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REPORT BY THE

Comptroller General

OF THE UNITED STATES

Hazardous Waste Disposal Methods: Major Problems With Their Use

Hazardous waste disposal on the land is the Nation's predominant disposal method, resulting in potentially costly future cleanup efforts and serious environmental problems.

Other disposal methods (deep well injection and high temperature burning) and project development approaches (facilities established on a regional or areawide basis) offer more environmentally sound solutions that should be explored and developed.

The Environmental Protection Agency's recent issuances of hazardous waste regulations, though very general, are a good start. But more detailed technical requirements and approaches to project development are needed.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

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The Honorable Robert C. Eckhardt, Chairman
Subcommittee on Oversight and
Investigations
Committee on Interstate and Foreign
Commerce
House of Representatives

The Honorable Albert Gore, Jr.
House of Representatives

By letter dated July 12, 1979, and in subsequent meetings with your offices, you asked us to study alternative methods of disposal and cleanup of hazardous wastes. Specifically you asked us to look into (1) the environmental and cost effectiveness of hazardous waste disposal on the land; deep well injection; and high temperature incineration, including the need for additional research and development in these areas, (2) the establishment of facilities on a regional or areawide basis as opposed to an individual company basis, and (3) the hazardous waste regulations recently promulgated by the Environmental Protection Agency (EPA). On July 2, 1980, we testified on these matters before the subcommittee.

Overall, we found that each of the disposal methods used has merit and that all are needed to cope with the volume and types of hazardous wastes that have to be disposed of. None of the three methods used, however, is 100 percent safe either from an environmental or public health standpoint. While each disposal method can be made reasonably safe, the degree of safety depends largely on the effectiveness of control and enforcement procedures. Also, disposal should be thoroughly analyzed at specific locations.

We believe the technology to clean up problem sites is available. Who should pay for disposal and the source of funding for cleanup are major questions still to be answered.

In our review work at commercial and governmental disposal sites, only general cost data was available to us. We found it difficult to compare the relative costs of the various disposal methods because the costs varied greatly depending on the substance and the volumes disposed of, ranging from pennies to over a dollar a pound or gallon. Costs also varied greatly by location.

--Disposal facilities providing services on a regional or areawide basis, whether intrastate or interstate, offer economic and environmental advantages.

--To date, the national problem of what to do about closed and abandoned hazardous waste sites has not been fully confronted by the Federal, State, and local governments or by industry.

--Much more time will be needed before the hazardous waste regulations required by the Resource Conservation and Recovery Act (42 U.S.C. 6901), are fully promulgated and implemented, even though EPA's recent issuances of hazardous waste regulations are a good first step.

OBJECTIVES, SCOPE, AND METHODOLOGY

The basic purpose of our review was to assess alternatives for the disposal and cleanup of hazardous wastes. Our work was done at EPA headquarters and at three EPA regional offices--Chicago, Dallas, and Philadelphia--and at State agencies in Illinois, Louisiana, Maryland, Michigan, Pennsylvania, and Texas. (See app. I.) We reviewed operations at 24 commercial and governmental hazardous waste sites. (See apps. II and III.) We selected sites to visit that were representative of the various types of disposal operations. Site characteristics such as the method of hazardous waste disposal, type and volume of wastes handled, and location and geology of the area were also considered in the selection decision. We held meetings and discussions about our review with representatives from the Chemical Manufacturers Association, the National Solid Waste Management Association, and the Environmental Defense Fund, all of whom provided their views and observations.

LAND DISPOSAL SHOULD BE CUT BACK

EPA has estimated that tens of millions of tons of hazardous waste are disposed of annually and that about 94,000 landfills and 173,000 surface impoundments--pits, ponds, and lagoons--are used for waste disposal. At the three EPA regional offices and six States we visited, however, only limited data had been developed on the extent that land disposal was being used for various hazardous substances and on the locations of these disposal sites. However, it

low for extended periods. It has general application for the less hazardous, biologically degradable substances. One of its current uses is for the disposal of oil sludge residues.

To date, while EPA has acknowledged in various publications that land disposal should be only a last resort alternative for solving the hazardous waste disposal problem, it has not yet specified in regulations that the method should be limited in its use or curtailed as the predominant disposal method.

