



# Hazardous Waste

## Prevention rather than cure

1989, in 'Taiwan 2000'

Foto: [www.greenandgrowing.org/types-of-hazardous-waste](http://www.greenandgrowing.org/types-of-hazardous-waste)



### 1. The Emerging Problem of Hazardous Wastes

In the West, especially in the United States and Europe, hazardous waste has become increasingly a major pollutant of air, water, and soil.

Three major obstacles exist when addressing this problem:

- Insufficient data are available on where and how much hazardous waste is being produced.
- The most common approach, specially in the United States but also in Europa has been to concentrate on waste management and end-of-pipe treatment.
- The regulatory measures are administratively costly and in many instances ineffective.

Beyond the need to clean up all the already existing heavily contaminated dumping sites – the cost of which exceeds US\$100 in the West alone – the problem of future management of hazardous wastes is very urgent.

The production of organic chemicals represents the fastest-growing sector of the chemical industry and, in the United States, responsible for approximately 60% of all toxic pollution of air, water, and soil. Of all the money spent on pollution control in the United States (some US\$70 billion in 1986), 99% was spent on managing waste produced and just on reducing waste at the source.

This report offers a survey of the hazardous waste problems in the West, an assessment of the U.S. situation, U.S. proposal recently drafted by a nonprofit U.S. organization on how to change the emphasis in hazardous wastes from pollution control to pollution prevention, and some recommendations on dealing with the current and future problem of hazardous waste in Taiwan.

### 2. General Overview of Western Experience

Minamata Bay, Japan, was one of the first widely reported incidents in a long list of horror stories involving improper discharge, transport, storage, or disposal of hazardous wastes. Today, names like Love Canal, New York, and Times Beach, Missouri, in the United States; Lekkerkerk in the Netherlands; Reyersdorf-Schonkirchen in Austria; BT Kemi in Sweden; and Vac, Hungary, are synonymous with toxic wastes and the problems associated with their release into the environment.

Increasingly governments and international agencies are attempting to control the growing problem of hazardous wastes, but it is a long and frustrating process. Regulation is complicated by the multimedia nature of hazardous wastes—they affect air, water, and soil; further, definitions of hazardous and toxic wastes differ among countries, as do the concentrations of those wastes considered hazardous wastes to human health. In short, the problem is a regulatory nightmare. Undeniably, much progress has been made over the

past decade to control the manufacture, distribution, and disposal of hazardous substances, particularly chemical wastes, but governments everywhere still struggle with the complexities and magnitude of the problem.

The chemical industry produces not only large profits – \$450 billion for the Organization for Economic Co-operation and Development (OECD) countries in 1980 – but also large quantities of hazardous wastes. In the industrialized countries of Europe and North America, chemical and petrochemical industries are responsible for nearly 70 % of all hazardous wastes; in developing countries, the figure is 50-66 %. Most toxic and hazardous wastes come from the chemical and related industries that produce plastics, soap, synthetic rubber, fertilizers, synthetic fibers, medicines, detergents, cosmetics, paints, pigments, adhesives, explosives, pesticides, herbicides, and numerous organic and inorganic intermediate chemicals.

#### A. Hazardous Wastes: How Much and Where?

The total amount of hazardous wastes generated each year throughout the world is nearly impossible to estimate with any degree of accuracy. Definitions and legislation vary radically among countries. In the Third World, because many nations have no laws whatsoever governing the production and disposal of toxic wastes, they have no idea how much of their industrial waste is hazardous.

While some attempts have been made to estimate the annual amounts of hazardous wastes generated globally, there is no general acceptance of any of these estimates. It is clear that the United States leads the world in the generation of hazardous wastes, with an annual total of about 264 million metric tons. But estimates for the rest of the world are largely speculative. One estimate of the global total was 330 million metric tons, while another estimate for only 19 countries was more than 100 million metric tons higher. The broad discrepancies in the estimates of hazardous wastes generated throughout the world highlight the nature of the problem: in fact, little is known about how much hazardous wastes are generated, where they are generated, and what happens to them.

