (intrinsically safe)

*Optional

CRITERIA FOR SELECTION OF LEVEL A PROTECTION

When the chemical substance(s) have been identified and require the highest level of protection for the respiratory system, skin and eyes based on:

1. Measured or potential for high concentration(s) of vapors, gases or particulates in the atmosphere that will effect the skin.

2. Site operations and work functions involve high potential for splash, immersion or exposure to unexpected vapor generation of chemical compounds which are extremely hazardous to the skin.

When extremely hazardous substances such as, but not limited to, dioxin, cyanide compounds, concentrated pesticides, Department of Transportation Poison A materials, carginogenic agents, and infectious substances, are known or suspected to be present and contact with this material is possible.

Operations that must be conducted in confined, poorly ventilated areas, until the absence of hazards requiring Level A protection is demonstrated.

Total atmospheric readings on the OSHA/NIOSH approved portable air monitoring devices or equivalent instrumentation, indicate Immediately Dangerous to Life or Health (IDLH) concentrations present of a known contaminant or 500-1000 ppm of an unknown contamiant.

GUIDANCE ON SELECTION CRITERIA FOR LEVEL A PROTECTION

The fully-encapsulating suit provides the highest degree of protection to the skin, eyes, and mucous membrane providing the suit material is impermeable to the chemical(s) of concern over the period of time the suit is to be worn and/or at the measured or anticipated concentrations. While Level A provides the maximum protection available, clothing material may be rapidly permeable to and penetrated by certain chemicals in extremely high air concentrations, splashes or immersion of boots or gloves in concentrated liquids or sludges. Although these limitations are seldom encountered in response operations, they should be recognized and considered.

The use of Level A protection requires that the problems of physical stress, in particular heat stress associated with the wearing of impermeable protective clothing, be evaluated. Response personnel shall be carefully monitored for physical tolerance and recovery. Heat stress problems are also associated with wearing Level B and C protection.

Many toxic substances are not amenable to field detection or rapid qualitative and quantative analysis. In situations where these materials are known or suspected to be present and personnel contact with them unavoidable, especially those which are readily

absorbed by the skin, Level A protection should be worn, until more definitive information can be obtained.

An upper valve of 1000 ppm total organic vapors/gases has been established for the use of Level A Protection. An indication of 1000 ppm or greater should not be misinterpreted as a level that will exceed the protection afforded by a fully-encapsulating suit, but as a check point for evaluating the need for more extensive qualitative and quantitative analysis before entry continues.

LEVEL B PERSONAL PROTECTIVE EQUIPMENT

Pressure-Demand, Self-Contained Breathing Apparatus (OSHA/NIOSH approved)
Chemical resistant clothing (overalls and long sleeved jacket; coveralls; hooded, two-piece chemical-splash suit; disposable chemical resistant coveralls)
Coveralls (under splash suit)*
Gloves, outer, chemical resistant
- Gloves, inner, chemical resistant
Boots, outer, chemical resistant, steel toe and shank
Boots, outer chemical resistant (disposable)*
2-way radio communications (intrinsically safe)
Hard Hat*
Face Shield*

CRITERIA FOR SELECTION OF LEVEL B PROTECTION

When the type(s) and atmospheric concentration(s) of toxic substances are known and require the highest degree of respiratory protection, but a lower level of skin and eye, protection. These would be:

1. Atmospheres with concentrations Immediately Dangerous to Life and Health (IDLH) or

2. Air concentrations exceeding protection afforded by a full-face, air-purifying mask or

3. Atmospheres containing substances for which air-purifying cartridges or canisters do not exist or have low removal efficiency.

Atmospheres with less than 19.5% oxygen.

Potential dermal and eye exposure due to site operations or work assignments is highly unlikely or is within skin exposure guidelines or does not require a fully-encapsulating suit.

Total atmospheric vapor concentrations range from 5 ppm to 500 ppm on instruments such as the OSH/NIOSH air monitoring system and vapors are not suspected of containing high levels of chemicals toxic to the skin.

GUIDANCE ON SELECTION CRITERIA FOR LEVEL B PROTECTION

Level B personnel protective equipment provides a high degree of protection to the respiratory tract, but a somewhat lower level of protection to the skin and eyes. The chemical resistant clothing required in Level B is available in a wide variety of styles, materials, construction detail, permeability, etc. these factors all effect the degree of protection afforded. Therefore, the selection of the most effective chemical resistant clothing (and fully-encapsulating suit) should be done by a qualified individual based on the known or anticipated hazards and/or job function required.