DEEP WELL DISPOSAL SHOULD BE ENCOURAGED

Deep well disposal is the subsurface injection of liquid wastes into permeable rock or other geological formations below potable ground water supplies or other natural resources, such as mineral deposits, at depths as low as 12,000 feet. Underground areas receiving wastes should be isolated both above and below by formations that are impermeable, so that the wastes injected are permanently confined.

Little evidence exists of any environmental problem resulting from deep well disposal (EPA-designated Class I wells). In a few instances some ground water contamination, ground tremors, and blowouts did occur. The problem cases were caused by improper technology and the lack of safety equipment, including the use of incorrect drilling procedures and waste injection rates. Ground water became contaminated when tubing used was not compatible with the substances that were injected or when the well was improperly prepared for the process by packing.

A substantial drilling technology has been developed and is available for application to deep well disposal. The method was first put into use in Texas in the late 1930s and has been used effectively in Texas and Louisiana, where through December 1978 over 73 billion gallons of wastes have been disposed of by this method.

Depending on the substances, a considerable amount of the waste volume injected could be reclaimed and returned to the surface by natural pressure without pumping. Once a well has been closed, it can be made permanently secure by proper plugging with concrete.

combustibility characteristics which require fossil fuel for effective incineration. Also, incinerators that are not operated properly may cause air pollution problems. Finally, there is the problem of disposal of incinerator ash and scrubber wastes. Though the waste volumes are substantially reduced by burning, the residue from the burning process may be significantly more concentrated and more toxic and may pose substantial disposal and potential health problems. Before high temperature burning can provide any real relief to the disposal problem, more facilities will be needed.

ALMOST ALL BASIC RESEARCH AND DEVELOPMENT HAS BEEN COMPLETED

We found that the necessary research on how to develop facilities has been completed for land disposal, deep well injection, and high temperature burning disposal processes. Additional research will be necessary for the long term, however, and for specific land disposal sites and the burning of certain very hazardous substances.

Until recently, EPA waste disposal research and development activities emphasized nonhazardous waste disposal problems. Research projects often concentrated on municipal landfill design, operating problems, and resource recovery from solid wastes. In 1979, however, EPA revised its research strategy to emphasize the following six categories: (1) hazardous waste identification, (2) uncontrolled waste site problems, (3) hazardous waste technology, (4) hazardous waste risk assessment, (5) energy and mineral wastes, and (6) nonhazardous wastes.

REGIONAL OR AREAWIDE FACILITIES NEED TO BE PROMOTED

Disposal facilities providing services on a regional or areawide basis as an alternative to individual company onsite facilities are being planned in various parts of the country. Examples where such facilities are being considered include facilities being proposed by the New England Regional Commission and the Delaware River Basin Commission. Because of the greater geographic area that can be considered in locating facilities, regional facilities can be established in geologically better suited locations, away from highly populated areas. In addition, the number of disposal sites may be reduced.

To date, however, EPA's inventory of closed and abandoned sites has been a consolidation of available site information developed by others, such as State and local governments and the general public. EPA has not initiated the type of comprehensive, county-by-county search for closed and abandoned sites that we envisioned. The recently completed inventory mandated by the New York State Legislature in 1979 is an example of the kind of survey we had in mind for EPA to prepare, with input from the State and local governments. We continue to believe that a similar national inventory is needed and that a need still exists to completely assess the scope and nature of the closed and abandoned site problem and its total economic and environmental cost to the country.

INCOMPLETE HAZARDOUS WASTE REGULATIONS

The recently published hazardous waste regulations are voluminous and complex. EPA continues to acknowledge that it may take several years to fully develop the data base and to perform the analysis necessary to resolve the more complex technical issues that may be raised regarding disposal facility operations before nationally applicable, detailed technical standards for facility operations can be promulgated.

As we have noted, while EPA has acknowledged the relative environmental advantages of the different disposal methods, it has not specified in regulations which method is most preferred for use as opposed to which method is least preferred. For example, on-the-land disposal poses the greatest challenge to the environment of all the disposal methods, yet it remains acceptable as the predominant disposal method in use.

The regulations promulgated to date, called "Phase I," are not highly technical and largely deal with prescribed recordkeeping, reporting requirements, and "good management practices." The more specific standards for the operation of hazardous waste facilities are to be promulgated in Phases II and III.

