You should know the telephone numbers of these and other programs. For your convenience a list has been prepared in the form of Fig. 4.1. Make copies of the list and keep in proximity of your Emergency Action Bulletin.

Part A — National Plan*

"The National Oil and Hazardous Substances Pollution Contingency Plan" published in the *Federal Register* (Vol. 38, No. 155, Aug. 13, 1973 – prepared and updated at the direction of Congress) coordinates a federal response to a spill of oil or other hazardous polluting substances that present an imminent or substantial threat to the public health or welfare.

The plan provides for a system of regional response teams composed of regional federal interagency representatives who act as an emergency response team. The national response team coordinates and oversees the performance of the regional response teams.

The response effort is supported by such major agencies as (1) the Environmental Protection Agency, (2) the Dept. of Transportation, through the US Coast Guard,(3) the National Transportation Safety Board, (4) the Corps of Engineers, and (5) the Food and Drug Admin. Poison Control Center. (See Fig. 4.2.)

4.0. Environmental Protection Agency (EPA)

The EPA was established in 1970 to coordinate federal government action undertaken to ensure protection of the environment by abating and controlling pollution. The responsibility of the EPA in relation to other federal, state, and local agencies in the control and prevention of environmental pollution is in the process of being established.

Ten regional EPA hazardous materials offices have been established throughout the country to provide spill response and administer the program for that region. Information and assistance may be obtained from these offices on specific problem areas. See Fig. 4.3 for phone list.

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*Under the Direction of CEQ; Ref: National Oil and Hazardous Substances Pollution Contingency Plan. Fed. Reg., 40:28 (pt. II) (Mon., Feb. 10, 1975).

EMERGENCY ASSISTANCE TELEPHONE NUMBERS

Hazardous Materials EPA Region Number	Telephone
1-10	See Fig. 4.3 (a)

Hazardous Materials
EPA Headquarters

(202) 245-3045	8:00AM - 4:30PM Mon.-Fri.
All other times*	

USCG District Number	Telephone
1-17	See Fig. 4.3 (b)

Washington, D.C.
USCG Headquarters Duty Officer

(202) 426-1830	24-hr service from D.C. area, Alaska, and Hawaii only
(800) 424-8802	All other times

---

*Call listed number of employees in sequence until a response is received.

Hans. J. Crump-Wiesner (202) 554-2329
Walter S. Miguez (301) 268-4618
Harold J. Snyder (301) 730-5948
Henry D. VanCleave (703) 280-3672

FAA Flight Service Station

(Ask local operator for number) ______________

FDA Poison Control Center†

(202) 496-7691	8:00AM - 4:30PM Mon.-Fri.
(202) 963-7512	All other times

CHEMTREC

(800) 424-9300 Except Alaska, Hawaii, and Washington, D.C. — (202) 483-7616

CHLOREP — Use CHEMTREC

NACA Pesticide Safety Team — Use CHEMTREC

State Agencies (list name and numbers)

____

____

____

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†To be used only concerning hazardous materials spilled or threatening public water supplies *For ingestion of poisons by individual,* caller should contact nearest hospital emergency room, or if this is not possible, the nearest FDA poison control center

Fig. 4.1

U.S. GOVERNMENT ORGANIZATION CHART for Organizations involved in the Control, regulation or cleanup of Hazardous Materials

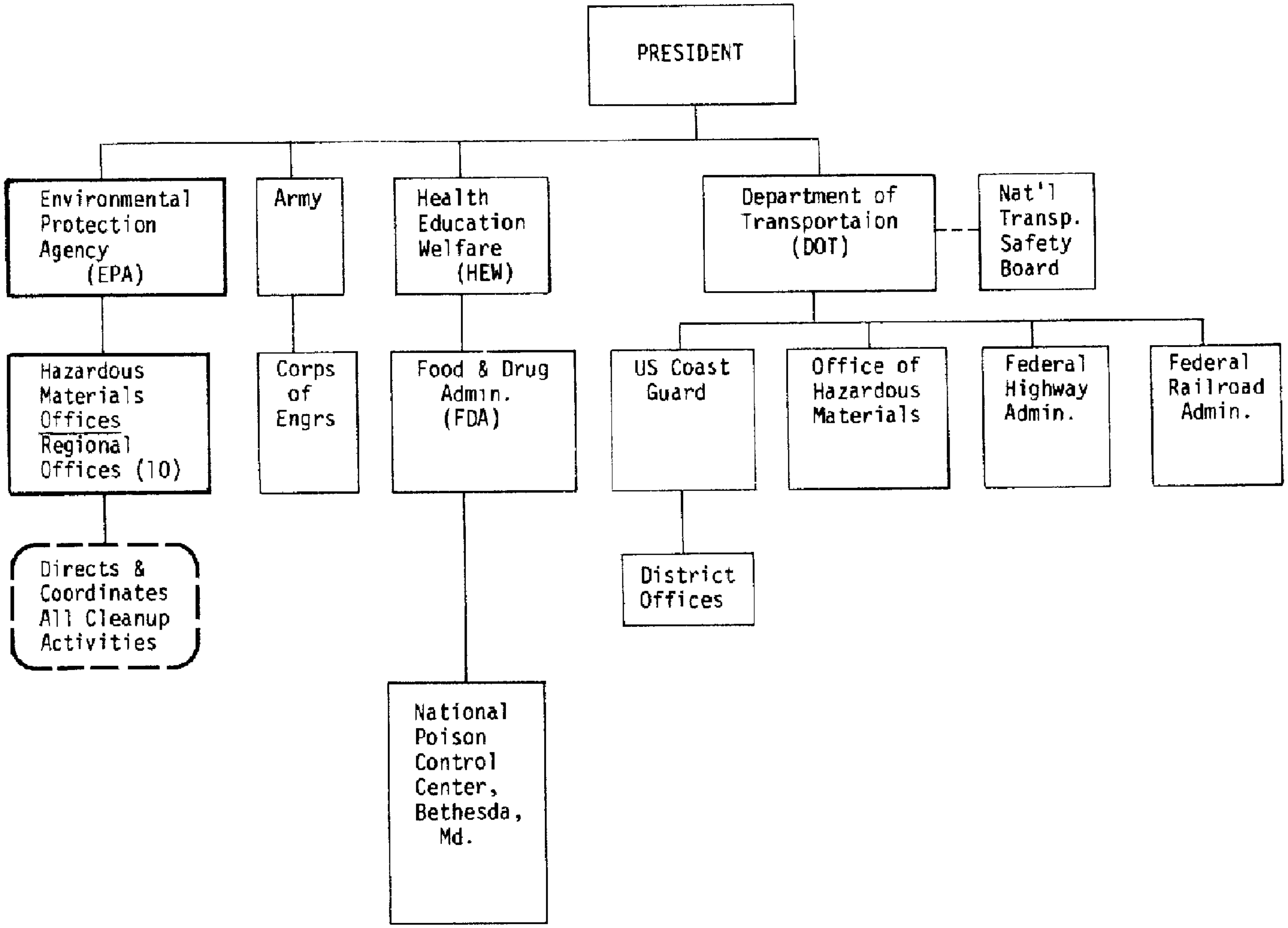
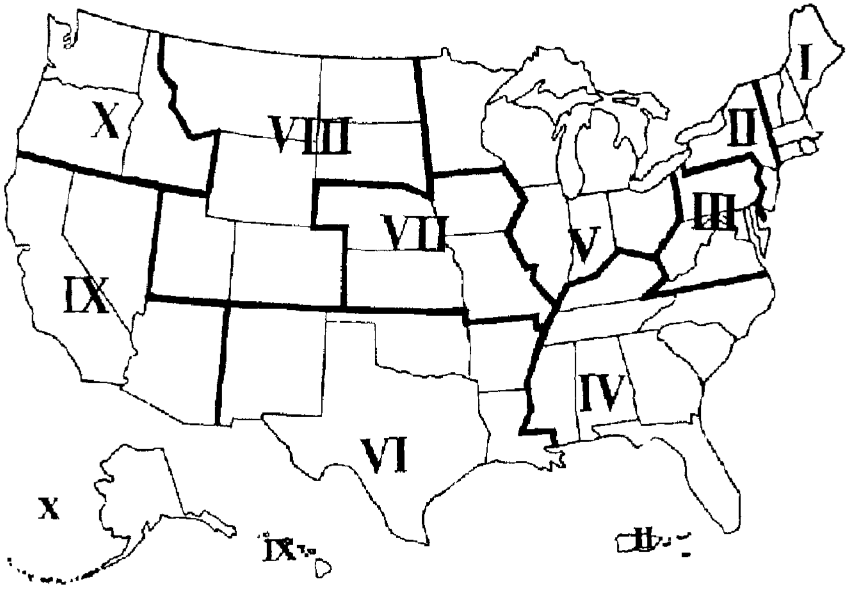