The selection of Level B rather than Level A is generally based on the protection needed against known or anticipated toxic hazards affecting the skin. The determination is based on:

1. Comparison of air concentrations of identified substances with criteria for protection for skin.

2. A lesser potential for splash, vapor generation, or contact with substances because of job functions and/or the substances encountered are judged to present a lesser degree of hazard to the skin.

3. The absence of toxic substances affecting the skin, or substances that are not amenable to rapid field analysis or monitoring.

For initial site entry and reconnaissance at an open site, approaching whenever possible from the upwind direction, Level B Protection (with good quality, hooded, chemical resistant clothing) should protect response personnel providing the conditions described in selecting Level A Protection are known or judged to be absent.

An upper value of 500 ppm total vapor/gas concentration for wearing Level B was selected as a concentration above which upgrading to Level A protection may be warranted. A major factor for reevaluation is the identification and potential for the vapor/gases to be skin hazards requiring a higher degree of protection.

In situations where extensive personnel decontamination may be required, the exposed self-contained breathing apparatus (SCBA) presents a decontamination problem. To prevent or reduce such difficulties, Level A protection which is less difficult to decontaminate could be worn, or a modified Level B using a chemical resistant apron (smock), or a disposable, encapsulasting garment worn over the chemical resistant suit.

LEVEL C PERSONAL PROTECTIVE EQUIPMENT

Full-face, air-purifying respirator (OSHA/NIOSH approved)
- Chemical resistant clothing (one-piece coverall; hooded, two piece chemical splash suit; chemical resistant hood and apron; disposable chemical resistant coveralls)
Gloves, outer, chemical resistant
Gloves, inner, chemical resistant*
Boots, steel toe and shank, chemical resistant.
- Cloth coveralls* (inside chemical protective clothing)
Hard Hat (face shield)*
Boots, outer, chemical resistant (disposable)*
2-way radio communications (intrinsically safe)
Escape mask

CRITERIA FOR SELECTION OF LEVEL C PROTECTION

Measured air concentrations will be reduced by the respirator to or below the substance's protection guideline and the concentration is below the service limit of the canister.

Atmospheric contaminant concentrations do not exceed the IDLH levels.

Contaminant exposure to unprotected areas (head and neck) are within skin exposure guidelines, or dermal hazards do not exist.

Job functions and potential for high exposures have been judged not to require a higher Level of Protection.

Total vapor readings register between 0 ppm and 5 ppm above background on OSHA/NIOSH approved portable air monitoring instruments.

Periodic air monitoring must occur.

GUIDANCE ON SELECTION CRITERIA FOR LEVEL C PROTECITON

Level C protection is distinguished from Level B in the equipment used to protect the respiratory system, assuming the same type of chemical resistant clothing is used. The main selection criteria for Level C is that conditions are such that air-purifying devices may be worn.

The air-purifying device must be a full-face mask (OSHA/NIOSH approved), equipped with a chin or harness suspended canister. Canister/cartridges must be appropriate to remove the substances encountered. Quarter or half-masks or cheek cartridge full-face masks, should not be used on a routine basis for response activities and only when their use is approved by a qualified individual.

*Optional

In addition, a full-face, air-purifying mask shall be used only under the following conditions:

1. Oxygen content of the atmosphere is at least 19.5% by volume.
2. Substance(s) is identified and it's concentration(s) measured.
3. Substance(s) has adequate warning properties.
4. Individual is successfully qualitative fit-tested to the mask.
5. Appropriate cartridge/canister is used and its service limit concentration is not exceeded.

Whenever Level C is used, an air monitoring program must be instituted to detect any changes in atmospheric concentrations. An air monitoring program is required during all longer-term site operations where atmospheric contamination may occur.

Total unidentified vapor/gas concentrations of 5 ppm above background concentrations require that Level B protection be used. The selection of Level C (air-purifying respirators) protection for use in an unidentified vapor/gas concentration from 0-5 ppm above background should only be done by a qualified individual. When using the cannister-type mask for known contaminants, Level B protection should be used when readings over 1000 ppm. are detected.