#### B. The Multimedia Hazards of Toxic Wastes

Hazardous wastes contaminate the environment by many pathways. But even before hazardous wastes are disposed of, they pollute air, water, and soil simply by virtue of how they are stored or contained prior to final disposal. For example, surface impoundments (settling ponds), for which most countries in Europe and North America have set operating standards, remain a source of air pollutants because volatile organic compounds (VOC) often evaporate from the ponds. Yet because the wastes have not been formally disposed of, they are not covered by most hazardous waste legislation. Further, the ponds also threaten surface and groundwater unless they are properly lined.

Another example of how potentially toxic wastes escape adequate regulation – and are transferred from one medium to another in the process – is the sludge generated by both wastewater treatment plants and air pollution control devices. These wastes often contain heavy metals, and they are potential hazards to human health and the environment. But they may not be regulated nationally or regionally. As a result, many end up in uncontrolled industrial or municipal landfills, where toxic substances in the wastes can migrate into surface and groundwater and can pollute the soil.

Multimedia pollution also results from permissible discharges in accordance with permits granted by federal, state, or local governments. In the United States, for example, hazardous wastes classified under RCRA are not regulated in the same way as traditional water or air pollutants. According to the U.S. Congress, “RCRA does not limit releases; it sets standards for the management (treatment, storage, and disposal) of whatever is produced. RCRA regulations apply to all industrial categories but unequally depending on the amount generated. The body of substances defined as RCRA hazardous wastes are not regulated under the Clean Air or Clean Water Acts as air or water pollutants although they can be the same chemical. Therefore, if it is technically possible and economically beneficial, a regulated RCRA hazardous waste can be legally emitted into the air or water”. Such provisions create legal opportunities for wastes to be shifted from one medium to another – from land to water to air and back again. Similar loopholes exist in the laws governing the handling and disposal of hazardous wastes in most other OECD countries.

Once toxic or hazardous wastes are treated and disposed of, they can still pose a persistent threat to human health and the environment through contamination of air, water, and soil. Uncontrolled incineration, whether on land or at sea, can contaminate the atmosphere and the surrounding environment. The discharge of hazardous substances into the sea or into lakes and rivers often kills fish. Further, disposal on land in abandoned dumps or improperly controlled landfills can pollute both the soil and the groundwater.

In 1983, an EPA study reported 230 hazardous chemicals or groups of chemicals present in the immediate vicinity of waste sites requiring Superfund action. (The Superfund legislation, enacted in 1980, authorized EPA to identify and clean up abandoned toxic waste dumps that are a clear threat to human health and the environment.) Of the 230 chemical compounds, 173 were found in nearby groundwater reservoirs, 162 in surface waters, and 65 in the air. Fortunately, there have been few incidents like Minamata, where hundreds died of mercury poisoning as a result of the deliberate discharge of toxic wastes, but these dramatic incidents are just the tip of the iceberg. The real danger lies in the long-term effects on human health and the environment from the millions of tons of hazardous wastes scattered about the earth – dumped in ditches, poured down drains, abandoned

in fields, discarded in warehouses, sunk in the sea, injected into the ground, or incinerated with inadequate safeguards. Too much hazardous waste ends up seeping into drinking water, contaminating the food chain, or polluting the air.

### C. Living with Past Mistakes: Hazardous Waste Dumps

The industrial world is living with a deadly legacy: decades of uncontrolled and unregulated disposal of industry’s toxic by-products and other hazardous wastes. After nearly a century of uncontrolled dumping ignorant of the environmental and human consequences of discarding toxic industrial wastes wherever it was convenient, industrialized countries (and increasing numbers of developing countries) discovering that the cost of ignorance is high. In both Europe and North America, toxic waste dumps have displaced entire communities, fouled the air, poisoned surface and groundwater, and adversely affected human health. The problem of old dump-sites is perhaps the most serious. The diversity of chemicals found in abandoned waste dumps, coupled with the paucity of documentation of what was dumped, underlines the enormity of the clean-up tasks involved in detoxifying these dumps and the futility of trying to characterize a typical site. Nearly all industrialized countries are faced with costly clean-up bills, some of them massive. Despite progress, like the work being done in the European Community to regulate hazardous wastes, the situation still seems out of control.

Not only is clean-up costly, but most government regulatory agencies do not know how to proceed. An expert testifying before the House of Lords Select Committee on Science and Technology (in the United Kingdom) told a stunned audience that “we do not know how much hazardous waste is produced in the UK, who produces it, what it is, and what happens to it”. He could just as well have been addressing any other parliamentary or legislative body in Europe or North America.