Fig. 4.2

ENVIRONMENTAL PROTECTION AGENCY
REGIONAL OFFICES



Environmental Protection Agency
Region I, Room 2303
John F. Kennedy Federal Building
Boston, Massachusetts 02203
Tel: (617) 223-7265 ★

Environmental Protection Agency
Region II, Room 908
26 Federal Plaza
New York, New York 10007
Tel: (201) 548-8730 ★

Environmental Protection Agency
Region III
Curtis Bldg.
6th and Walnut Streets
Philadelphia, Pennsylvania 19106
Tel: (215) 597-9808 ★

Environmental Protection Agency
Region IV
1421 Peachtree St., NE.
Atlanta, Georgia 30309
Tel: (404) 526-5062 ★

Environmental Protection Agency
Region V
1 North Wacker Drive
Chicago, Illinois 60606
Tel: (312) 353-6188 ★

Environmental Protection Agency
Region VI, Suite 1600
1600 Patterson St.
Dallas, Texas 75201
Tel: (214) 749-3840 ★

Environmental Protection Agency
Region VII
1735 Baltimore Ave.
Kansas City, Missouri 64108
Tel: (816) 374-3778 ★

Environmental Protection Agency
Region VIII, Suite 900
1860 Lincoln Street
Denver, Colorado 80203
Tel: (303) 837-3880 ★

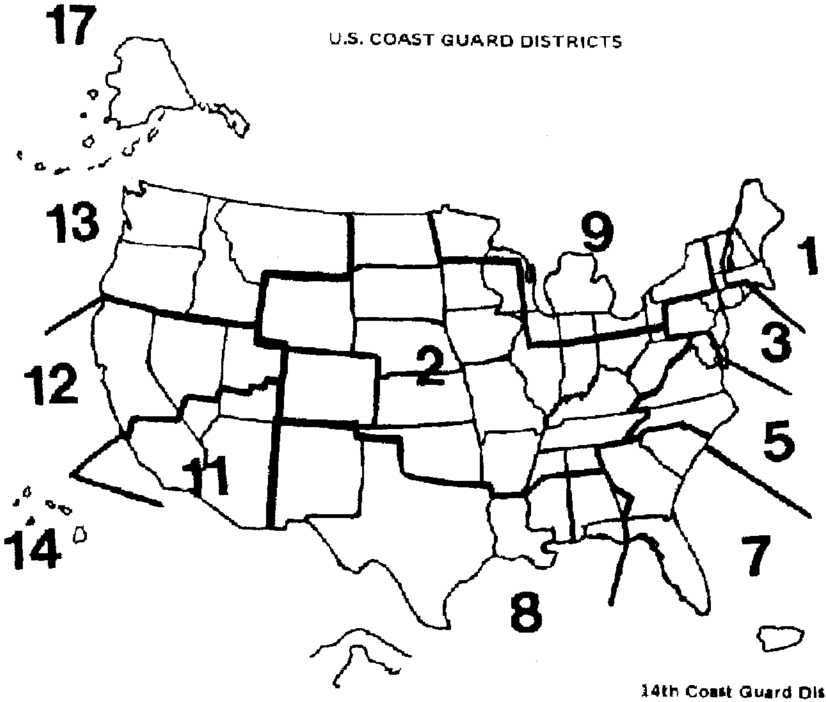
Environmental Protection Agency
Region IX
100 California Street
San Francisco, California 94111
Tel: (415) 556-6254 ★

Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101
Tel: (206) 442-1200 ★

★ 24 hour telephone

Fig. 4.3 (a)

U.S. COAST GUARD DISTRICTS



14th Coast Guard District
677 Ala Moana Blvd.
Honolulu, Hawaii 96183
Duty Officer: (808) 546-7109
(COMMERCIAL ONLY)
AUTOVON—421-4845

17th Coast Guard District
P.O. Box 3-5000
Juneau, Alaska 99801
Duty Officer: (907) 586-7340
(COMMERCIAL ONLY)
AUTOVON—388-1121

1st Coast Guard District
130 Causeway Street
Boston, Mass. 02114
Duty Officer: (617) 223-6650

2nd Coast Guard District
Federal Building
1520 Market Street
St. Louis, Mo. 63101
Duty Officer: (314) 622-4614

3rd Coast Guard District
Governors Island
New York, N.Y. 10004
Duty Officer: (212)264-4800

5th Coast Guard District
Federal Building
431 Crawford Street
Portsmouth, Va. 23705
Duty Officer: (703) 393-9611

7th Coast Guard District
Room 1018, Federal Bldg.
51 S.W. 1st Avenue
Miami, Fla. 33130
Duty Officer: (305) 350-5611

8th Coast Guard District
Customhouse
New Orleans, La. 70130
Duty Officer: (504) 527-6225

9th Coast Guard District
1240 East 9th Street
Cleveland, Ohio 44199
Duty Officer: (216) 522-3984

11th Coast Guard District
Heartwell Bldg.
19 Pine Avenue
Long Beach, Calif. 90802
Duty Officer: (213) 590-2311

12th Coast Guard District
630Sansome Street
San Francisco, Calif. 94126
Duty Officer: (415) 556-5500

13th Coast Guard District
618 2nd Avenue
Seattle, Wash. 98104
Duty Officer: (206) 524-2902

Fig. 4.3 (b)

4.1. The Department of Transportation (DOT)

There are within the Dept. of Transportation the following agencies concerned with hazardous material spills: the US Coast Guard (USCG), the Office of Hazardous Materials, the Federal Highway Admin., and the Federal Railroad Admin.