LEVEL D PERSONAL PROTECTIVE EQUIPMENT

Coveralls
Boots/shoes, safety or chemical resistant steel toe and shank
Boots, outer (chemical resistant disposables)*
Safety glasses or chemical splash goggles*
Hard Hat (face shield)*
Escape Mask*
Gloves*

CRITERIA FOR SELECTION OF LEVEL D PROTECTION

No idication of any atmospheric hazards.

Work function precludes splashes, immersion, or potential for exposure to any chemicals.

GUIDANCE ON SELECTION CRITERIA FOR LEVEL D PROTECTION

Level D protection is primarily a work uniform and should not be worn in any area where the potential for contamination exists.

In situations where respiratory protection is not necessary, but site activies are needed, chemical resistant garments high quality or disposable must be worn.

CONSIDERATIONS FOR SELECTING LEVELS OF PROTECTION IN UNKNOWN ENVIRONMENTS

The protection of the health and safety of response personnel is an important consideration in all site operations. Selecting the appropriate personnel protection equipment to be worn is one of the first requirements in reducing the potential for adverse health effects. Until the hazardous conditions presented by an environmental episode can be identified and personnel safety commensurate with the recognized hazards - real or potential - instituted, preliminary measures to protect the health and safety of response personnel will have to be based on experience, judgement and professional knowledge applied to the particular incident at hand. Lack of knowledge concerning the hazardous environment that could be encountered precludes the use of conventional decision logic for selecting protective equipment based on comparing environmental concentrations of known toxicants against protection factors associated with various types of personnel protective equipment.

One of the first considerations for evaluating the risk of an unknown environment is the presence of immediate atmospheric hazards such as the concentrations of vapors/gases or their potential, oxygen content of the air, explosive potential, and to a lesser degree, the possibility of radiation exposure. In addition to air measurements, the degree of risk from other materials that are explosive, have a high fire potential, are extremely toxic or exhibit other hazardous characteristics that can not conveniently be monitored by field instruments, must be determined by visual observation and/or an evaluation of existing data.

The initial on-site survey and reconnaissance which may consist of more than one entry is to characterize the immediate hazards and based on these findings, establish safety requirements. As data is obtained from the initial survey, the Level of Protection and other safety procedures are adjusted accordingly. No method exists for selecting a level of proteciton in an unknown environment which is applicable to all situations. Each unknown situation must be examined based on its own unique circumstances. Some general criteria or approaches can be given, however, for judging the situation and determining the Level of Protection required.

A. Level C protection (full-face, air-purifying respirator) should not be worn routinely in an atmosphere until the type(s) of air contaminant(s) is identified and its (their) concentrations measured. To permit a degree of flexibility in prescribing a Level of Protecton at certain environmental episodes and/or site operations air-purifying respirators could be considered for use by a qualified individual, in

unidentified vapor/gas concentrations of a few parts per million. The guideline of total vapor/gas concentration of 0-5 ppm above background should not be the sole criteria for selecting Level C. Using the canister-type mask with known contaminant level readings up to 1000 ppm may be acceptable. Should there be additional unidentified vapor/gas concentrations in the atmosphere, it may be necessary to upgrade the level of protection. Since the individual contributors to the total vapor/gas concentrations may never be completely identified, a value judgement for continual wearing of Level C must be made, after assessing all safety considerations.

QUALIFIED PERSONNEL

The selection of the most effective Level of Protection requires not only expertise in the technical areas of respirators, protective clothing, site safety procedures, environmental monitoring, etc., but also experience and professional judgement. The correct decisions concerning the selection of personnel protection equipment can only be made by an individual who through a combination of professional education, on-the-job experience, short course training, and continual study is qualified. The technical judgements that are required for evaluating a particular set of circumstances and determining the apropriate safety requirements should only be done by a competent, qualified person.

9.1.4 Medical

All personnel who will be involved in field activities where there is a potential for exposure to hazardous substances should be offered pre-assignment and periodic medical exams and an appropriate medical exam after each exposure to hazardous substances. The examination should be designed specifically to detect results of low-level exposures.