Although OECD reports that abandoning hazardous wastes is prohibited in nearly all OECD countries, legislation regulating the handling, transport, and disposal of hazardous wastes did not take effect until the mid- to late 1970s. Sweden, one of the few countries in Europe to require “cradle-to-grave” manifests on hazardous wastes, did not bring its Ordinance on Environmentally Hazardous Waste into force until January 1, 1976. France’s controlling legislation dates from 1975 and 1979. Likewise, the Netherlands passed the Chemical Waste act in 1976 but failed to implement it until 1979. The Federal Republic of Germany’s Federal Waste Disposal Act did not take effect until January 1977. And the United Kingdom’s key legislation dates from 1974, with important amendments in 1976 and 1981. In effect, hazardous wastes were ignored until the mid-1970s. Says one West German official, “a decade ago, most of Western Europe’s toxic garbage just disappeared down a black hole somewhere.” Companies kept spotty records, if any, concerning the amount of hazardous wastes generated,

what form they were in, or where they went. Decades of unregulated disposal have resulted in a profusion of toxic wastes in Europe and North America. As to be expected from the amount of toxic wastes generated each year, the United States is near the top of the toxic heap, in terms of both the number of hazardous waste dumps needing immediate attention and the severity of their health threats (see below). Europeans are also paying a heavy price for their negligence. Every country in Europe (except Norway and Sweden) is plagued by an abundance of toxic waste sites – both old and new – needing urgent attention. Tiny, overcrowded Holland is a prime example. Authorities estimate that up to 8 million metric tons of hazardous chemical wastes may be buried in Dutch soil – most of it in leaking metal drums – with estimates of the clean-up bill ranging from \$3.2 to \$5.6 billion. The United Kingdom faces the same situation. Of the estimated 5.5 million metric tons of notifiable hazardous wastes disposed of in 1980, three quarters were disposed of in municipal or industrial landfills with inadequate safeguards to prevent contamination of the environment. Further, there is no central authority in the United Kingdom charged with supervising the transport and disposal of hazardous wastes. Instead, there are 165 local waste disposal authorities, which are expected to cope with all manner of wastes in their jurisdictions. Although decentralization is often a good idea, it does not always work, particularly when standards vary from county to county. When the House of Lords Select Committee on Science and Technology circulated a questionnaire to these waste disposal authorities in 1981, of the 140 that replied, only 12 had hazardous waste disposal plans available, even though they had seven years to design them. The United Kingdom is the only European country to encourage and endorse widespread codisposal of liquid industrial wastes and domestic solid wastes at the same site. The British approach is to mix the wastes, then allow soil chemistry processes to break down hazardous components. Little is done, however, to protect the soil or groundwater from contamination. Because of the uncontrolled nature of this technique, codisposal is seldom used in other OECD countries. Because of the scarcity of data on hazardous waste in the Third World, little is known about how much is generated, what form it is in, or how it is handled or disposed of.

**(1) Source Reduction:** Turning Off the Toxic Tap. Some companies that generate toxic wastes are beginning to cut off the flow of toxic wastes at the source – they are generating less hazardous materials in their manufacturing processes. In the United States, Minnesota Mining & Manufacturing Corporation (3M) pioneered the concept of reducing pollution at the source instead of at the end of a pipe. In 1975, the company initiated a Pollution Prevention Pays program that by 1984 had eliminated 10,000 metric tons of sater pollutants, 149,000 metric tons of sludge, and 90,000 metric tons of air pollutants. Further, the company cut its effluent discharge by 3.7

