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by

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INTRODUCTION

On August 15, 1986, Congress' Office of Technology Assessment issued a report on the prospect of ocean incineration of some of this country's most hazardous wastes "could be an attractive, though not essential, interim option" for managing those wastes.[1] In addition, the report says that ocean incineration may be the safest disposal method for highly chlorinated liquid wastes, including polychlorinated byphenyls (PCB's). The attractiveness of the option is that the current method for disposal of these liquids is land-based incineration, a process that produces toxic hydrogen chloride gas. This process is especially dangerous because most land incineration occurs close to population centers. Ocean incineration would move the process far from population centers and away from most direct human contact. Additionally, the ocean itself is able to neutralize some hydrogen chloride gas, reducing the amount of toxic by-product and at the same time eliminating the need for gas neutralizing machinery necessary for land-based incinerators. The report emphasized however, that ocean incineration should be considered only as an interim measure to bridge the gap between past practices of land disposal and future practices of waste reduction and recycling. Also, ocean incineration should not be considered as a solution to all of our hazardous waste disposal problems, as only about eight percent of all hazardous wastes could be eligible for incineration because of technical restrictions on the type of wastes suitable for the process.[2]

In spite of the promise associated with the ocean incineration proposal, the OTA report has met with mixed response. Senator Ernest F. Hollings (D-S.C.) praised the report and ocean incineration, calling it "an important new option for disposing of dangerous chemical wastes."[3] Representative Roy Dyson (D-Md.), on the other hand, called the process an "unacceptable and unnecessary risk when we can continue to support our safer technologies which include treating, recycling and reducing the amount of toxic waste generated."[4] Numerous citizen and environmental groups oppose the process, feeling that the hazards of ocean incineration far outweigh its benefits. Among

the hazards cited are: extension of the hazardous waste crisis out to sea; increased long distance transportation of hazardous waste to port loading facilities; release into the ocean environment of at least some of the original chemicals fed into the incinerators; creation of more highly toxic by-products; a decreased incentive toward waste avoidance, source reduction, and recycling; and the operators of the incinerator ships' acceptance of only limited liability in the event of a marine accident.

MAGNITUDE OF THE PROBLEM

"[T]his nation faces a serious hazardous waste management problem. Each year, 250 million tons of hazardous waste - more than a ton for every man, woman, and child living in this country - is created."[5] The horror stories of Love Canal, New York and similar landfills have still not completely disappeared from our memories, and neither have the problems associated with them. It is in this context that the search for a means of permanently disposing of hazardous chemicals is conducted.

Europeans were the first to look toward ocean incineration as a solution in 1969. Thereafter, the United States conducted test-burns of toxic chemicals in the Gulf of Mexico and the Pacific Ocean from 1974 to 1977 using a European incineration ship. The burns were conducted in part to provide data for studies into the feasibility of a full scale incineration program. In recent years, permits for further test-burns, in 1983 and 1986, have been rejected by the Environmental Protection Agency, but research into the possibility of large scale ocean incineration continues.

Studies have been done which serve to relate the magnitude of the hazardous waste problem as a whole to that part of it which could possibly be dealt with through ocean incineration. These studies are based on data collected by, among others, the EPA and the U.S. International Trade Commission. The most extensive report, completed in 1980, projected the amount of waste for which it would be both economically and technologically feasible to consider ocean incineration. The results are summarized in the following table:[6]

Table I

U.S. Net Ocean Incineration Quantities
Organic Chemicals and Pesticides
(10^3 metric tons)

Category	1983	1989
Organic Chemicals	637.9	953.9
Pesticides	30.7	44.3
Total	668.6	998.3

Based on actual 1977 figures, these net totals can be further broken down on a state by state basis.[7]

Table II

Net Organic Toxic Wastes, 1977
(± 5000 metric tons)

State	% of Total	Rank
Alabama[a]	0.87	13
California	0.49	16
Delaware[b]	1.12	11
Florida[a]	1.35	9
Georgia[a]	0.44	18
Illinois[a]	0.58	15
Kentucky[a]	4.78	6
Louisiana[b]	12.31	2
Michigan	1.02	12
New Jersey[b]	2.17	7
New York	0.28	19
North Carolina	1.43	8
Ohio[a]	0.45	17
Pennsylvania[b]	5.49	5
Puerto Rico	0.81	14
South Carolina	1.13	10
Tennessee[a]	10.34	3
Texas[a]	44.96	1
West Virginia[b]	9.21	4
All Others	0.77	

[a]Has access to Gulf Coast
[b]Has access to MD. - Del. - N.J. coast (parts of W. Va. and western Pa. not accessible)

Assuming that wastes would be transported down the Mississippi and Ohio Rivers, it can be seen that approximately seventy-five percent of the hazardous waste available for incineration would have easiest access to the Gulf Coast, with Texas and Louisiana being the major suppliers. Approximately nine percent would have easiest access to the East Coast.