Phase II, to be issued later this year, will provide additional regulations to allow permits to be issued for facilities based on each EPA Regional Administrator's "best engineering judgment" of (1) the data the applicant submits and (2) the technical requirements the facilities

by the State of New York. The inventory would be used to assess the total economic and environmental costs of past hazardous waste disposal.

As requested by your offices we did not obtain official agency comments. The Deputy Assistant Administrator for Solid Waste reviewed our recommendations and expressed no basic objections. He did, however, state that enlisting the cooperation of the many States would take some time.

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As arranged with your offices, we are sending copies of this report to the Director, Office of Management and Budget; the Administrator, EPA; and other interested parties.

Comptroller General
of the United States

DISPOSAL SITES VISITED

Name and location	Type of disposal	Type of waste handled
Illinois		
CID, Calumet City	Land disposal (codisposal), Chemical treatment	Pickling acids, chemical by-products, industrial and municipal sludge, coolants, wash water.
Environmental Sanitary Landfill, (ESL) Joliet	Land disposal (codisposal)	Chemical by-products, solvents, pickling acids, coolants, food processing waste, municipal sludge.
Maryville Landfill, Des Plaines	Land disposal (codisposal)	Municipal sludges, coolants, solvents, wash water, food processing wastes.
Peoria Disposal Company, Peoria	Land disposal (codisposal)	Coolants, paints, solvents, oil sludges.
Savanna Army Depot, Savanna	Temporary storage	Sodium hydroxide, PCBs, acids, lubricating and cutting oils.
Winthrop Harbor, Waukegan	Land disposal (codisposal)	Chemical by-products, municipal sludge, food processing wastes.

APPENDIX II

DISPOSAL SITES VISITED

Name and location	Type of disposal	Type of waste handled
Texas		
Badische Chemical Plant, Freeport	Deep well injection	Acid and caustic water, benzene.
DuPont Plant, Victoria	Deep well injection	Brine, mild nitric acid waste.
Gulf Coast Waste Disposal Authority, (note a) Texas City	Land disposal	Oil sludge, cans, drums, resin, coke, carbon, metals and catalysts, waste water and sludge, flouride, acid and caustic solutions. (note b)
Rollins Environmental Services, Deer Park	Incineration, biological and chemical treatment, landfill	Amines, hydrocarbons, cyanide, PCBs, VCM wastes, ketones, organic and inorganic acids, phenolics, alkalies, sulfide heavy metals.

a/We also visited an adjacent site called the 40-acre plant which the Authority owned. The biological and chemical treatment of the industrial wastewater took place there.

b/The Authority opened in March 1980 and at the time of our visit not all the wastes listed were being handled, but facilities were available for all listed substances.

APPENDIX II

CLEAN-UP SITES VISITED (note a)

Maryland

Hawkins Point, Baltimore City
Sharptown, Wicomico County (note b)

Michigan

Hooker Chemical Company, Montaque
Oakland County Company, Oakland County

Pennsylvania

ABM-WADE, Chester
Tobyhanna Army Depot, Tobyhanna (note b)

Texas

Sonics, Eastland County (note b)

a/In addition to the closed sites undergoing cleanup operations, we also visited Motco, an abandoned dump site in Lamarque, Texas. The types of waste that have been disposed of at this site are unknown.

b/We did not personally visit these sites, but instead reviewed other parties' documentation of site visits and related documents.

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DISPOSAL SITES VISITED

Name and location	Type of disposal	Type of waste handled
Maryland		
Solley Road Landfill, Glen Burnie	Land disposal	Chrome tailings, treated chemical material, municipal waste.
Michigan		
Chem-Met Services, Wayandotte	Chemical treatment	Acids, cyanide, plating waste, pickling solutions.
Dow Chemical Company, Midland	Incineration	Tar, refuse, solvent, and laboratory waste.
Liquid Disposal, Utica	Incineration	Pollyols, paint sludges, cyanide.
Nelson Chemical Company, Detroit	Physical and chemical treatment	Acids, cyanide, plating waste, pickling solutions.
Pennsylvania		
Geological Reclamation Operations and Waste Systems, Bucks County	Land disposal	Food, heavy metals, water base paints, organic material.