9.1.5 Training

Personnel responding to spill incidents must be thoroughly trained in both program and safety areas pertinent to their respective tasks. Program training should include a basic orientation to legislation, field procedures, coordination requirements, etc. Safety training should involve recognition of hazards, use and limitations of appropriate personal safety equipment, basic first aid, etc. This training is for the purpose of enabling personnel to recognize and avoid hazardous situations and should not be construed as encouraging deliberate exposure to hazardous substances. Periodic training and practice in use and care of safety equipment is necessary to maintain adequate skill levels.

9.2 WATERFOWL CONSERVATION

Oil and hazardous substance discharges, particularly in estuarine and near shore areas, often cause severe stress to resident and migratory bird species. The DOI (Department of

the Interior) representatives and the State liaison to the RRT will arrange for and coordinate actions of professional and volunteer groups that wish to establish bird collection, cleaning, and recovery centers.

9.3 ENVIRONMENTAL DAMAGE ASSESSMENT

Even though initial response to an environmental emergency does not include a formal damage assessment, the field investigator should be alert to the obvious signs of environmental harm. This could include indications of a fish kill, oiled and dying birds, contamination of beaches and marshlands, etc. Any signs of environmental damage should be reported to the EPA Emergency Response Team who will, in conjunction with the appropriate resource agencies, coordinate any necessary damage assessment.

10.0 SAMPLING AND DOCUMENTATION

10.1 SAMPLING PROCEDURES

The collection and subsequent analyses of samples is important in evaluating the progress of spill clean-up, the exposure levels of clean-up personnel and exposed general population and the damages to natural resources. Therefore, it is also important to collect samples as soon as possible after the spill occurs for spill identification and assessment and for later use as evidence. Likewise, it is important to collect samples at the beginning of and during the cleanup operation to document the progress of the cleanup. Proper sample collection involves a variety of factors relating to container material, quantity of samples, preservation, hazards to sampling personnel and others which are most properly addressed by having a sample collection SOP prepared in advance of response activities and having sampling done by professional personnel operating in concert with the selected analytical laboratory.

10.1.1 Method of Sampling

Sample collection during the early phases of response actions will generally be discrete grab samples collected manually. Samples should not be collected without adequate forthought as to the desired data outputs and the hazard of the material involved. There are certain objectives of sampling during hazardous materials incidents which occur frequently enough to list as generally applicable to all incidents.

1) releases material - a sample (generally 1 pt or less in glass) of the undiluted spilled material may be collected by hand with adequate safety precautions to document the hazard, identify responsible parties and evaluate treatment and disposal options.
2) reaction products released material mixed in some environmental matrix (soil or water) may be sampled (generally for more of the same containers as the pure spilled product) to assist with evaluations of removal and recovery options.

3) exposure of personnel - sampling of atmospheric or potable water supply contamination is generally performed by an experienced team with specialized materials.

In summary, sampling at the scene of a spill will usually be performed manually because of the emergency and temporary nature of the situation. Also, the presence of personnel on the scene may make it convenient and economical to take manual field samples. Guidance on selection and use of automatic samplers analytical devices can be found in other publications. The following discussion will assume manual sample collection although the theory could also apply to the use of an automatic sampler.

10.1.2 Type of Samples

There are two types of samples which can be collected for analysis: 1. Grab (discrete samples) and 2. Composite samples.

Grab or discrete samples characterize the material being sampled at a particular instant in time. The purpose of a composite sample is to mix discrete samples in such a way to represent the average characteristic over a period of time or over an extensive area. In addition to generating an average value, composition is often done to reduce the analytical load placed on the laboratory.

The choice of the type of sample should depend on the objective of the sampling and the variability of the material or area. If the variability of the parameter of interest is low (that is, if the concentration of the parameter of interest changes little over time), then a grab sample may characterize the quality adequately. On the other hand, if the variability is high, then a composite should be formed from grab samples taken at short intervals, or the grab samples themselves should be collected and analyzed. If nothing is known about the variability of the material, then grab samples should be collected and analyzed initially to determine the variability. Judgement will have to be exercised in terms of the allowed variability.

10.1.3 Sample Containers

Samples must be taken in appropriate sample containers to reduce the possibility of contamination or adsorption which will yield incorrect results. The container must be completely clean and equipped with a tightly fitting cap. Organic hazardous materials must be contained in a glass jar or bottle to reduce adsorption to the container walls. Specifically, oils and grease, pesticides, or even short chain organic compounds should be placed into glass containers. Other materials such as metallic salts, can be stored in plastic containers with no adverse effect.