THE INCINERATION PROCESS

The most common type of land based incineration is carried out by a process known as liquid injection incineration. This process involves forcing liquid wastes through a specially designed nozzle into a combustion chamber. The nozzle vaporizes the waste into particles small enough to be efficiently burned. The temperature of the combustion chamber can exceed 1200° Celsius. At present there are approximately 220 incinerators of this type in the U.S., making it the most widely used design. Its major advantages are its economy and its adaptability to a wide range of liquid wastes. Maximum efficiency of these type incinerators is estimated to be 99.99%. Its specific disadvantages are that its adaptability does not extend to non-liquid wastes, and that some units (especially smaller ones) have run into the problem of clogged nozzles, leading to incomplete combustion.[8]

The next most prevalent type of incineration is by means of rotary kilns. These are cylinders, ranging in size from 3 ft. in diameter by 8 ft. long to 20 ft. in diameter by 30 ft. long, which rotate to circulate the waste and maintain an even temperature. The main advantage of this type of incinerator is its ability to burn waste in almost any form from gas to solid. The big disadvantage associated with rotary kilns is their size and cost. Although many large companies operate on-site kilns (such as Dow Chemical Co., 3M Corp, and Eastman Kodak), smaller companies are forced to rely on regional incinerators. This increases the transportation of wastes, with a corresponding increase in the risk of spills and mishandling.[9]

The third major incineration process in the U.S. is by means of cement kilns. Although basically similar to rotary kilns, they rely on mixing of liquid waste with the base fuel of the kiln for efficient combustion, rather than rotation. This is a slow process only available for liquid wastes, but is attractive for the destruction of harder to burn waste. After some concern over the efficiency of these incinerators, recent studies indicate that with improving technology, maximum combustion of waste can reach 99.99%, comparable to liquid injection. The major public concerns with this process have been uncertainty over safety of the vented residue and fear of the same transportation and storage hazards associated with rotary kilns. In addition, the ash left in the kiln after combustion must then be stored at a dump site. The potential long-term effects of this solid residue are unknown.[10]

Ocean incineration is basically incineration technology used at sea. It usually involves a liquid injection system with the combustion chamber located in the hold of a ship. Consequently, ship-board incinerators have the same restrictions on suitable wastes as their land-based counterparts. An additional restriction is that wastes which are shock sensitive, capable of spontaneous combustion, or chemically or thermally unstable, are not suitable because of the normal roughness of ocean transport. The primary use of ocean incineration will be the destruction of PCB's.

The neutralizing effect of the ocean environment has resulted in the removal of anti-pollution devices from ship incinerators which normally control the escape of hydrogen chloride gas. This omission makes ship-based incinerators more attractive than land based liquid injectors for two reasons: the cost of the anti-pollution equipment is eliminated, and the rate of incineration is increased.

Along with the pesticide DDT, PCB's are the most prevalent of the chlorinated wastes. PCB's have been used extensively by industry in paints, plastics, adhesives, coating compounds, and electrical equipment. The attractiveness of PCB's to industry is a result of

their chemical stability. PCB's are very inert, fire resistant and stable at high temperatures. Their largest use has been in the electrical industry in various heat transfer systems. All of the characteristics of PCB's which make them desirable in industry, plus their low solubility in water, mean that they are environmentally persistent when disposed of as waste products.[11]

PCB's have already been the cause of much environmental damage to land and marine environments both in the U.S. and abroad.[12] PCB's are carcinogenic and their danger is increased once they reach a food chain, because they accumulate as they pass upward through the food chain. As a result, their concentration in fish can be tens of thousands times greater than in surrounding contaminated water. Recent studies have also discovered the capacity of PCB's to be transported as suspended airborne particles.[13]

It has been known that one by-product of the combustion of PCB's is hydrochloric acid. Evidence now indicates that unless extremely high temperatures are used (in excess of 1000° - 1200° C) additional by-products are created, including polychlorinated dibenzodioxins (PCBD's or dioxins) and furans. These chemicals are similar to PCB's but are even more toxic. Under constant high temperature these by-products will not be created.[14] There is concern whether such temperature consistency can be maintained in a ship-board operation.

RECENT HISTORY

The public controversy over ocean incineration exploded in 1983. Chemical Waste Management, Inc. (CWM) had made requests of the EPA for permits to conduct test burns 161 miles off the coast of Delaware. While the EPA took considerable time considering the permits, a public hearing was held in Ocean City, Maryland, on April 14, 1983. The hearing was well attended by citizens, environmentalists, local officials and U.S. congressmen. Speaking on behalf of CWM was John P. Sandstedt, Vice President of Environmental Affairs for At-Sea Incineration, Inc. (At-Sea) of Port Newark, New Jersey. He stressed that ocean incineration should not be considered 'dumping' because nothing is deposited in the sea. He called ocean incineration the most regulated mode of hazardous waste disposal because it is subject to ten stringent international codes, as well as federal laws and local regulations. At-Sea has expressed an intention to conduct its own incineration operations in the North Atlantic. It has received federal subsidies to construct two state-of-the-art incinerator ships, designed in co-operation with EPA, the U.S. Coast Guard, National Bureau of Standards, and the American Bureau of Shipping.[15]