4.1.1. US Coast Guard. The USCG is the authorized federal agency to be notified of a hazardous material spill into or upon navigable US waters, adjoining shore lines, or waters out to the 12-mi limit. It is concerned primarily with the safety aspects of containing a hazardous material spill. Notification of such a spill should be made to the nearest coast guard district office. (See telephone list, Fig. 4.3.) Spills into inland navigable waters may also be reported to the nearest USCG district office or to the nearest EPA regional office (see telephone list, Fig. 4.3). The USCG provides on-scene coordinators (OSC) for hazardous material spills on navigable waters other than inland ones. EPA provides the OSCs for hazardous material spills into inland navigable waters.

4.1.2. Office of Hazardous Materials. This office provides specialized technical knowledge concerning such items as container specifications, classifications of products, labelling requirements, and vehicle specifications to the Hazardous Materials Regulation Bd., which regulates and grants special permits for the transportation of hazardous materials.

4.1.3. Federal Highway Admin. The work of the administration includes jurisdiction over the safe movement of dangerous cargoes, such as explosives, flammables, and other hazardous materials over the nation's highways It exercises jurisdiction over the safety performance of commercial motor carriers engaged in interstate or foreign commerce. Safety investigators and inspectors investigate truck and bus accidents, make carrier terminal and vehicle inspections, and conduct compliance investigations with a view toward criminal prosecution of flagrant violators.

4.1.4. Federal Railroad Admin. One purpose of this administration is to serve as the principal organization for assistance to the secretary of tranportation on all matters relating to rail transportation and safety. The Bureau of Railroad Safety administers and enforces the federal laws and related regulations designed to promote the safety of railroads and liquid carrying pipelines as related to employees, travelers, and the general public. Collisions, derailments, and other railroad accidents' resulting in serious injury to persons or to property of a railroad are investigated and reports are issued.

4.2. National Transportation Safety Bd.

The National Transportation Safety Bd. was created in 1966 to investigate, determine the cause, and issue reports on all civil aviation accidents; make final cause determination and report circumstances of major surface transportation accidents; and make recommendations for preventing accidents and promoting safety in transportation.

The board is composed of five members appointed for five-year staggered terms by the president with the consent of the US Senate, with one member designated as chairman.

The board is aided in its work by the accident investigation staff, Flight Standards Service, and the Federal Aviation Admin. In the event of an air accident in which air-cargo hazardous materials in the water threaten a water supply, an accident investigation staff member from that region, or possibly headquarters, would go to the scene. In a major accident, a safety board member would also go to the scene. Emergency assistance to a water-supply official can be obtained by calling the nearest FAA flight service station. There are some 3 600 such stations in the US, and they can be contacted through the appropriate commercial telephone operator if the number is not already on an emergency list in the water-supply office.

4.3. US Army Corps of Engineers

One of the missions of the corps is the improvement of rivers, harbors, and waterways for navigation, flood control, and related purposes. The corps administers laws for the protection and preservation of navigable waters.

The corps may participate in the removal of hazardous materials that are threatening a water supply under unusual circumstances. The removal of containers containing hazardous substances from waterways, the removal of huge piles of hazardous materials that have entered the water by failure of a bank, shore line, or supporting structure, and the removal of an unrestrained or uncontrolled carrier of hazardous materials are examples of instances in which the corps may act to reduce the threat of hazardous materials to a water supply.

4.4 The Food and Drug Admin. Poison Control

The Food and Drug Admin. operates the National Clearing House for Poison Control centers in Bethesda, Md. [phone: (see Fig. 4.1) , which provide toxicity information, describe symptoms, and recommend treatment in emergencies where humans, usually children, have swallowed poisons of various kinds, including drugs, pesticides, metals, and the like. This information is given over the telephone by request of the caller. The national center can also provide the location of 500 local poison control centers located throughout the US.

Part B — State Contingency Plan

Each water utility should obtain a copy of the oil and hazardous materials spill plan of its own state and place the plan in this manual if such a document is available If a plan is not available, a summary should be prepared of the state agencies that can provide assistance in the event of a spill emergency. The summary should contain the names and phone numbers of the nearest office and the headquarters of appropriate state agencies.

Part C — The CHEMTREC Plan

What it is

CHEMTREC (Chemical Transportation Emergency Ctr.) a public service of the Manufacturing Chemists Assn. provides immediate advice for those at the scene of emergencies, then promptly contacts the shipper of the chemicals involved for more detailed assistance and appropriate follow-up.

CHEMTREC operates around the clock—24 hr/day, seven days a week—to receive direct-dial toll-free calls from any point in the continental US through a wide area service (WATS) telephone number, (800) 424-9300 [483-7616 for calls originating within the District of Columbia; (202) 483-7616 for Alaska and Hawaii].

In Canada, the Canadian Chemical Producers' Assn. operates a Transportation Emergency Assistance Program (TEAP) through regional teams prepared to give phone and field response.

Also, a number of individual companies have information and service networks for their own products. Du Pont's "TERP," Union Carbide's "HELP," and American Cyanamid's "TWERP," are examples. CHEMTREC does not displace such specialized programs, but rather acts to collaborate with them and enhance their effectiveness.

Shippers, principally MCA member companies, are notified through preestablished phone contacts, providing 24-hr accessibility.

As circumstances warrant, the National Transportation Safety Bd. appropriate offices of the Environmental Protection Agency, and others may be notified.

What it is not

Because chemicals find so many uses and have such a wide range of characteristics, there is much need for information about them–composition and purity, physical and chemical properties, effects on people and the environment, sources of supply, etc. It is important to understand that CHEMTREC is not intended and is not equipped to function as a general information source but by design is confined to dealing with chemical transportation emergencies.

Mode of Operation

The emergency reported to the center is received by the communicator on duty, who records the details of what happened, where, and when; the chemical(s) involved; type and condition of containers; shipper and shipping point; carrier; consignee and destination; general nature and extent of injuries to people and property, if any; prevailing weather; composition of the surrounding area; who the caller is and where he is located and–of utmost importance–how and where telephone contact can be reestablished with him or another responsible party at the scene.

With the caller remaining on the line, the communicator draws on the best available information on the chemical(s) reported to be involved, thereby giving specific indication of the hazards and what to do (as well as what not to do) in case of spills, fire, or exposure as the immediate first steps in controlling the emergency. Information on each chemical, furnished by its producers, is within arm's length. Trade names and synonyms of chemical names are cross-referenced for ready identification by whatever name is given.

The communicators are chosen for their ability to remain calm under emergency stresses. To preclude unfounded personal speculation regarding a reported emergency, they are under instructions to abide strictly by the information prepared by technical experts for their use.

Having advised the caller, the communicator proceeds immediately to notify the shipper by phone. The known particulars of the emergency thus relayed, responsibility for further guidance–including dispatching personnel to the scene or whatever seems warranted–passes to the shipper.

Although proceeding to the second stage of assistance becomes more difficult where the shipper is unknown, the communicator is armed with other resources to fall back on–for example: concerning radioactive materials he can call on Atomic Energy Com. personnel.

Mutual-aid programs exist for some products, whereby one producer will service field emergencies involving another producer's product. In such cases, initial referral may be in accord with the applicable mutual-aid plan rather than directly to the shipper. Arrangements of this sort are established for chlorine through the Chlorine Inst. and for pesticides through the National Agricultural Chemicals Assn. NACA has a pesticide safety network of some 40 emergency teams distributed throughout the US (see Sect. 4D).