Sample containers should be provided from the nearest analytical laboratory to insure use of the proper type or, if necessary, the bottles can be purchased from a local bottle supplier. If possible, use wide mouth containers with a lined cap except where interaction between the sample and cap material must be modified. (Then use narrow necked containers.) If commercial sample bottles can not be obtained, wide mouth canning jars can be used if an aluminum foil liner is provided. Where a plastic container is applicable, distilled water can be purchased, the bottles emptied and the containers used when no other bottles are avaialble. However, the use of these bottles is not recommended without specific instructions from the OSC.

To clean sample containers prior to reuse, the following procedures have been found to be effective:

1. Wash containers and caps with non-phosphate detergent and scrub strongly with a brush.
2. Rinse with tap water, then distilled water.
3. Invert to drain dry.
4. If additional cleaning is needed, rinse with sulfuric acid, tap water and distilled water.

In certain cases, sample bottles are further rinsed with chemicals to remove traces of materials left by previous samples. These procedures are outlined as follows:

1. Acid Rinse: If metals are to be analyzed, rinse the container with a solution of one part nitric acid to four parts water, then with distilled water. If phosphorus is to be analyzed, rinse the container with a solution of one part hydrochloric acid to one part water followed by distilled water.
2. Solvent Rinse: If oil and grease or pesticides are to be analyzed, rinse the sample container with hexane, then acetone, and distilled water. The container should have been previously cleaned with acid solution. Treat the container caps similarly.

For long term monitoring, however, the analytical laboratory performing the analyses should provide prepared bottles for sampling.

10.1.4 Sample Preservation

The purpose of sample preservation is to maintain the constituents of interest in the same concentration as when the sample was collected. Even with preservation, the concentrations of the constituents may be a function of the time between sample collection and alayses. Therefore, for any given preservation method a maximum holding time is also specified. Other factors related to preservation that may affect the integrity of the sample include the type and material of the sample container, sample identification, and the chain of custody for sample handling. For the preliminary or initial sampling, refrigeration of the samples should be adequate. While not effective for all parameters, refrigeration is recommended as a standard technique since it comes closest to being a universal preservative and does not interfere with any analyses.

For a long term sampling program or for process monitoring samples, the laboratory performing the analyses should be consulted for specific instructions regarding preservation techniques and sample containers.

10.1.5 Sample Identification

Once the sample is taken, certain procedures must be followed to allow the identification of the sample and to record the chain of custody. It is important that these techniques be standardized and become a part of normal field procedure.

Each sample should be assigned a unique number to allow easy identification in the field and the laboratory. It is important that the number include relatively few digits so that it will not be abbreviated during successive handling. It is recommended that each person who samples be assigned a roll of peel back labels. These labels would include the person's initials and sequential numbering. As a sample is taken and sealed, a numer will be affixed to the bottle. The label would include sufficient space for added information such as date, preservative added,etc. Then the specifics regarding the sampling location, type of sample, and other pertinent facts would be recorded in the field notebook.

10.1.6 Chain of Custody

In cases of litigation, there must be proof of the chain of possession that occurs from the time of sample collection to final destruction. If a sample cannot be traced completely, the validity of the analytical result may be doubtful. Therefore, it is important that procedures for a written record of chain of custody be included as normal field practice. A person has custody of a sample if one of the following requirements are fulfilled:

1. It is in his actual physical possession.
2. It is in his view after being in his actual physical possession.
3. It was locked up by him after being in his physical possession.
4. It was kept in a secured area, restricted to authorized personnel after being in his physical possession.

When the sample leaves his custody, then a record should be made indicating that this has been done.

10.2 DOCUMENTATION

The importance of keeping written records cannot be emphasized too strongly. As documentation of the events surrounding

the spill and its cleanup, these written records may have important legal implications, particularly in cost recovery or reinbursement. The records may also serve as a learning tool in that the knowledge gained from the spill can be applied to future spill situations. It is a good practice after the spill is cleaned up, and the emergency is over, to go back and assess the measures taken at the scene. Evaluation of this sort is important in improving response techniques. A record of the progress being made in the cleanup is also important in making decisions at the scene of the spill.

