CHAPTER 27

HAZARDOUS WASTE

27-1 INTRODUCTION

Love Canal

On August 2, 1978, state officials ordered the emergency evacuation of 240 families from the Love Canal neighborhood of Niagara Falls, New York. After heated confrontations among the local residents and city, state, and federal officials, some action finally was taken. With Love Canal, the eyes of the nation opened to the problems of hazardous waste in the United States.

Love Canal began in 1880 as the dream of William T. Love. He began construction on a dream city surrounding an electrical generating plant that was to use diverted water from the Niagara River to produce direct current power. A canal from the river would provide water to the plant. Economics and the invention of alternating current that could travel long distances ended the dream during its early development. Between 1942 and 1952, the abandoned canal became a dumping ground for waste from local chemical plants. In 1953, Hooker Chemical Company, the owner of the site, deeded the land to the local school district for $1.00. A school playground and housing were constructed on and adjacent to the site. The new owners did not know what the site contained.

After Love Canal received national attention, a study by New York State[1] reported that nearly 22,000 tons of chemical waste were dumped in Love Canal (see Table 27-1). The study found that 152 of 215 waste disposal sites in Niagara and Erie Counties of New York were known to have or were suspected of containing hazardous waste. Some contained even more waste than Love Canal. At one site, entire tank cars of waste were buried.

Times Beach

The Centers for Disease Control began investigating Times Beach, Missouri, in 1971. On December 23, 1982, they issued a warning to residents of Times Beach that their town was unsafe because of dioxin (2,3,7,8-tetrachlorodibenzoparadioxin, or TCDD) contamination. Sax[2] lists TCDD as a "very, very toxic material." Just 2 weeks before, the town's residents had faced a record flood of the Merimac River. After the 1982 warning and evacuation of residents, the federal government removed contaminated soil from the community at a multimillion dollar cost.

Other Sites

Although the above two episodes gained national attention, there are many other stories related to hazardous waste. In the "Valley of the Drums" near Shephardsville, Kentucky, between 17,000 and 100,000 drums were abandoned illegally. On April 22, 1980, a major

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TABLE 27-1 Waste Content of Love Canal

Type of Waste	Estimated Quantity (tons)
Miscellaneous acid chlorides	400
Thionyl chloride	500
Miscellaneous chlorinations	1,000
Mercaptans	2,400
Trichlorophenol	200
Benzoyl chloride	800
Metal chlorides	400
Liquid disulfides	700
Benzyl hexachloride	6,900
Chlorobezenes	2,000
Benzyl chlorides	2,400
Sulfides	2,100
Miscellaneous	2,000
Total	21,800

fire on the waterfront of Elizabeth, New Jersey, consumed thousands of containers of hazardous materials and gave off noxious smoke and gases. In several locations, midnight dumping operations left roads and communities with hazardous waste problems. Radioactive mine tailings form the foundations of houses and yards in some uranium mining communities in Colorado and Wyoming. In the summer of 1988, medical waste washed ashore at several public beaches along the east coast of the United States. The waste was improperly dumped at sea.

In 1990, the Department of Energy estimated that the immediate costs to clean up contaminated nuclear production facilities and their sites would be $30 billion. Cumulatively, these stories have alerted the public to the problem. New laws continue to emerge. Even disposable baby diapers, a product for the modern family, have been banned in some locations unless they are made of biodegradable materials. Even biodegradable plastics do not degrade easily in landfills, where they are isolated from air. Engineers face a growing challenge to create products from materials that create fewer waste problems, as well as a need to find more effective methods for managing waste problems, particularly hazardous waste. The public in the "throwaway" society faces a challenge to reduce the volume of waste through recycling, changed packaging, and other means.