Despite precautions taken, train derailments, truck upsets and collisions, and barge accidents do occur with disturbing frequency. Emergency services–fire and police–are normally well prepared to cope with common materials, including certain flammables such as fuel oil and gasoline. Too often they are at a disadvantage when chemicals are encountered, especially since "what should be done"–and of equal importance, "what should *not* be done"–in the early stages may bear heavily on the outcome. They need accurate and clearly understandable information to help them evaluate the situation and act with proper precautions for their own safety, as well as for the protection of the general public.

For further particulars about CHEMTREC, contact manager, Chemical Transportation Emergency Ctr., 1825 Connecticut Ave., N.W., Washington, D.C. 20009. Phone: (202) 483-6126.

Part D — The Pesticide Safety Team Network*

In 1970 the National Agricultural Chemicals Assn. (NACA) formed a network of teams designed to minimize the risk of injury arising from the accidental spillage or leakage of Class B† poison pesticides. This is a cooperative, voluntary program operated as a public service by the association and participating companies.

In order to report pesticide spill emergencies and to obtain assistance from NACA, the 24-hr CHEMTREC phone number presented in Part C should be used. Many association members are now participating in the pesticide safety team (PST) by cooperatively furnishing personnel, equipment, and expertise for the prompt and efficient clean up and decontamination of Class B poison pesticides involved in a major accident. More than forty safety teams currently make up the network.

Ten of the participating association members have each been assigned a specific area of the US to act as the area coordinator. It is their responsibility to receive from telephone central reports of any accident involving a Class B poison pesticide occurring in the area and to act in one of several ways to make sure that the potential hazard to the public has been reduced or eliminated.

Immediately following the receipt of an emergency message from telephone central, the area coordinator endeavors to communicate with the manufacturer or producer of the involved product and agree on a procedure to be followed. The person reporting the incident to telephone central is then contacted and advised about immediate steps to be taken and whether a safety team, if needed, is on the way, either from the manufacturer or dispatched by the area coordinator from a roster of teams in his area. A blocked-out illustration of procedural steps is shown in Fig. 4.4.

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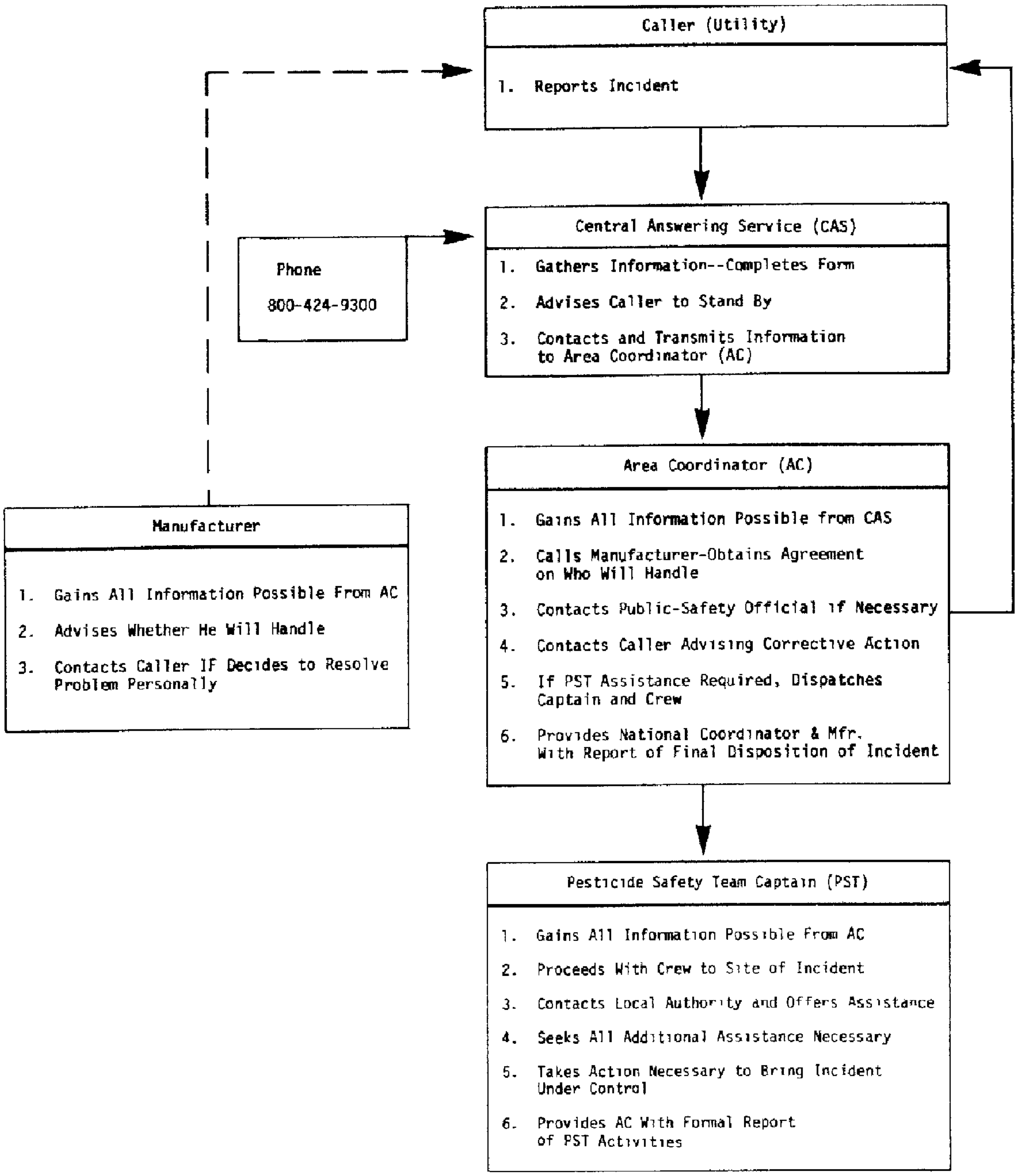
*Of the National Agricultural Chemicals Assn.

†Code of "Federal Regulations," Title 49, I, pt. 172

SPILLS OF CLASS B POISON PESTICIDE CHEMICALS



Caller (Utility)

1. Reports Incident

Phone

800-424-9300

Central Answering Service (CAS)

1. Gathers Information--Completes Form
2. Advises Caller to Stand By
3. Contacts and Transmits Information to Area Coordinator (AC)

Area Coordinator (AC)

1. Gains All Information Possible from CAS
2. Calls Manufacturer-Obtains Agreement on Who Will Handle
3. Contacts Public-Safety Official if Necessary
4. Contacts Caller Advising Corrective Action
5. If PST Assistance Required, Dispatches Captain and Crew
6. Provides National Coordinator & Mfr. With Report of Final Disposition of Incident