It is recommended that the OSC keep in a permanent bound book a log or diary of the chronological events from the time of notification of the spill until the cleanup and his duties are completed. All events of any significance should be recorded in the log with notation of the date and time. The information should include records of flow, operation, maintenance, sampling, fuel used, problems encountered, telephone conversations, meetings held, orders issued, weather observations, etc. The log should be kept in a bound, sequentially numbered notebook. Entries should be made in the log immediately and the date and time indicated. No pages should be removed from the notebook. If a page is ruined, it should be marked "VOID". Important observations involving judgement and sampling records should be signed by the principal investigator and countersigned by a witness.

The important records that should be kept in the notebook can be listed as follows:

1. General events for each day start/stop times for cleanup activities, arrival or procurement of equipment, documentation for authorization, weather observations.

Treatment gallons treated by each process, hours of operation of each process, maintenance needed and/or performed, fuel used, equipment breakdowns, ultimate disposal.

3. Sampling - records of sampling, sample preservation methods, and destination and analyses required of samples

4. Personnel - a record of all personnel on site, their function, and the actual times present. This is especially important for those personnel, whether from a government agency or third party contractor, associated with the cleanup/treatment operation itself. It is imperative that the OSC develop a rigid communication network with the personnel attending the respective operation.

5. Photographs a record of times and locations of all photographs including a brief description of the subject.

APPENDIX

APPENDIX A

A SPILL INFORMATION

A-1 INFORMATION CONTACTS

Information Source	Type of Assistance	Access Telephone
OHMTADS-EPA Oil and Hazardous Materials Technical Assistance Data System	2,4	EPA Regional Office 913/236-3778
CHEMTREC - Chemical Transportation Emergency Center	2,3	800/424-9300
CHLOREP - Chlorine Emergency Plan	1,2,3	Through CHEMTREC (see above)
Chevron	2-Chevron Products	415/233-3737
Shell	2-Shell Chemicals	618/254-7331
Pesticides Safety Team Network	1,2,3	Through CHEMTREC (see above)
Posion Control Centers:	2	See local directory
CHRIS - Coast Guard Chemical Hazards Response Information System	2,4	Natl. Response Center 800/424-8802
EPA ERT - Environmental Response Team	1,2	EPA Regional Office (above)
Coast Guard National Strike Force	1	Natl. Response Center of Gulf Strike Team 601-688-2380

Information Source	Type of Assistance	Access Telephone
U.S. Army Technical Escort Center, Chemical Emergency Response Team	1	EPA Regional Office or 703/521-2185

*Key
1. Respond to scene with trained personnel if required
2. Provide information on identify, hazards, or what to do
3. Refer to knowledgeable contact
4. On-line computer available

A-2 INFORMATION SOURCES

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APPENDIX B

Clean-up Contractors
Superfund Approved Contractors

Contractor & Service	Phone
Amino Brothers Co., Inc. 8110 Kaw Dr. P.O. Box 11277 Kansas City, Kansas 66111 General response service.	913/287-4510 913/334-2330
Broski Brothers Co., Inc. 6400 E. 35th St. Kansas City, MO 64129 Manufacturer, supplier, and installation of chain link fence fabric and gates.	816/924-0044
Double Check Co. 4614 Prospect Kansas City, Missouri 64130 Service station leaks and spills; related fuel leaks and spills.	816/921-5032
Environmental Emergency Services Co. 529 Spirit of St. Louis Blvd. Chesterfield, Missouri 63017 Nationwide oil and hazardous materials contractor-no nukes or explosives.	1-800/547-0792
Environmental Int'l, Inc. 912 Scott Kansas City, Kansas 66104 Nationwide planning response services for hazardous waste. Services include engineering, laboratory analyses, and professional investigate services for remedial action design or damage assessment.	913/648-6778
Holland Bros. Cons. Co., Inc. Highway 9 West Decorah, Iowa 52101 Grading, embankment, excavation, clearing, grubbing and demolition.	319/382-2412 or 319/382-4620
J.H. Berre Const. Co., Inc 5091 New Baumgartner Road St. Louis, Missouri 63129 General response service and also marine transporter. Demolition.	218/628-5180
Kehe Const. Co. 2700 5th Ave. N.W. P.O. Box 827 Waverly, Iowa 50677 General construction service - Iowa only.	319/352-3212