billion liters and saved 254,000 barrels of oil per year. This program used 1,200 employee suggestions and saved \$192 million in less than ten years. Laws and regulations dealing with solid and hazardous waste disposal are beginning to drive industrial behaviour toward pollution prevention. It is no longer cheaper to pollute. In the United States and Europe, where strong waste disposal laws have been enacted over the past 15 years, the administrative machinery is reversing the economic incentives to pollute. These laws highlight the problem of cross-media pollution and the need for an integrated approach to waste management. “In the long run,” concludes a U.S. Environmental Protection Agency researcher, “only the reduction in the generation of wastes and an increase in recovery and by-product production will permit the achievement and maintenance of desired levels of environmental quality”. Unfortunately, source reduction is still largely untried. The chemical and allied products industries account for roughly half the hazardous wastes generated in the United States. Yet in a recent study of 29 chemical plants, source reduction was being tried for only a small fraction of the toxic wastes being generated. The study by INFORM, a New York-based research organization, reported that “the largest reported waste reduction figures of two to three million pounds per year are dwarfed by the largest reported waste streams: 51.9 million pounds of carbon tetrachloride wastes at Du Pont’s Deepwater, New Jersey, plant; 17.5 million pounds of chromium wastes at International Flavours and Fragrances’ plant in Union Beach, New Jersey; and 15.7 million pounds of phenol wastes at USS Chemicals’ Haverhill, Ohio, plant”. The INFORM study concluded, that “waste reduction alternatives were seldom considered until circumstances virtually forced plants to revise their waste management practices. Recycling, treatment, and disposal options prevailed”. Fewer than one quarter of the plants examined (12 of the 79) had made any reductions in wastes generated. At the Borden Chemical Company’s Fremont, California, plant, managers first resorted to use of the traditional evaporation pond to meet a more stringent phenol limit in its wastewater discharge. Only when that technique failed did they seriously look at their waste reduction potential. By revising their equipment-rinsing procedures in resin operations, they cut the organic discharge by 93 percent. Eliminating the evaporation pond also reduced the generation of phenolic resin sludge from 350 to 25 cubic yards, saving the company \$48,750 per year in disposal costs. In the United States, pioneering pollution prevention research began at the University of North Carolina School of Engineering in 1972. The state of North Carolina now has a \$6000,000 per-year program to publicize successful pollution prevention efforts. The Institute for Local Self-Reliance in Washington, D.C., also provides technical information to promote waste elimination in urban areas (111). In Europe, a similar effort is conducted by La Mission Technologies Propres de la Direction de la Prevention des Pollutions du

Ministère de l'Environnement in Paris. The French Government documented examples of industrial waste reductions in "Les Techniques Propres dans l'Industrie Française," which has also been translated and published in the United States.

The biggest hurdle facing efforts to promote pollution prevention is company reluctance to share information. "Companies are hesitant to (accept) any outreach, whether it's from government or a non-profit organization," says Roger Schechter, North Carolinas's program director, "because they don't know whether the information is going to (result in) increased costs or increased regulations. Uncertainty about the use of the information has made a lot of industries gun-shy". Many companies also argue that the information is proprietary. Yet, as schecter points out, the companies that participated in the North Carolina Pollution Prevention Pays program in 1985 saved a total of \$12 million. Other major constraints to waste reduction are the relatively low costs of raw materials and water. What will sell pollution prevention at the source will be the rising costs of waste management and mismanagement. Until now, the costs of pollution control in the United States have amounted to only 1 or 2 percent of total business costs. But the 1984 amendments to the U.S. Resource Conservation and Recovery Act are expected to add an estimated 46 percent to industry's compliance costs by 1990.

As mentioned earlier, most Western European nations have made more progress in waste reduction and reuse than North America has. The first waste exchange was established in the Netherlands in 1969, and it now lists 100-150 wastes annually. A waste exchange acts as an information clearinghouse and operates on the principle that one factory's waste can be another's feedstock. The leaders in pollution prevention now are the Federal Republic of Germany, France, the Netherlands, and Sweden.

The shift in emphasis from pollution control to pollution prevention, however, will remain uncertain and subtle. Most environmentalists and government officials believe that economic incentives alone will not motivate industries to look for waste reduction opportunities in their operations, at least in the short term. In a survey of how Japan, Canada, Sweden, Denmark, the Federal Republic of Germany, and the Netherlands approach waste reduction, Tufts University researcher Kenneth Geiser found that these governments are aggressive in promoting low - and non-waste technologies. Sweden, for example, recently established a franchise board that considers waste reduction in issuing operating permits to industries. Denmark and the Netherlands have established competent technical assistance laboratories to work with companies. The Federal Republic of Germany and Norway motivate firms with large cash grants.

Yet it is recognized that government interference can stifle the kind of innovation that companies like the 3M Corporation have pioneered. As Professor Michael R. Overcash at North Carolina State University notes, "waste elimination is much more a thought process or problem solving sequence that attempts to go further

back into the source of waste". How that process can be hastened remains one of pollution prevention's primary challenges.