Manufacturer

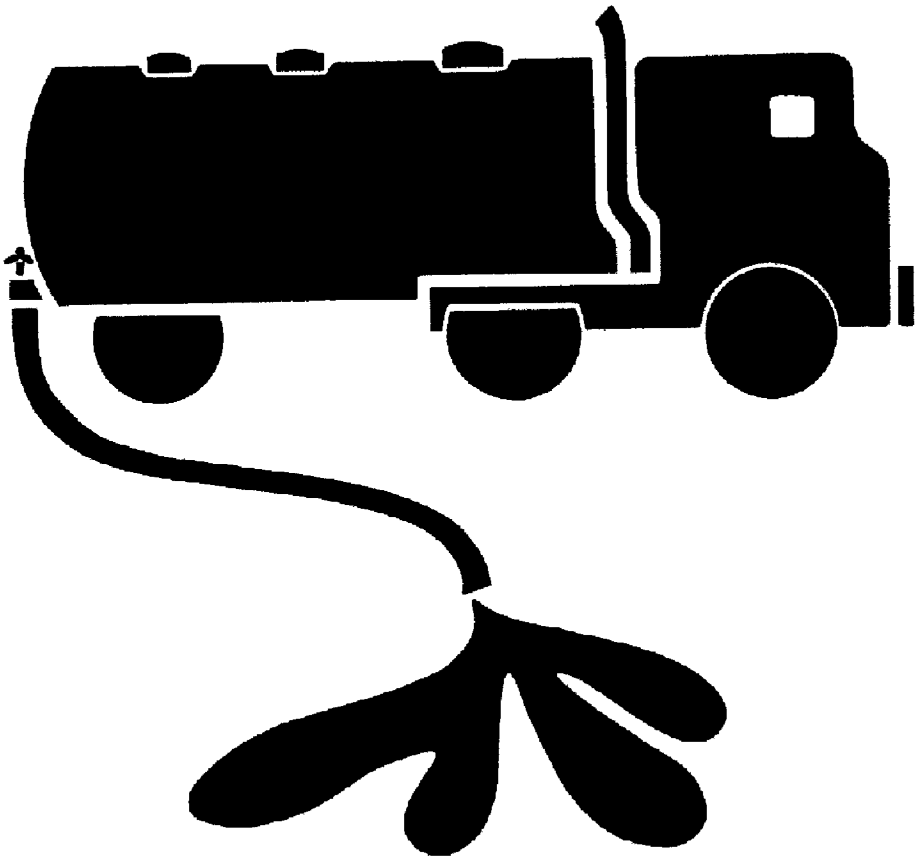
1. Gains All Information Possible From AC
2. Advises Whether He Will Handle
3. Contacts Caller IF Decides to Resolve Problem Personally

Pesticide Safety Team Captain (PST)

1. Gains All Information Possible From AC
2. Proceeds With Crew to Site of Incident
3. Contacts Local Authority and Offers Assistance
4. Seeks All Additional Assistance Necessary
5. Takes Action Necessary to Bring Incident Under Control
6. Provides AC With Formal Report of PST Activities

Fig. 4.4

Section 5 – Removal Methods



Part A — Materials Hazardous to a Water Supply

Many materials are potentially hazardous to a water supply. The degree of hazard usually depends upon the amount and concentration of a material, its properties, and its effect on the waters to which it was introduced.

The following general classes of materials can be hazardous to a water supply. (See Table 5.1.)

1. Oil and oil products
2. Radioactive materials
3. Any material transported in large commercial quantities (such as in 55-gal drums), which
   a. is a very soluble acid or base
   b. causes abnormal growth of an organ or organism, or
   c. is highly biodegradable, exerting a severe oxygen demand
4. Biologically accumulative poisons
5. The active ingredients of economic poisons that are or were ever registered in accordance with the provisions of the Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 USC 135 *et seq.*)
6. Substances highly lethal to mamallian or aquatic life

Part B — Removal of Spilled Substances

The methods and procedures that have been utilized for the removal of spilled hazardous materials from a water system are discussed below and are referenced in Table 5.1. The information presented in this section is only intended as a general guideline and does not contain enough detail to direct cleanup crews.

The following are descriptions of methods and techniques for the removal of spilled hazardous substances. The code letters for each method that follows, such as *Ab* for accelerated biodegradation, are used in Table 5.1. Appropriate code letters indicating an applicable removal method are placed after each designated hazardous substance in the table and are defined as follows.

1. **Ab (accelerated biodegradation).** Many hazardous substances may be totally detoxified through biodegradation. Therefore, it has become an occasional ultimate disposal practice to contain such spilled substances safely on land and seed the contained materials with appropriate mixed microbial cultures The seeding material usually applied is sewage sludge, unless an acclimated seed is available from a local industrial treatment plant. Care must be exercised that there will be no surface- or ground-water contamination.
2. **Ac (activated carbon).** Activated carbon is the single most improtant vehicle for removal of nonionic hazardous substances from water. Most organic compounds, including the organic pesticides, are readily sorbed on activated carbon. Application methods are extremely variable and depend primarily on the conditions of the spill. Past experience, however, has proved the feasibility of processing large quantities of water contaminated with trace amounts of very toxic materials. *In situ* removal of soluble organic compounds by the use of flow-through activated carbon systems is recommended. Other methods of contacting the activated carbon with the polluted water are left to the discretion of the on-scene coordinator (OSC).
3. **Ae (aeration).** Many substances present a high chemical or biochemical oxygen demand when discharged into the water. These will reduce the dissolved oxygen level below that required by a large portion of aquatic life for life support. By artificially maintaining the required dissolved-oxygen level through mechancial aeration or other oxygen-replacement techniques, the lethal effects from the discharge of such substances can be eliminated. The possibility of stripping volatile materials should be noted and, where a toxic inhalation threat exists, proper safety precautions should be followed.
4. **Bs (booms and skimmers).** Although this may well be classed as a containment method, the coupling of booms and skimmers represents one of the more useful physical removal techniques for a number of floating hazardous substances. *Booms* include a large variety of materials and configurations that function to contain a floating, insoluble material physically. Booms employed should be constructed of nonreactive materials. *Skimmers* are mechanical devices designed to concentrate the less-dense liquid or solid phase, to provide some temporary storage of this two-phase system, and to permit the recovery of the spilled pollutant by some suitable procedure. (This method frequently overlaps into the use of oleophilic material, which is discussed later.)
5. **Bu (burning).** In open areas where very low risk to beneficial water uses or to other properties exists, burning of a combustible hazardous substance is an effective method of removal from beaches, shore lines, and, occasionally, the water. The approval of this method by EPA and the OSC is subject to several restrictions, namely (a) it must be shown that burning presents no significant air-pollution problem; (b) it must be shown that recovery of the material is not feasible; and (c) it must be shown that life, property, or the beneficial uses of water will not be endangered by the fire.
6. **Ic (ionic clays).** Anionic clays have been used with some success in the removal of objectionable substances from water. Bentonite and attapulgite clays have been chosen because they possess the necessary dispersive and adsorptive properties. They flocculate readily in the presence of oppositely charged ions (cations), especially if

these ions are polyvalent. The clays, which are dispersed as negatively charged particles (anions) in water's containing electrolytes, coagulate to form flocs that entrap suspended impurities. Montmorillonite clays display major cation exchange properties, expanding accordion-like in water to permit free ingress and egress of ions of various kinds. Their strong negative charge attracts them to positively charged particles, causing flocculation In a dilute dispersion the flocs settle quickly. In thicker mixtures settling occurs more slowly; suspension may be sustained unless a substance such as alum is added to enhance settling. Ionic clays have proved most successful in the removal of ammonia and ammonia compounds. Their general use for removing hazardous substances from water, however, is limited by several variables–the turbidity of the water electrolytic concentration, the presence of protective colloids (causing dispersion rather than coagulation), water temperature, the minimum or optimum dosage necessary for clarification, and the period of time required for coagulation and sedimentation–all of which affect the cost of treatment

7. **Ix (ion exchange).** The removal of ionic, hazardous, polluting substances can be achieved by the use of a number of commercially prepared polymeric organic resins or inorganic ion exchangers. This technique can be applied by either diking techniques using porous bags filled with exchanger or treatment outside of the water column. For efficiency, strong anionic or cationic resins with high exchange capacities are preferred, and the resins should be in either the hydrogen- or hydroxide-ion form. Mixed-bed resins are suitable for either external treatment or bagged exchanger diking. The removal of a specific ion may be carried out with the specific anionic or cationic resin required if the resulting pH change is not greater than 1.0. Where removal of one ionic species causes a pH change greater than 1.0, the other ionic species should be exhanged with the complementary resin to minimize pH changes.