APPENDIX II

STATE ENVIRONMENTAL AGENCIES VISITED

Illinois

Illinois Environmental Protection Agency
Illinois Institute of Natural Resources

Louisiana

Louisiana Department of Natural Resources
Louisiana Attorney General's Office

Maryland

Maryland Department of Natural Resources
Maryland Department of Health and Mental Hygiene
Maryland Environmental Services

Michigan

Michigan Department of Natural Resources
Great Lakes Basin Commission (note a)

Pennsylvania

Pennsylvania Department of Environmental Resources

Texas

Texas Department of Water Resources

a/The Great Lakes Basin Commission which is headquartered in Ann Arbor, Michigan, includes representatives from eight Great Lakes States and two Federal agencies.

should meet. It will be left to each EPA region to determine what constitutes an adequate operation. Our experience shows that a governmental agency needs to speak with one voice to avoid confusion and the possibility that a facility developed according to requirements for one region may not be acceptable in another.

The Phase III regulations, which EPA has stated may take several additional years to promulgate, will deal with the further resolution of specific technical issues such as disposal site design and engineering requirements. Standards may eventually be established for specific industries as well as for wastes requiring special controls. Throughout the process, the regulations will continue to be changed and revised.

RECOMMENDATIONS

We recommend that the Administrator, EPA:

--Set priorities, through regulation, of the preferred sequence by which the various disposal methods should be applied to encourage the States and industry to work toward a reduction in the use of on-the-land disposal as the predominant disposal method.

--Identify additional areas of the country suitable for the deep well disposal of hazardous wastes (EPA-designated Class I wells) and, where appropriate, encourage industry to use deep well disposal as a hazardous waste disposal alternative.

--Encourage the development of high temperature burning facilities, in conjunction with the States and selected industries, in various areas of the country to better show their long-term cost advantages and environmental viability.

--Prescribe in regulations that regional or areawide disposal facilities be developed in addition to individual company disposal operations.

--Initiate, in conjunction with the State and local governments, on a county-by-county basis, a comprehensive national inventory of closed and abandoned dump sites of the type recently completed

The siting of facilities is one of the most difficult problems since no one wants such a facility in his backyard. Some evidence exists that regionalization reduces public opposition to the siting of facilities because of the broader base of participation in the site selection process.

Overall, the establishment of facilities on a regional basis results in cost and environmental advantages and also improves the facility planning process by bringing together more people with a greater expertise level. In some cases, however, additional hazardous waste transportation problems may result, warranting special control procedures.

EPA has provided technical advice and support as well as limited planning grant funds to groups considering the regional concept in the planning of hazardous waste facilities. In a letter to the State Governors on July 23, 1980, EPA stated it believes the States, either separately or in regional groups, must assume the prime responsibility for the development of adequate capacity for hazardous waste disposal. (The facilities themselves are to be constructed and operated by the industries affected.) However, EPA has not expressed, through regulation, the merits of the regional approach and the advisability of adapting it on a broader national basis.

CLOSED AND ABANDONED SITES PROBLEM NOT DEFINED

We testified before the subcommittee more than a year ago that no accurate and complete information is available on the total number of closed and abandoned sites, the extent of environmental danger that these sites pose, or the total cost of cleanup. Yet EPA has not been able to complete the type of national inventory and site assessment program that the subcommittee has recommended.

Although EPA has tried somewhat to confront the cleanup problem, more needs to be done. EPA has initiated a hazardous waste task force and tracking system and contracted for site investigations of emergency cases that have been brought under public scrutiny by the Congress, the general public, and the media.

The injection of hazardous wastes into deep wells can be used only in geologically selective areas where conditions below the surface are such that the wastes injected cannot migrate to pollute surface or ground water and reclaimable minerals. The dangers of this method lie in the so-called "what if" area. For example, though certain areas of the country never have had earthquakes, no absolute assurance exists that none will occur. A strong commitment by government and industry is required to (1) establish strict controls over the drilling technology used, (2) monitor the well in the drilling and operating phases, and (3) limit the types of substances that can be injected. Substantial geological information is needed so that only areas where wastes can be securely held are identified for site development.