27-2 HAZARDOUS WASTE

The Hazardous Waste Problem

Hazardous wastes comprise a small portion of the total waste generated in the United States. The U.S. Environmental Protection Agency (EPA) estimated that 80 billion pounds of hazardous waste are produced each year; others believe the amount is higher. The EPA estimated that for a time, only 10% of these wastes were properly disposed of through on-site disposal methods and secured landfills. The remainder were placed in unlined lagoons and ponds, in nonsecure landfills, or were disposed of in other ways. Alternate disposal methods include ocean dumping, placing waste in sewer systems, dumping on roads, deep-well injection, or burning in ordinary incinerators. An EPA survey in 1980 produced a list of more than 32,000 known waste sites containing hazardous waste. These results led to tighter disposal regulations, a Superfund cleanup program for existing hazardous waste sites, and increased liability for owners of contaminated land. More recent legislation has reduced the dispoal options and tightened standards that have controlled management of hazardous waste.

There are two categories of wastes. Producer wastes are those generated by industry. They are usually concentrated and found in particular locations. Consumer wastes are those disposed of by the ultimate user of products. They are usually low in concentration, but widely dispersed.

On June 13, 1989, the EPA released a list of 595 waterways (rivers, creeks, streams, oceans, and lakes) across the United States that are polluted above acceptable levels by 126 chemicals considered harmful to the environment. More than 17,000 other waterways are contaminated at lower levels or by other substances. The EPA created a cleanup plan by 1992. In a number of areas, cleanup plans and implementation actions have led to reduced hazardous waste problems.

Hazardous Waste Definition

Under the Resource Conservation and Recovery Act (RCRA) of 1976, the EPA has a complicated definition for a hazardous waste. Figure 27-1 is a summary flow chart of the definition. In short, a hazardous waste is any material that meets the RCRA definition of a solid waste and is not excluded as a hazardous waste.

Referring to Figure 27-1, materials are one of three categories:

1. garbage, refuse, or sludge
2. solid, liquid, semisolid, or containing gaseous material
3. other

These categories help determine if a material is an RCRA solid waste. Materials that are a RCRA solid waste are evaluated further to see if they are RCRA hazardous wastes; materials that are not RCRA solid wastes are not RCRA hazardous wastes. Category 1 materials are RCRA solid wastes, and some materials in category 2 are RCRA solid wastes. Category 3 materials (other) are excluded. They include domestic sewage, Clean Water Act point source discharge, irrigation return flow, source, special nuclear or by-product materials regulated under the Atomic Energy Act of 1954 and amendments, or in situ mining waste.

RCRA solid wastes appearing in an EPA list of hazardous materials[3] or containing a waste found in the list may be RCRA hazardous wastes. They are evaluated further to see if they are excluded from the list by other parts of the regulation. In some cases, one can also petition to have them removed.

Materials that are not in the list must be checked for other characteristics to determine if they are hazardous wastes. Hazardous characteristics are ignitability, corrosivity, reactivity, and toxicity. To be an RCRA hazardous waste, materials with any of these characteristics must also (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Furthermore, the materials must be reasonably measured or detected.

If a material is an RCRA hazardous waste, there are regulations governing it. The regulations vary for different conditions, including the following:

1. Whether it is generated by a small-quantity generator.
2. Whether it is intended to be reused, recycled, or reclaimed.
3. Whether it is sludge or is or contains material in the EPA hazardous waste list.
4. Whether the handler is (a) generator, (b) transporter, or (c) owner or operator of a treatment, storage, or disposal facility.