8. **Np (neutralization-precipitation).** Nuetralization or precipitation is to be used only as an external treatment. For the purposes of this section, neutralization means either a Lewis acid-base normalization of pH or the conversion of a toxic compound or ion into a less-toxic species by the addition of a specific chemical reactant that results in oxidation, reduction, complex formation, chelation, or other physical-chemical alteration. Precipitation means either the formation of an insoluble material because of the addition of a chemical reactant or the coprecipitation of hazardous suspended solids by the use of flocculating materials. Removal of the precipitate from the spill site is required and recycling of the material is recommended.

9. **Op (oleophilic materials).** Straw, specially treated perlite and talc, polymeric material, or rigid foam has been proved effective in treating oil spills. Providing that recovery of such sorbents from the water is feasible and the sorbents are available, every effort should be made to sorb the spilled substances as soon as possible after the discharge Upon recovery of these contaminated sorbents, extraction or separation of the pollutant frequently leaves the oleophilic sorber ready for reuse and the recovered pollutant available for recycling. Many floating, low-solubility hazardous substances can be treated in this way, even if these pollutants are partially soluble. In the latter case, additional methods must be applied in order to remove the soluble fraction.

10. **Pm (peat moss).** Although this material is not as widely used as activated carbon (discussed previously), it has much of the same versatility. Peat moss is effective in sorbing both ionic and neutral solutes and has an advantage over activated carbon in being biodegradable. In the case of biodegradable pollutants, the broadcasting (*in situ*) of slurried peat moss will absorb the hazardous material and settle to the bottom. This treatment is then followed by vacuum pumping to remove the spent peat moss. Other methods employing peat moss for removal include sorption of the pollutant followed by recovery and proper disposal of the spent peat moss.

11. **Vp (vacuum pumping).** Vacuum pumping may offer the best removal method when a dense, insoluble spilled substance coats or lies on the bed of the river, lake, or sea. Restrictions on the use of this method of removal are that (1) it must be followed by an approved dredge spoil treatment technique, (b) there must be careful control of the turbidity and suspended solids released into the water column, and (c) the operation must be designed to minimize alterations of the character and structure of the substrate. Prior to initiating a vacuum pumping operation, one must clearly demonstrate that the effects of the hazardous substance will produce damage to the aquatic community greater than that of the removal operation.

Discussion of Table I

The removal methods shown in Table 5.1 are recommended for the treatment of hazardous material spills. Three columns appear at the right-hand side of the table, namely phase 1 removal methods, phase 2 removal methods, and other removal methods. When both phase 1 and 2 removal methods are listed, the former are the phase separation techniques that must be applied before phase 2, which is applied to remove the soluble fraction, in the case of partially soluble substances.

In cases where removal methods are begun after the material has all been dissolved, phase 2 methods should be initiated. For both columns alternates are frequently listed, and either method is equally good. Both are included in order to provide for flexibility. Single cleanup-phase recommendations are self-explanatory. The column labeled as *other* lists techniques that may be effective but can be applied only after consultation with the OSC; or they may reflect different methods for different water conditions. EPA approval should be sought for techniques that have not been demonstrated prior to the proposed use.

The pesticides-removal problem is especially important because of the common usage and extreme toxicity of many of these formulations. In general, organically based pesticides should be adsorbed from all affected waters on charcoal and incinerated in specially controlled furnaces. Exceptions to this general rule include neutralization and precipitation techniques for some organophosphates, using caustic soda or calcium hypochlorite for neutralization. Naturally, any insoluble portion should be recovered as soon as possible by whatever means appropriate. The inorganically based pesticides should be removed from all affected water, using the appropriate ion-exchange resin. Since many of these pesticide formulations are proprietary, immediate contact should be established with the appropriate regional office of the EPA and the pesticide manufacturer or the NACA. Recommended removal methods and assistance will be provided by one or more of these organizations.

An index to removal methods for Table 5.1 follows.

Index to Removal Methods

Abbreviation	Removal Method	For Discussion See Page
Ab	accelerated biodegradation	33
Ac	activated carbon	33
Ae	aeration	33
Bs	booms and skimmers	33
Bu	burning	33
Ic	ionic clays	33
Ix	ion exchange	34
Np	neutralization–precipitation	34
Op	oleophilic materials	34
Pm	peat moss	34
Vp	vacuum pumping	34

TABLE 5.1

*Materials Hazardous to a Water Supply and Removal Methods**

Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Abietic acid	Vp**	Ac	
Acetaldehyde	Ac		Bu
Acetamide	Ac/Ix	Ae	
Acetanilide	Vp	Ac	
Acetic acid	Np/Ix	Ae	
Acetic anhydride	Np/Ix	Ae	
Acetone cyanohydrin	Vp	Ac/Np	
Acetonitrile	Vp	Ac	
Acetophenone	Vp	Ac/Pm	
Acetyl bromide	Vp	Ac	
Acetylene	Ac		
Acridine	Ac/Pm		
Acrylic acid	Np/Ix		Ac
Acrylonitrile	Ac/Pm		Np
Adipic acid	Np/Ix	Ac/Pm	
Adiponitrile	Bs	Ac/Pm	
Alkyldimethyldichlorobenzylammonium chloride	Np/Ix	Ac/Pm	
Alkyldimethylbenzylammonium chloride	Np/Ix	Ac/Pm	
Alkyldimethylbenzyldimethylammonium chloride	Np/Ix	Ac/Pm	
Alkylethylbenzyldimethylammonium chloride	Np/Ix	Ac/Pm	

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*Based on evaluation and advice of George B. Grimes and Allen L. Jennings, Hazardous Mat'ls Br., USEPA, Washington D.C.

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§Other removal methods—to be used only after consultation with local authority, the federally appointed on-scene coordinator (OSC), or approval of the federal EPA.