In addition to the Texas-Louisiana area, other areas possibly suitable for deep well hazardous waste disposal include the Salina Basin area in Kansas, the Williston Basin in North Dakota, and small basins along the Atlantic Coastal Plain.

HIGH TEMPERATURE BURNING OFFERS AN EFFECTIVE ALTERNATIVE

The burning of hazardous wastes in incinerators at very high temperatures offers an alternative solution to the hazardous waste disposal problem. The process can permanently reduce large volumes of hazardous substances to nontoxic gaseous emissions and small amounts of ash and other residues.

High temperature incinerators, when temperature and retention time of the substance in the incinerator are applied properly, can be 100 percent environmentally safe for certain substances. Industry spokesmen believe this method is best applied to destroy organic substances. It should also be part of a combined disposal system which includes the land disposal of wastes. Facilities that have used high temperature incinerators include vessels at sea and fossil fuel electric power generating plants that burn hazardous wastes.

A substantial drawback with high temperature incineration is that it is much more expensive than deep well injection or landfill. This method may also be energy intensive if the hazardous waste being burned has low

is the most common disposal method used, and in many States, such as Maryland and Pennsylvania, it is the predominant method used. To date, detailed estimates of the number of closed and abandoned sites have not been made.

For the immediate future, land disposal will keep its appeal largely because it is the least expensive method of disposal. Until a greater capacity for other disposal methods is developed for the country, land disposal will remain predominant. But eventually we will run out of land on which to develop sites. In addition, depending on location and the substances being disposed of, land disposal sites can eventually leach and contaminate ground water. Many hazardous substances such as chlordane and benzene do not degrade except over very long periods of time. Disposing of them in a land site close to ground water presents an almost permanent future danger. Where ground water is used or planned for use as a drinking water source and hazardous waste is disposed of on the land, many observers believe that land disposal needs to be very closely controlled and, where possible, substantially reduced.

During the past several years, various studies have reported or confirmed the fact that land disposal of hazardous wastes contaminates ground water. Some EPA studies have estimated that 75 percent of all active and inactive disposal sites leak contaminants into the ground and ground water. Fred C. Hart Associates, an EPA contractor, estimated that nationally over 55,000 active and inactive dump sites contain potentially dangerous amounts of hazardous wastes. (See p. 8.) Of over 24,000 impoundments handling industrial waste liquids--pits, ponds, and lagoons--EPA estimated almost 70 percent were unlined, thus potentially allowing contaminants to leach unimpeded into the ground.

Total elimination of land disposal would not be practical. It will always be required to dispose of certain solids, such as the residues from incineration and solids that cannot be injected into deep wells. After EPA imposes more specific controls over land disposal, which will increase costs, its use should decline.

One other method of land disposal used is land treatment or land farming, which involves putting substances on the land and periodically plowing them under until they naturally degrade. Land farming has only limited application because it requires large land areas and can be used only in areas where temperatures are relatively mild, never falling too

Land disposal traditionally has been the least expensive method of disposing of wastes. However, when long-term liability and possible future cleanup costs are considered, the overall costs of land disposal rise dramatically. One corporate official estimated the cost of incineration would be about three times as expensive as deep well injection, although deep well disposal costs varied greatly depending on location, substances to be injected, and depth of the well.

In summary we found that:

--Disposal on the land is the predominant hazardous waste disposal method used. Yet it presents the greatest potential risk for surface and ground water contamination and liability for damages. For the long term interests of the country, on the land disposal needs to be drastically reduced.

--Little evidence exists of any environmental problem resulting from the deep well disposal of hazardous wastes (EPA-designated Class I wells). However, this method should be applied only in geologically selective areas below aquifers where the wastes cannot migrate and pollute surface or ground water and reclaimable minerals.

--Burning of hazardous wastes in incinerators, at temperatures generally over 1,000 degrees Centigrade with a specific retention period in the incinerator, may be one solution to the hazardous waste disposal problem. To date, however, the process has had only limited application because few facilities have been built and the cost is high--estimated at about three times the cost of deep well injection. Like other methods, it must be properly operated.

--For land disposal, deep well injection, and high temperature incineration, research on how to develop facilities has been essentially completed. However, additional research on specific substances and site locations will continue to be needed for the long term.

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