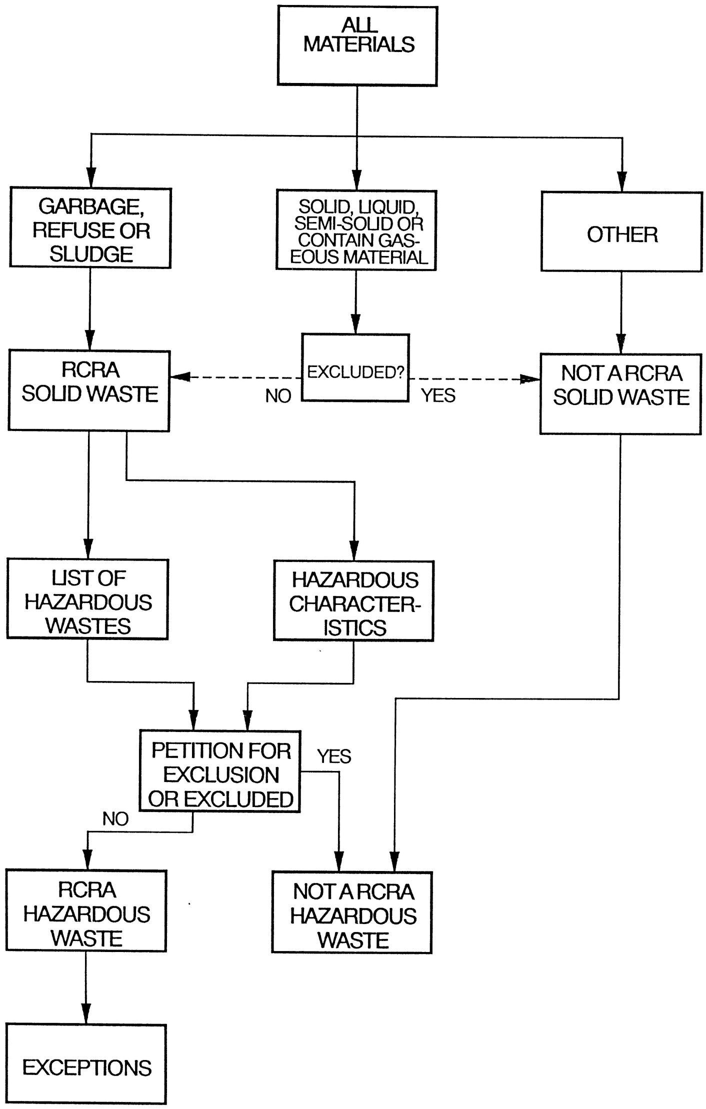

Figure 27-1. Logic tree for EPA definition of a hazardous waste.

Beside the EPA definitions, there are many ways to classify hazardous waste. One classification for hazardous waste relates to how long a material is hazardous. Some materials, like heavy metals, are toxic for extended periods. Most often the hazard is an intrinsic property of the material. Some materials lose their hazardous property over time at a moderate rate, whereas other materials, such as acids or bases, lose their hazardous property rather quickly in contact with other materials.

Hazards

The major hazards of waste are those already identified for other substances in Chapter 24: ignitability (flammability), reactivity, corrosivity, and toxicity. In addition, damage to the environment is important. Hazardous materials may contaminate groundwater and water supplies, cause closing of wells, destroy natural habitats, contaminate soil, kill fish or livestock, incapacitate sanitary sewer treatment facilities, damage crops, or contribute to air pollution. Hazardous waste may also have biohazards.

Problems

A number of practices add to the general waste problem. The hazardous materials portion of the waste has gained public attention and brought about new laws and regulations accompanied by new technologies. However, even though significant efforts have been underway to clean up hazardous waste sites, many waste sites resulting from poor practices of the past will be with us for some time.

A serious problem in the past was hazardous waste management. Not that long ago, people disposed of hazardous waste by passing it along. One simply called a waste hauler and paid to have it removed. There was little concern on the part of waste generators, whether consumer or producer, about what happened to waste after it was hauled away. Engineers, among others, received little training about what to do with materials that were not needed or left over from manufacturing processes. Laws and regulations have changed things, but improper disposal has not disappeared totally.

Another problem, still with us, is that we are a “throwaway” society. We design products for disposal after we are through using them or after they fail. Even products which become obsolete, such as personal computers, cannot be upgraded or repaired economically and become waste. A large portion of the waste generated in this country could be used again or recycled for additional uses, but not always economically. The throwaway products and packaging add to the waste problem.

Another problem of the past was selection of waste sites. We located dumps on the least desirable land, land of little value for agriculture, business, or residences. Unfortunately, the undesirable lands were often wetlands or land with porous, sandy soil, which allowed materials dumped in these sites to migrate into surface and underground water supplies. Recovery of these leaching materials is extremely difficult.

Beside selection, waste site design created additional problems because there was very little design. One dumped waste or piled it up and sometimes covered it. Little attention was given to preventing dump contents from leaching into the soil below or to nearby areas.