Contractor & Service	Phone
Lionmark, Inc., & Subsidiaries 1620 Woodson Road St. Louis, Missouri 63114 Land of subsurface excavations, all types of trucking and hauling, loading and lifting.	314/991-2180
Olson-Deane Co. 1850 Walton Road St. Louis, MO 63114 General response services.	314/428-7870
Petroleum Maintenance Service, Inc. 2431 Dean Ave. Des Moines, Iowa 50317 Off-shore, inland water, land, and subsurface for Region VII. Pads, booms, sweeps, skimmers and boat.	515/285-8778
Radium Petroleum Co. P.O. Box 6206 1633 S. Marsh Kansas City, MO 64126 General response services.	913/631-8181
React P.O. Box 27310 St. Louis, MO 63141 Land, inland water, and subsurface for Region VII. Hazardous material cleanup, treatment and disposal capabilities including manpower, equipment and supplies, and technical engineering services.	314/569-0991
Russell & Sons Const. Co., Inc. P.O. Box 535 Eureka, KS 67045 Kansas only Full line of heavy construction equipment, earth moving and excavation. Environmental aquatic control capability.	316/583-5512
Sajan Construction Corp. P.O. Box 628 Sikeston, MO 63801 Complete line of construction equipment and specializing in excavating and hauling.	314/725-3533

Contractor & Service	Phone
Shaw & Sons Enviro-pro 500 Bennington Kansas City, Missouri 64125 Respond to oil spills in Missouri, Nebraska, Kansas and Iowa and parts of Oklahoma.	816/637-5487
Thompson Const. Co., Inc. P.O. Box 65 Ellinwood, Kansas 67526 General construction.	316/564-3204
Environmental Specialists, Inc. 3001 East 83rd St. Kansas City, Missouri 64132 Oil and hazardous waste at any level in four-state area; Transporter services, Analytical services.	800/821-5446
M. W. Watson, Inc. P.O. Box 978 Topeka, Kansas 66601 General construction.	913/235-6228

Clean-up Contractors
Not Superfund Approved Contractors

Amoco Oil Company Terminal Des Moines, Iowa Provide supplies only. Oil clean-up supplies, 3m absorbent, containment barriers (available on replacement basis).	515/223-6666
Amoco Oil Company 829 E. Southbridge Road Council Bluffs, Iowa Equipment and personnel for petroleum recovery. Portable filter pump can recover up to 99% of a spill. Have absorbent booms, etc. Can provide service throughout state; Council Bluffs, Bettendorf, Ottumwa, Dubuque, etc. Prefer to have companies provide their own personnel. Provide service to Nebraska also.	712/366-9462
Cooper Equipment Co. 1601 North 84th St. Omaha, Nebraska Petroleum products only, personnel and equipment, sorbents, pump unit, booms, sweeps, rolls, particulate, SCUBA, remote air masks, rubber gear. Install tanks, clean tanks.	402/393-7563

Contractors & Service	Phones
Ebco Safety Service Co 13326 C Street Omaha, Nebraska 68144 Sales - Absorbent pads, bales, booms, etc., personal safety gear and supplies (clothing, respirators, etc.).	402/330-4200
Emergency Response Sec. Calgon Activated Carbon Division 11506 Rock Island Court Maryland Heights, Missouri 63043 Nationwide response to all types of spills Primary expertise in surface and groundwater treatment. Also, capability for vapor phase toxics.	402/831-0596
Hartnett Service Company 903 East 18th Kansas City, Missouri 64108 Sells and services service station equipment. Has Kentmore testing equipment. Will go as far as anybody wants to pay.	816/776-6736
Petroleum Equipment & Service, Inc. 220 35th St. Marion, Iowa Have absorbent pads, test underground storage tanks (Kent-Moore system). Main job is installation, service work and cleaning of bulk storage tanks. Handle some spills. Work mostly within a 60-mile radius of their offices.	319/377-6357
Petroleum Maintenance Service, Inc. 2431 Dean Ave. Des Moines, Iowa Petroleum incidents only surface and underground spills. Equipment to be used for spills available. Will work entire region. Run three trucks 1,000 gallons of storage carry some booms. Can get additional equipment from distributors.	515/285-8778
Reddi Root'r 5171 Leavenworth Rd. Kansas City, Kansas Primarily plumbing for residences and business · possibility for oil spills work in greater Kansas City area.	515/441-3638
United American Minorities Box 201 Republic, Missouri 65738 General engineering services.	417/732-7976