***See index to removal methods*

Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Allyl alcohol	Bs/Op	Ac	
Allyl chloride	Bs/Op	Ac/Pm	Np
Aluminum fluoride	Np/Ix		
Aluminum sulfate	Np/Ix		
Aminoethyl ethanol amine	Ac/Pm		Ix
Ammonia	Ix		Ic
Ammonium acetate	Ix		Ic
Ammonium carbonate	Ix		Ic
Ammonium chloride	Ix		Ic
Ammonium chromate	Ix		
Ammonium dichromate	Ix		
Ammonium ferricyanide	Ix		Ic
Ammonium ferrocyanide	Ix		Ic
Ammonium nitrate	Ix		Ic
Ammonium perchlorate	Ix		Ic
Ammonium peroxydisulfate	Ix/Np		Ic
Ammonium phosphate	Ix/Np		Ic
Ammonium picrate	Vp	Ix/Ac	Ic
Ammonium sulfate	Ix/Np		Ic
Ammonium sulfide	Ix		Ic
Ammonium thiocyanate	Ix		Ic
Amyl acetate	Bs/Op	Ac/Pm	Bu
Aniline	Ac/Pm		Ab
Antimony potassium tartrate	Np/Ix		
Antimony trichloride	Np/Ix		
Antimony trifluoride	Np/Ix		
Antimony trioxide	Vp	Np/Ix	
Barium chloride	Vp	Np/Ix	
Barium cyanide	Vp	Np/Ix	
Barium hydroxide	Vp	Np/Ix	

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Barium nitrate	Vp	Np/Ix	
Benzene	Bs/Op	Ac/Pm	
Benzoic acid	Vp	Pm/Ix	
Benzonitrile	Vp	Ac/Pm	
Benzoyl chloride	Vp	Pm/Ix	Np
Benzylamine	Ac/Pm		Ix
Beryllium chloride	Ix/Np		
Beryllium nitrate	Ix/Np		
Beryllium sulfate	Ix/Np		
Boranes	Np/Ix		
Boric acid	Ix/Np		
Bromine	Vp	Np/Ac	
Butyl acetate	Bs/Op	Pm/Ac	
Butyl acrylate	Bs/Op	Pm/Ac	
Butyl alcohol	Ae		
Butylamine	Pm/Ac		Ix
Butylene glycol	Pm/Ac	Ae	
Butyl mercaptan	Bs	Ac	
Cadium chloride	Np	Ix	
Cadium nitrate	Np	Ix	
Cadium sulfate	Np	Ix	
Calcium carbide	Np	Ac	
Calcium cyanide	Np	Ix	
Calcium hypochlorite	Np		
Calcium phosphide	Np		
Carbon disulfide	Vp	Ac/Pm	Bu
Carbon monoxide	Np		Ac
Carbon tetrachloride	Vp	Ac/Pm	
Cetyldimethylammonium bromide	Ac/Pm		Ix
Cetyldimethylbenzylammonium chloride	Ac/Pm		Ix

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Cetylpyridinium chloride	Ac/Pm		Ix
Cetyltrimethylammonium bromide	Ac/Pm		Ix
Cetyltrimethylethylammonium bromide	Ac/Pm		Ix
Chloramine	Ix		Ac/Pm
Chlorine	Np		Ac
Chloracetic acid	Np		
Chlorobenzene	Vp	Ac/Pm	
Chlorobutadiene	Bs/Op	Ac/Pm	
Chloroform	Vp	Ac/Pm	
Chloroplatinic acid	Ix/Np		
Chlorosulfonic acid	Np		
Chlorothiazide	Vp	Ac/Pm	
Citric acid	Np/Ix	Ae	
Cobalt chloride	Np/Ix		
Cobalt nitrate	Np/Ix		
Cobalt sulfate	Np/Ix		
Copper chloride	Ix/Np		
Copper nitrate	Ix/Np		
Copper sulfate	Ix/Np		
Cresol	Vp	Ac/Pm	
Crotonaldehyde	Ac/Pm		
Cyanamide	Ac		Np
Cyanoacetic acid	Np		
Cyanobutadiene	Bs	Ac/Pm	
Cyanogen bromide	Np	Ac	
Cyanogen chloride	Np	Ac	
Cyclohexane	Bs/Op	Ac/Pm	Bu
Diaminoethane	Ac/Ix		
Diamylamine	Bs/Op	Ac/Pm	Ix
Dibutyl phthalate	Vp	Ac	Bs

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Dichlorobenzene	Vp	Ac/Pm	
Dichloroethane	Vp	Ac/Pm	
Dichloromethane	Vp	Ac/Pm	
Dichlorophenol	Vp	Ac/Pm	
Dichloropropane	Vp	Ac/Pm	
Diethanolamine	Ac/Pm		Ix
Diethylamine	Ac/Pm		Ix
Diethyl phthalate	Vp	Ac	Bs
Diethylhexyl phthalate	Bs/Op	Ac	
Diisobutylcresoxyethoxyethlmethyl benzylammonium chloride	Ac/Pm		Ix
Diisobutylphenoxyethoxyethyldimethyl benzylammonium chloride	Ac/Pm		Ix
Diisopropanolamine	Ix		Ac
Diisopropylamine	Ix		Ac
Dimethylamine	Ix		Ac
Dimethylbenzylammonium chloride	Ac/Pm		Ix
Dimethyl sulfate	Vp	Ac	
Dimethyl sulfoxide	Ac		
Dinitrobenzene	Vp	Ac/Pm	
Dinitrophenol	Vp	Ac/Pm	
Disodiumdibutylphenylphenoldisulfonate	Ac/Pm		Ix
Epichlorohydrin	Vp	Ac/Pm	Np
Ethanolamine	Ix		Ac
Ethyl acrylate	Bs/Op	Ac/Pm	
Ethyl alcohol	Ae		Bu
Ethylamine	Ix		Ac
Ethylbenzene	Bs/Op		
Ethylene	Ac/Pm		Bu
Ethylenediaminetetraacetic acid (EDTA)	Ix		Ac
Ethylene glycol	Ae		Bu
Ethylene glycol diacetate	Ac/Pm	Ae	

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Ethylene glycol monobutyl ether	Bs	Pm/Ae	
Ethyleneimine	Ac		Ix
Ferric hydroxide	Ix/Np		
Ferric chloride	Ix/Np		
Ferric sulfate	Ix/Np		
Ferrous hydroxide	Ix/Np		
Ferrous sulfate	Ix/Np		
Ferrous sulfite	Ix/Np		
Fluorine	Np		
Formaldehyde	Np		Ae
Fumaric acid	Vp	Ac/Ix	
Furfural	Vp	Ac/Pm	Ae
Furfuryl alcohol	Np		Ae
Gallic acid	Vp	Ac/Ix	Np
Gluconic acid	Ac/Ix		Ae
Glucose	Ae		
Glycerol	Pm		
Heptanol	Bs	Pm/Ac	Bu
Hexamethylene diamine	Ac/Ix		
Hexanol	Bs	Pm/Ac	Bu
Hydrazine	Ae		
Hydrochloric acid	Np		
Hydrocyanic acid	Np/Ix		
Hydrofluoric acid	Np/Ix		
Hydrogen peroxide	Np		
Hydroquinone	Ae		
Hydroxylamine	Ix/Ac		Ae
Hypochlorous acid	Np		
Indole	Vp	Ac/Pm	
Isoprene	Bs/Op	Ac/Pm	

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method §
Lactic acid	Ac/Ix		
Lanthanum acetate	Np		
Lauryldimethylbenzylammonium chloride	Ac/Pm		Ix
Lead acetate	Np/Ix		
Lead arsenate	Vp	Np/Ix	
Lead chloride	Vp	Np/Ix	
Lead nitrate	Np/Ix		
Lead sulfate	Vp	Np/Ix	
Lead tetraethyl	Vp	Ac	
Lead tetramethyl	Vp	Ac	
Linoleic acid	Bs/Op	Ac	
Lithium chloride	Np/Ix		
Maleic anhydride	Ac/Ix		
Maltose	Ae		
Mercury	Np/Ix		
Methanethiol	Bs/Op	Ac/Pm	
Methanol	Ae		Bu
Methyl acetate	Ac/Pm	Ae	Bu
Methyl acrylate	Ac/Pm	Ae	Bu
Methylamine	Ac/Ix	Ae	
Methyl azide	Ac/Ix		
Methylethyl pyridine	Bs/Op	Ac	
Methylisobutyl ketone	Bs/Op		Ac/Pm
Methylmethacrylate	Bs/Op	Ac/Pm	
Molasses	Ae		
Molybdic trioxide	Vp	Ix/Np	
Mustard gas	Vp	Ac	
Naphthalene	Vp	Ac	
Naphthalic acid	Vp	Ac/Ix	
Naphthenic acid	Vp	Ac/Ix	Bs