Another problem is liability for past dumping. It was not uncommon in the past that companies transferred waste to waste management and disposal companies. Later, the waste company went out of business. Under current law, the parties involved, including the generator, have a financial liability for the cleanup of sites contaminated by their waste. The cost for past practices, even if well managed under previous standards, can be very high. Selling a plant to another company does not always relieve the first owner of financial responsibility if contamination is discovered after the sale. Although the purchase price for the new owner may be very low, failing to investigate the property for hazardous waste may drive the real price high when cleanup costs are figured in.

27-3 CONTROLS FOR HAZARDOUS MATERIALS

There are many choices involved in reducing the dangers from hazardous waste, and the appropriate choices will vary with particular materials. Methods include eliminating the hazardous material, reducing quantities generated, restricting the area contaminated by containing the waste, storing the waste, separating wastes by degree of hazard, pretreatment, treatment, detoxification, and disposal. Other methods include reusing, recycling, or reclaiming materials and managing distribution.

There are many factors that affect the choices available. One factor is laws and regulations. Federal and state law and regulations specify acceptable methods for different hazardous materials. Some methods are not technically feasible or practical for particular materials. Economics is very important, so it is necessary to keep the waste management and treatment costs as low as possible. Social and political factors play an important role. Some communities will not accept locating landfills, incinerators, recycling, or other hazardous materials processes in their area. "Not in my backyard" is a common public theme. There are many court cases where existing and proposed waste control facilities were challenged by individuals and communities. Even at the national level, the process of selecting a disposal site for hazardous waste and radioactive waste can drag on and on.

Cost is another critical factor. The cost to dispose of hazardous waste has increased dramatically. Some companies pay several hundred dollars or more per 55-gal drum for hazardous waste removal and disposal. Even consumers are charged for disposal of certain products, such as tires, batteries, and other auto parts, when their repair shops replace them with new products. Rising costs are the result of many factors. There are few new companies entering the hazardous waste business and there are fewer and fewer approved waste sites. Haul distances are long for many parts of the country, particularly the East and Northeast. Hazardous waste companies or would-be companies have difficulty obtaining liability insurance, and the insurance is expensive and usually does not exceed 1 million. Because the generator of waste has a responsibility for it, even when it is transferred to someone else, the processes for managing waste and waste records are expensive.

Eliminate Hazardous Wastes

One way to minimize the dangers of hazardous wastes is to prevent their generation, which can be accomplished by substituting less hazardous material in a process, using materials that do not produce hazardous waste, or changing a process to reduce the amount of hazardous material used or to prevent generating hazardous waste.

Reduce Quantities

Often complete elimination of hazardous waste is not possible. However, the economics of hazardous waste management and disposal provide an incentive to produce as little as possible. Several approaches are possible: some are preventive; some apply to waste after it is produced.

Analysis and Plans An important approach is analysis of waste streams and formulation of a hazardous waste reduction plan. A National Academy of Sciences report suggests three phases in a waste minimization program. Each phase must deal with hazards, risk, and economics of options, and the involvement of management and workers is important for each phase. Follow-up for each phase must evaluate the effectiveness of actions taken or to be taken.

The first phase is reviewing and improving operating practices. It is important to document the processes by which hazardous materials are created. Improved practices may result from employee training, management changes, hazardous material inventory control from procurement through disposal, and keeping different waste streams separate. A process change may be as simple as buying the minimum quantity needed instead of large quantities that have a low purchase costs and high disposal costs. Spills also can be avoided through improved materials handling practices, and leaks can be prevented through preventive maintenance programs.

The second phase addresses processes in greater depth through a feasibility study. The options for reducing hazardous waste may involve changes in processes and equipment, quality control, and instrumentation. Options must evaluate cost, process reliability, on-site and off-site safety, potential waste reduction, regulatory compliance, and other factors.

The final phase is the implementation phase. The selected changes in processes are completed through redesign and modification or new construction and replacement. Implementation may require participation of process equipment vendors. This phase requires evaluating vendors carefully to ascertain what experience they have in waste minimization and how well their products will work when installed.