Representative Roy Dyson (D-Md.), speaking at the public hearing, stated that he was willing to explore new waste disposal technologies, but that he could not "blindly trust in the promises of an agency (EPA) which has not yet proven itself a responsible steward of our environment." He felt that studies done to date were of questionable reliability in part because they involved CWM and in part because CWM was represented by James Sanderson, a paid EPA consultant, alleged to have accelerated EPA consideration of the permits. Rep. Thomas R. Carver (D-Del.) said that he did not wish to dismiss possible solutions to the problem but that he had "serious concerns" about the incinerator ships. He also questioned the ability of the EPA to oversee long-term ocean incineration. Sen. Joseph B. Biden (D-Del.) submitted a statement urging postponement of the site designation pending further study. He emphasized that the EPA's environmental impact statement ignored the consequences of a major spill or the sinking of an incinerator ship. Sen. Paul S. Sarbanes expressed concern over the possible consequences of ocean incineration on the Maryland-Delaware recreational and fishery resources.[16]

Despite the opposition, the EPA made a tentative decision on October 17, 1983 to issue the permits to CWM. However, the Assistant Administrator for Water issued the final decision on May 23, 1984, denying the permits. The rationale for this turn-about is that the EPA should not issue permits until it develops specific criteria for regulating the activities. The EPA subsequently issued these criteria in

its report of February 19, 1985, entitled "Incineration-at-Sea Research Strategy."

Following this report, in its most recent permit request, CWM filed an application on May 24, 1985. The application proposed a research burn to provide additional physical, chemical, and biological information. CWM proposed the loading of 3,500 metric tons of waste on board its incinerator ship in Philadelphia, with the proposed site located approximately 140 miles east of the mouth of the Delaware river. The EPA made tentative approval on December 16, 1985, which would have allowed the burning of 708,958 gallons of fuel oil containing 10-30 percent PCB's over a nineteen day period. Four public hearings were held in January of 1986 which raised at least as much concern as that in 1983. Submissions were received from members of Congress, Federal, state and local government agencies, governors, public interest and environmental groups, industrial and labor organizations, professional societies and academia. In general, concern was expressed over the dangers to the coasts and resources of Maryland, Delaware, and New Jersey, along with the dangers to the residents of Philadelphia because of the storage and handling of the waste. By the close of the public comment period, the EPA had received submissions by 1,644 persons, including those made at the public hearing.[17]

On May 28, 1986, the EPA decided to deny the permits. The reported decision cited numerous issues the EPA felt still needed addressing: financial responsibility requirements and questions related to liability; risks of land and sea transport of hazardous waste; whether there is a need for an ocean incineration program; criteria of a permit applicant's integrity; requirements for a contingency plan; applicability of other Federal statutes to applications for a research permit (e.g. the Coastal Zone Management Act and the Endangered Species Act). The report concluded that:

> "the more appropriate process [than the granting of permits] for addressing these complex policy, technical and legal questions is through the Agency's on going rulemaking for development of comprehensive ocean incineration regulations ... Many of the most controversial issues related to the establishment of a permitting program are complex issues of policy and law that do not depend for resolution on the type of information intended to be gathered through Research Strategy ... An essential finding required by 33 U.S.C. 1412a(b) (Section 2 of Pub. Law 96-572) for issuance of a research permit is a finding of need. The Agency has determined that sufficient need does not exist at this time to warrant issuance of a research permit.[18]

COMMENT

The EPA's decision emphasizes some of the problems with viewing ocean incineration as an 'attractive interim option.' It is obvious that there are many questions as yet unanswered concerning the safety of ocean incineration and its environmental effects. All of these questions have been raised time and again over the last several years in the context of a research program, not a full-scale, long-term project that could have significant impact on the reduction of the hazardous waste in this country. In light of all the questions associated with the research into an interim program, it seems to make sense to divert this effort and expense into the 'future practices' alluded to by the EPA and the Office of Technology Assessment, rather than continue the ocean incineration debate.

END NOTES

[1] *Environment Reporter*, vol. 17, no. 16, 558.
[2] *Id.*
[3] *Chemical Regulation Reporter*, vol. 10, no. 20, 643.
[4] *Id.*
[5] Jensen, *Final Decision to Deny* Chemical *Waste Management's Application for a Research Permit to burn Hazardous Waste at Sea*, Statement, May 28, 1986.
[6] Halebsky, *Ocean Incineration of Toxic Chemicals*, Toxic and Hazardous Waste Disposal, vol. 4, (Robert B. Pojasek, ed.), pp. 214-15.
[7] *Id.*, at 213.
[8] *See*, Piasecki, ed., *Beyond Dumping: New Strategies for Controlling Toxic Contamination*, (1984).
[9] *Id.*
[10] *Id.*
[11] Hood, ed. *Impingement of Man on the Oceans*, p. 265.
[12] *See*, Higuchi, ed. *PCB Poisoning and Pollutions.*
[13] Hood, *supra*, at 265.
[14] Melius, *Facility Siting and Health Questions*, 15 Environmental Law Reporter, 10243 (1985).
[15] *Environment Reporter*, vol. 13, no. 51, 2345.
[16] *Id.*
[17] *Final Determination to Deny a Research Permit for the Incineration of Chemical Wastes at Sea*, EPA report, May 28, 1986.
[18] *Id.*