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method §
Naphthol	Vp	Ac/Ix	
Naphthylamine	Vp	Ac/Ix	Bs
Nickel ammonium sulfate	Np/Ix		
Nickel chloride	Np/Ix		
Nickel nitrate	Np/Ix		
Nickel sulfate	Np/Ix		
Nitric acid	Np		
Nitrilotriacetic acid (NTA)	Ac/Ix		
Nitroaniline	Vp	Ac/Pm	
Nitrobenzene	Vp	Ac/Pm	
Nitrochlorobenzene	Vp	Ac/Pm	
Nitrocresol	Vp	Ac/Pm	
Nitrophenol	Vp	Ac/Pm	
Nitropropane	Bs/Op	Ac/Pm	Vp
Nitroxylene	Vp	Ac/Pm	
Octadecenyldimethylethylammonium–bromide	Ac/Pm		Ix
Octyl alcohol	Bs/Op	Ac	
Oleic acid	Bs/Op		
Oxalic acid	Vp	Np	
Oxydipropionitrile	Ac		
Paraformaldehyde	Vp	Ae/Ac	
Pentanal	Bs/Op	Ac	
Pentane	Bs/Op	Ac/Pm	Bu
Pentanol	Bs/Op	Ac/Pm	Bu
Pentene	Bs/Op	Ac/Pm	Bu
Phenobarbital	Vp	Ac/Pm	Ae
Phenol	Vp	Ac	
Phenylcarbylamine chloride	Vp	Ac	
Phosgene	Np		
Phosphoric acid	Np		

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Phosphorus	Np		
Phosphorus oxychloride	Np		
Phosphorus pentasulfide	Np	Ae	
Phosphorus trichloride	Np		
Polychlorinated biphenyls (PCB's)	Vp	Ac/Pm	
Polyglycol ether	Ac/Pm		Ae
Potassium chromate	Np/Ix		
Potassium cyanide	Np/Ix		
Potassium dichromate	Np/Ix		
Potassium hydroxide	Np/Ix		
Potassium permanganate	Np/Ix		Ac
Propanal	Bs/Op	Ac/Pm	Ae
Propanoic acid	Np/Ix	Ac/Ae	
Propanoic anhydride	Np/Ix	Ac/Ae	
Propanolamine	Ix/Ac		
Propyl alcohol	Ae		Bu
Propylamine	Ix/Ac		
Propylene oxide	Ac/Pm		Bu
Pyridine	Ac/Ix		
Pyrocatechol	Ac/Pm		
Pyrogallol	Ac/Pm		
Quinacrine hydrochloride	Vp	Np	Ac
Quinhydrone	Vp	Ac/Pm	
Quinine	Vp	Ac/Pm	
Quinoline	Vp	Ac/Pm	Bs
Quinone	Vp	Ac/Pm	
Resorcinol	Ac/Pm		
Salicylaldehyde	Vp	Ac/Pm	
Salicylic acid	Vp	Ac/Pm	
Selenium	Vp	Np/Ix	

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Silver nitrate	Np/Ix		
Sludge, chemical	All methods, depending on content		
Sludge, digested sewage	Vp		Np
Sludge, raw, undigested sewage	Vp		Np
Sodium	Np		
Sodium anthraquinone sulfonate	Ac/Ix		
Sodium arsenate	Np/Ix		
Sodium azide	Np		
Sodium bisulfite	Np/Ix	Ae	
Sodium bromobenzene sulfonate	Ac/Pm		Ix
Sodium butyldiphenyl sulfonate	Ac/Pm		Ix
Sodium butylphenylphenol monosulfonate	Ac/Pm		Ix
Sodium chromate	Np/Ix		
Sodium cyanate	Np/Ix		
Sodium cyanide	Np/Ix		
Sodium decylbenzene sulfonate	Ac/Pm		Ix
Sodium dichlorobenzene sulfonate	Ac/Pm		Ix
Sodium dichromate	Np/Ix		
Sodium dodecylbenzene sulfonate	Ac/Pm		Ix
Sodium ferricyanide	Np/Ix		
Sodium ferrocyanide	Np/Ix		
Sodium fluoride	Np		
Sodium fluosilicate	Vp/Ix		
Sodium hydrosulfide	Np	Ae	
Sodium hydroxide	Np		
Sodium lauryl sulfate	Ac/Pm		Ix
Sodium methylate	Np	Ae	
Sodium naphthalene sulfate	Ac/Pm		Ix
Sodium nitrite	Ix		
Sodium nitrochlorobenzene sulfonate	Ac/Pm		Ix

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Sodium octyl sulfate	Ac/Pm		Ix
Sodium oleate	Ac/Pm		Np
Sodium palmitate	Ac/Pm		Np
Sodium phosphate	Np		
Sodium selenite	Ix/Np		
Sodium silicate	Np		
Sodium stearate	Ac/Pm		Np
Sodium sulfide	Ix/Np		
Sodium sulfite	Np	Ae	
Sodium thiocyanate	Ix		
Sodium tungstate	Ix		
Stannous chloride	Ix/Np		
Strontium chloride	Ix/Np		
Strontium nitrate	Ix/Np		
Styrene	Bs/Op	Ac/Pm	
Sulfur chloride	Np		
Sulfuric acid	Np		
Sulfurous acid	Np/Ix		
Superphosphate	Np/Ix		
Tannic acid	Np/Ix		Ac
Tetraethylene pentamine	Ac/Ix		
Thallic oxide	Vp	Ix	
Thallium acetate	Ix		
Thioglycolic acid	Ix/Np	Ae	
Thorium chloride	Ix/Np		
Thorium nitrate	Ix/Np		
Titanium chloride	Ix/Np		
Titanium nitrate	Ix/Np		
Titanium sulfate	Ix/Np		
Toluene	Bs/Op	Ac/Pm	

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Hazardous Substance	Phase I Removal Methods†	Phase II Removal Methods††	Other Removal Method§
Toluene diisocyanate	Ac/Ix		
Toluidine	Ac/Pm		Ix
Trichlorophenol	Vp	Ac/Pm	
Triethanolamine	Ix		Ac
Triethylamine	Ix/Ac		
Triethylenetetramine	Ix/Ac		
Trimethylamine	Ix/Ac		
Vanadyl sulfate	Np/Ix		
Vinyl acetate	Bs/Op	Ac/Pm	
Vinyl bromide	Ac/Pm		
Vinyl chloride	Ac/Pm		
Xylene	Bs/Op	Ac/Pm	
Xylenol	Bs/Op	Ac/Pm	Vp
Zinc chloride	Np/Ix		
Zinc nitrate	Np/Ix		
Zinc sulfate	Np/Ix		
Zirconium sulfate	Np/Ix		

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