Compaction Compaction is an approach to reducing solid waste volume after it is generated. However, some types of waste do not lend themselves to compaction.

Reuse, Recycle, Reclaim

One way to minimize hazardous waste is to reuse, recycle, or reclaim materials. For example, there are many processes that require solvents. In some cases the solvent may evaporate, but because it cannot be exhausted to the atmosphere, it must be recovered through condensation, adsorption, or other means. It can be reused. Some processes may contaminate a solvent, but a user may be able to reprocess it or, perhaps, a supplier will reprocess it and provide a credit on new purchases. Another process may modify the solvent and its properties, and the waste may have economic value to someone else. The generator may sell it for use by another company. There are a number of waste exchanges among industrial groups and companies that help waste producers find potential users.

Containment

Another important option for controlling hazardous waste generation is containment. Processes and operations should be designed to minimize the amount of air, water, and other materials that become contaminated by hazardous material. The less material contaminated, the less there is to manage. For example, if one allows waste materials to mix with storm water, the task of removing contaminants increases substantially because a large volume of water must be treated to remove the contaminants.

Special equipment and devices may help contain contaminants. For example, sensors may be placed in sewer lines to detect the presence of hazardous waste. If hazardous waste is present, the lines divert to holding tanks and prevent spills into sewer systems. Automatically or manually activated valves also can prevent hazardous materials from entering sewer lines.

Storage

There is not always a place to put hazardous waste. After it is generated, it must be held for subsequent transport and processing, which may be in batches. Removal from the site may require waiting until there is a full truck load or a reasonable quantity for transport.

Liquid storage may involve tanks (underground or above ground) or open lagoons. Solid waste may be waste piles or other forms of surface impoundment. Wastes should be compatible. For example, strong acids should not be mixed with strong bases. Different wastes or types of wastes should be in separate containers when they are incompatible, and containers must be in good condition and not leak during the storage time.

Separation

Because materials contaminated with hazardous wastes are considered hazardous waste also, it is a good strategy to separate hazardous materials from general waste. Separating hazardous wastes into compatible groups is important, as is separating them into practical groups. For example, a supplier may give credit for return of a material for reprocessing. Therefore, mixing other materials with it may reduce the amount of credit and may make reprocessing more difficult or costly.

Pretreatment

Pretreatment is any process that makes final treatment more economical, feasible, or effective. The final treatment may not affect or be suitable for certain hazardous materials. Pretreatment may include any form of treatment, may involve several processes in sequence, often involves separation, and may reduce the variety, volume, or concentration of contaminates. One example of pretreatment is removal of oil from storm water runoff in parking lots. Holding tanks and skimmers, sludge pits, or other means are used to help extract the oil from the runoff water.

Detoxification

One form of pretreatment or treatment is detoxification. In detoxification, hazardous properties, particularly those that are toxic, are removed from a material. There is growing interest in this capability. Biologists are finding microorganisms that perform this function. For example, researchers have identified a fungus that will digest dioxin, DDT, benzopyrene, and polychlorinated biphenyls.

Treatment

There are many kinds of treatment for wastes, which may involve physical, chemical, or biological processes. Treatments may include disposal methods. Certain methods are applicable for only certain wastes.

Biological treatments typically involve organic wastes. Microorganisms of various types, including bacteria, break down substances into alternate, more desirable forms.

Chemical treatment may include adjusting pH with acids or bases. It may involve extraction of oils, heavy metals, ion exchange, oxidation, and other techniques.

Physical treatments primarily isolate or concentrate particular materials, reduce their volume, solidify, detoxify, or perform some combination of these functions. For example, evaporation can reduce volume, as can compaction. Adsorption may remove certain materials. In solidification, liquids or slurries are mixed with stabilizing or binding agents to prevent leaching of materials when they are buried in landfills. Cementation processes appear useful for binding high concentrations of inorganics and heavy metals. Thermoplastic processes mix paraffin, bitumen, or asphalt with dried sludge wastes at elevated temperatures. Polymerization and encapsulation are other forms of solidification processes.