APPENDIX C

C

OIL SHEEN REFERENCE

Standard Terms for High Viscosity Oil Films and Descriptive Appearance of High Viscosity Oil on Water

Standard Term	Approximate Film Thickness (millimeters)	Approximate Quantity of Oil in Film (Gals. per sq. mile)	(Liters per sq. km.)	Appearance
Barely visible	.00004	25	37	Barely visible under most favorable light conditions
Silvery	.00008	50	75	Visible as a silvery sheen on water surface.
Slightly colored	.00015	100	145	First trace of color may be observed
brightly colored	.0003	200	300	Bright bands of color are visible
Dull	.001	700	1025	Colors begin to turn dull brown
Dark	.002	1400	2045	Colors are much darker brown or black

NOTE: Each one-inch thickness of oil equals 5.61 gallons per square yard or 17,400,000 U.S. gallons per square mile.

APPENDIX D

D

STANDARD TERMS AND CONVERSION TABLE

Knowing	Multiply by factor to obtain U.S. Gallon	U.S. Barrel	Cubic Feet	Litre
Gallon(U.S)	1.0000	0.02381	0.13368	3.785
Barrel	42.0000	1.00000	5.6146	158.930
Cubic Feet	7.4805	0.1781	1.0000	28.310
Litre	0.2641	0.00629	0.03532	1.000

APPENDIX E

TELEPHONE DIRECTORY

	Phone
National Response Center	800/424-8802
U.S. Environmental Protection Agency	
Regional Office . . . 24-hour number: EP&R Program	913/236-3778
U.S. Coast Guard	
2nd District . . . . Operation Center:	314/425-4612
MEP Branch:	
MSO Offices . . . St. Louis:	314/425-4567
Davenport, Iowa:	314/425-6297
Gulf Strike Team	601/688-2380
Corps of Engineers	
Emergency Operations Manager.	816/426-6320
Federal Emergency Management Agency (FEMA):	
Regional Office . . . . Kansas City:	816/426-6882
Iowa Department of Environmental Quality	515/281-8694
State Emergency Operations Center:	515/281-8752
Kansas Department of Health and Environment	913/296-1500
Missouri Department of Natural Resources	314/634-2436
Nebraska - Department of Environmental Control	402/471-4545

Phone

Oil Spill Co-ops

Iowa Bi-State Metropolitan Oil Control Coordination Committee 918/743-5311

Kansas - Mutual Assistance Pact (Wichita Area) Texaco-Cities Service Pipeline 918/743-5311

Nebraska Omaha-Council Bluffs Metropolitan Oil Control Coordination Committee 402/342-5476

Hazardous Material Waste Disposal Site

Kansas: Kansas Industrial Environmental Services, Inc.
P.O. Box 475
Wichita, Kansas 67201

Contact: Lee Deets, (316) 744-1286

Permit: Kansas Dept. of Health and Environment (Solid Wastes

Facility: Hazardous Waste Landfill

Missouri: Bob's Home Service Special Industrial Waste Disposal Facility
Rt. 1 Box 116F
Wright City, Missouri 63390

Owner: Glennon Zykan, President
Rt. 1 Box 116F
Wright City, Missouri 63390

Contact. Mike Gill, Manager, (314) 745-3371 or 745-3372

Permit. Missouri Dept. of Natural Resources (Solid Wastes)

Facility: Hazardous Waste Landfill

BFI Liquid Reception Center and Sludge Disposal
Clay County, Missouri
(1/2 mile north of Missouri City, Missouri)

Owner: Lincoln Brothers Land, Inc.
Westowne, Box 283
Liberty, Missouri 64068

Operator Browning-Ferris Ind.
Waste Systems Division
3150 N. 7th St.
Kansas City, KS 66115

Contact: Manager, (816) 781-1614

Permit: Missouri Dept. of Natural Resources (Solid Wastes)

Facilities. Liquid solidification, sludge dewatering and disposal

FREQUENTLY CALLED NAMES AND TELEPHONE NUMBERS.

Name	Telephone Number

Name	Telephone Number