Disposal

There are three primary methods for waste disposal: burial in landfills, deep-well injection, and incineration. Laws and regulations often limit the methods available.

Burial There are two kinds of landfills: conventional and secure. Municipalities use conventional landfills for general waste because they are relatively cheap to operate. They also have a high potential for leaching of materials to the surface for runoff, lateral leaching into adjacent ground, and leaching into deeper soil. Leaching into deeper soils can contaminate aquifers and other underground sources of drinking water. Today, landfills must meet strict design standards. The standards help prevent leaching. Operating standards require dumped materials to be covered daily, which prevents air pollution and scattering of materials by wind and animals.

Secure landfills for hazardous waste must meet stringent standards of the EPA. A secure landfill must have an impervious clay base or an artificial liner. These features are intended to contain any leachate. A drainage system around the landfill collects groundwater and prevents it from entering the landfill. The drainage system and groundwater near and under the landfill are monitored for leachate.

A problem for many communities is having sites or access to landfills within a convenient distance. Establishing a new site or finding a suitable location for a site is not always easy. The public near a site usually resists having a site in their neighborhood. Some locations have haul contracts with sites several states away from their own state.

Deep-Well Injection Today, EPA regulations generally ban deep-well injection. In deep-well injection, liquid wastes are pumped through pipes deep into the earth into porous rock formations or natural underground domes. The depth is normally below any useful underground water sources. If suitable sites are available, deep-well injection can avoid transportation costs and processing costs. However, some deep-well sites have not been without problems. Layers of rock and soil above the disposal sites have become contaminated. There are questions about the reliability of geological sites to seal the waste adequately from movement and the potential failure of piping leading to the deposit site. Potential earthquakes, failures in overpressured sites, and other problems are not fully resolved for many sites.

Incineration Except for heavy metals and a few other forms of hazardous waste, incineration can be a safe method of disposal. Incineration processes are tailored to the kind of waste involved and they can produce heat and steam for other processes. Today, incinerators must have scrubbers downstream of the combustion process to ensure that hazardous materials do not escape. Researchers continue to study combustion methods and methods for recovering any dangerous gases or particulates remaining from combustion. A major problem for incinerators is public acceptance. Few are being built and communities that are potential sites for hazardous waste incineration plants frequently do not want such a facility in their neighborhood.

Manage Distribution

Another important control for hazardous waste is careful management. The Resource Conservation and Recovery Act of 1980 requires that anyone who generates, stores, transports, or disposes of hazardous waste must obtain an identifying number. The waste generated, stored, transported, or disposed of must follow a manifest system. The manifest system allows tracking of the type and amount of hazardous material generated until it is disposed of properly and the person who transfers hazardous waste to a disposal company receives information on where and how waste was disposed. Tracking of hazardous material purchased, received, stored, and used is essential in ensuring that hazardous waste is properly identified and disposed.

27-4 LAWS AND REGULATIONS

It is impossible to list all the laws and regulations that affect waste management and disposal. They change constantly at federal, state, and local levels. Some foreign laws and regulations are even more stringent than those in the United States. This section reviews selected federal laws and regulations that apply to hazardous waste.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 (RCRA) was the first major federal legislation on hazardous waste. The act does not cover radioactive waste, which falls under the Atomic Energy Act of 1954. Later, the Uranium Mill Tailings Radiation Control Act of 1978 gave the EPA responsibility for cleanup of radioactive materials from inactive uranium processing sites. The RCRA does not include water pollutants regulated by the Clean Water Act of 1972. Also excluded by the RCRA were boiler fuel incinerators. Many industrial or commercial boilers recover heat energy from materials defined as hazardous wastes.

The main portion of the law dealing with hazardous waste contains eight sections.

- The first required the EPA to develop criteria for identification of hazardous waste materials. It also required the EPA to develop a list of substances meeting these criteria. That list began to define hazardous waste.
- The second addressed record keeping, labeling, packing, and transporting of hazardous wastes. It created the requirement for the manifesting procedures.
- The third section required the EPA to develop regulations for transporters to ensure that hazardous waste does not endanger human health or the environment.
- The fourth required development of regulations for hazardous waste disposal facilities.
- The fifth required the EPA to issue permits to all operators of hazardous waste disposal facilities. These permits specify the type and amount of waste to be received and processes allowed for a particular site. They also state methods of disposal for particular wastes.
- The sixth allowed states to establish their own programs if they meet or exceed EPA programs.
- The seventh required inspection of hazardous waste sites and facilities.
- The eighth established civil and criminal penalties for violators of hazardous waste regulations.

1980 EPA Regulations In 1980, the EPA completed final rules on compliance with the RCRA. Earlier in this chapter, some provisions were discussed. Most of the regulations deal with the estimated 15,000 large-quantity generators (LQGs) of hazardous waste. LQGs are those producing 1,000 kg per month or more of waste.

1984 Hazardous and Solid Waste Amendments The original RCRA excluded from strict EPA regulations those small businesses generating less than 2,200 lb (1,000 kg) of hazardous waste monthly. In 1984, Congress changed the law to exclude small businesses producing less than 220 lb (100 kg) of hazardous waste per month. In 1986, the EPA issued regulations affecting approximately 175,000 small quantity generators (SQGs) that produce between 100 and 1,000 kg per month. These generators produce approximately 800,000 metric tons of hazardous waste per year, which is less than 0.5% of all hazardous waste produced in the United States.

Regulation of Underground Storage Tanks Revisions to the RCRA established controls for underground storage tanks. Many that were placed in the ground for storage of gasoline, petroleum products, and other substances developed holes from corrosion and other factors and leaked their contents into the ground. The material migrated and contaminated ground water. This portion of the RCRA caused a great deal of removal of unsued storage tanks and ones with designs that would not contain leaking materials. In addition, the standards established requirements for the design and use of new storage tanks that would prevent, monitor for, and remedy leaks.

Marine Protection, Research and Sanctuary Act of 1972

This act bans dumping of radioactive, biological, and chemical warfare wastes in the ocean. It requires permits for dumping of sewage sludge and dredged materials.

Medical Waste Tracking Act of 1988

This law established a 2-year demonstration program for tracking medical waste from generator to disposal. Although only a few states are included, others may volunteer. The law requires the EPA to establish regulations for medical waste generators, transporters, and treatment, storage, and disposal facilities. The agency is to monitor the program and report on results, costs, and benefits.

CERCLA (Superfund)

The problems of hazardous waste extend back many years. What to do with waste already disposed of also became a national issue. The result was development of a Superfund. Contributions by both government and private industry created a source to cover the cost of cleaning up the worst of the many hazardous waste sites of the past. Industry contributed 75% of the initial $1.6 billion fund. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), passed in late 1980, took action to clean up some of the hazardous waste sites. The act also addressed liability. It stated that those causing or contributing to a release or threatened release from an inactive hazardous waste site shall have strict, joint, and several liability for cleanup, containment, and emergency response activities at the site. Liable parties included generators and transporters of the waste and owners and operators of the disposal site.

The CERCLA legislation expired in 1985, but was reauthorized in 1986 under the Superfund Amendments and Reauthorization Act (SARA).

SARA Title III

Another problem addressed by legislation was informing citizens who might be exposed to hazardous materials. This idea is called community right-to-know. The Emergency Planning and Community Right- to-Know Act of 1986 (also known as SARA Title III) established the requirement to inform communities. The act also authorized states to pass laws requiring emergency planning for potential hazardous material release events. Under these state laws, companies must prepare emergency response plans and make them available to authorities in communities around a plant. Coordination with local medical services, fire departments, police departments, and other officials is essential for them to provide adequate time for people to protect themselves against the hazards of a release.

OSHA Regulations for Hazardous Waste Site Activities

As people began to clean up hazardous waste sites, workers faced dangers of exposure to unknown contaminants. Planning and management of cleanup activities must include the protection of workers. In December, 1986, OSHA created interim final rules for hazardous waste site and emergency responses. It protects public and private sector employees involved in handling hazardous waste materials. The final rule went into effect in early 1989.[4] The standard, sometimes referred to by the acronym HAZWOPER, includes site analysis and control, training, medical surveillance, air monitoring, protective equipment, informational programs, decontamination procedures, and emergency response plans.

California Proposition 65

In November, 1986, California voters overwhelmingly approved Proposition 65, which enacted the Safe Drinking Water and Toxic Enforcement Act. It requires that no business may expose people to chemicals that can cause cancer, birth defects, or reproductive harm without giving a clear and reasonable warning. One provision prohibits businesses from knowingly discharging these chemicals into the drinking water. However, the key provision of this law is that an employer has the burden of proof to prove that his products and emissions are safe; if not, the employer must give public warnings. This is in contrast to normal tort procedure where the burden of the proof on harm rests with the employee or consumer.

Nuclear Waste Policy Act of 1982

Late in 1982, Congress passed the Nuclear Waste Policy Act (NWPA). It addresses the national problem of what to do with high-level nuclear waste, which is mainly spent nuclear fuel from nuclear power plants. It also includes other forms of highly radioactive waste. Low-level nuclear waste includes contaminated clothing, waste from medical treatment, contaminated water, and other forms of waste with limited radioactivity.

NWPA provisions involved protecting public health and safety and the environment, acceptance of waste for disposal not later than January 31, 1998, creating a repository of permanent disposal of spent fuel and high level waste, safe transportation of waste to the repository, interim storage of spent fuel for utilities, public participation in the nuclear waste disposal solution, and costs recovered from waste generators. Establishing national waste sites for nuclear waste has yet to be resolved.

The Department of Energy (DOE) is the agency responsible for most provisions of the act. DOE recommended three sites to the president, who in turn, in 1991, was to recommend one site to the Congress. If Congress approved the recommended site, DOE was to build the national repository on this site. A second site was to be selected also, but a repository was not to be constructed on it. In addition, DOE was to develop the transportation system for moving the waste to the site. By 2005, the repository has not been completed and most nuclear fuel waste is stored at nuclear power plants where it is generated.

The act created the Nuclear Waste Fund to finance the waste disposal program. Since 1983, the federal government has collected from nuclear utilities fees that are determined by the amount of electricity generated.

EXERCISES

1. Investigate the design, special features, and design limitations for each of the following:
   (a) hazardous waste landfill
   (b) hazardous waste incinerator
   (c) high-level nuclear waste repository
   (d) high-level nuclear waste transport containers
   (e) deep-well injection facilities
2. Find out what plants or facilities in your community have emergency response plans. Obtain a copy of them and review them.
3. Find out if there are any hazardous waste sites in your area. Determine if any are on the Superfund National Priority List for cleanup or have been cleaned up.
4. Visit a hazardous waste generator, transporter, or disposal site. Find out how they manage manifest requirements and what procedures are involved.
5. Contact a local manufacturing plant to find out how the company manages hazardous waste.
6. Contact a hazardous waste hauling company and obtain their current waste hauling and disposal fees.
7. Check with a university in your area to find out how hazardous waste is managed across the entire campus.

REVIEW QUESTIONS

1. Describe the hazardous waste problem in the United States.
2. What is a hazardous waste?
3. What are the major dangers of hazardous waste?
4. What problems contributed to the hazardous waste issues of today?
5. Describe the controls for hazardous waste. Characterize each. Which controls are most preferred?
6. Describe the four-step process to reduce quantities of hazardous waste.
7. Briefly describe the role of each of the following in protecting the public against hazardous waste:

(a) RCRA
(b) Marine Protection, Research and Sanctuary Act of 1972
(c) Medical Waste Tracking Act of 1988
(d) CERCLA
(e) SARA
(f) SARA Title III
(g) NWPA

8. What does HAZWOPER refer to?

NOTES

1 "Draft Report on Hazardous Waste Disposal in Erie and Niagara Counties, New York," State of New York, Department of Environmental Conservation, Interagency Task Force on Hazardous Wastes, March 1979.

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