**(2) Escalating Costs.** Because the costs of safe hazardous waste disposal are mounting, waste handling firms - both private and public - are looking for better, cheaper ways to treat and dispose of highly toxic wastes. Without doubt the costs of dealing with industry's hazardous by-products are rising. In 1983, European countries spent roughly \$1.3 billion to dispose of their hazardous wastes, and 70 major U.S. industries spent an estimated \$4.2-\$5.8 billion on hazardous waste management.

The environmental costs of not managing hazardous waste, as witnessed in virtually every industrialized country, are astronomical. And as major generators of hazardous wastes remain liable for past mistakes, economic and regulatory incentives for complying with hazardous waste regulations continue to encourage responsible management.

#### D. Conclusion

Public recognition of the dangers of hazardous wastes is relatively recent. The industrialized countries of Europe and North America only began significant regulation of hazardous and toxic wastes during the past 15 years, and most developing countries require little or no controls of such substances. As a result, many countries are living with serious problems from prior uncontrolled dumping practices, while current systems for management of hazardous and toxic waste remain incomplete and incapable of even identifying all hazardous waste.

As discussed, there are a number of fundamental problems involved in hazardous waste management in both developed and developing countries. First, there is no agreement as to what constitutes a hazardous waste: definitions vary greatly from country to country. Moreover, little is known about the amounts of hazardous wastes generated throughout the world. The picture is further complicated by our limited understanding of the health effects of most hazardous wastes and the fact that large numbers of potentially hazardous chemicals are being developed faster than their health risks can be determined.

Management is also hampered by a set of technical and operational problems:

- a long history of uncontrolled and undocumented dumping;
- failure of the primary historical disposal method - and filling - to protect the environment, even when performed under controlled conditions;
- high costs of and limited facilities for complete destruction of hazardous wastes, and
- limited technologies (with many still under development) for improved handling, storage, and destruction of such wastes.

In the face of these largely unresolved problems, many European countries have responded with tightly

controlled, centralized systems of management and disposal that minimize the amounts of wastes dumped in landfills. But despite safeguards and watchdogs, abuses have not been eliminated. The United States and Canada, on the other hand, have instituted decentralized systems that may encourage more innovative technological solutions but that have not yet contributed to an effective overall management structure. Too much toxic waste is not managed properly and ends up in hazardous waste dumps with inadequate safeguards.

Clearly, national policies regarding hazardous waste management must be improved. With some notable exceptions like the Federal Republic of Germany, Sweden, and Switzerland, most national governments need to devote more resources to identifying and tracking hazardous wastes, developing new technologies and building new facilities for the destruction or recycling of hazardous wastes, and researching the health and environmental effects of exposure to hazardous wastes.

There is also a need for concerted international action to control the transport and final disposal of hazardous wastes. A number of institutional frameworks could be used to initiate an international agreement, but two organizations working together - the U.N. Economic Commission for Europe (ECE) and the United Nations Environment Programme (UNEP) - might spearhead a new offensive against toxic wastes. These two international organizations could begin to initiate comprehensive negotiations aimed at controlling the transboundary transport of hazardous wastes, and to establish international guidelines on types and quantities of wastes regarded as hazardous or toxic. Such guidelines could serve as a model for national legislation, which must become more comparable among countries for real progress to be made towards solving the toxic waste puzzle. So far, efforts have been limited to Western Europe and North America. The umbrella of international negotiations in this field should be extended to cover Eastern Europe and the Soviet Union, the developed countries of Asia and the Pacific, and eventually, the major generators of hazardous wastes in the Third World.

The ECE-UNEP framework has two major advantages: first, the ECE administers the Long-Range Transboundary Air Pollution Convention, which includes provisions to encourage the dissemination and use of low and non-waste technologies that are crucial to reducing the generation of toxic wastes; and second, UNEP is already involved in programs aimed at managing hazardous wastes in the developing world.

As mentioned earlier, another pressing need is for comprehensive data on the health effects of potentially toxic substances. Increased support should be given to the International Register of Potentially Toxic Chemicals (IRPTC), administered by UNEP in Geneva, Switzerland. After nearly a decade of hard work, IRPTC has compiled information on more than 600 hazardous chemical compounds, including known health effects. Much more remains to be done, particularly in encouraging chemical industries to cooperate.

Finally, hazardous waste management must move beyond dumping. Industries everywhere need to be encouraged to generate less hazardous wastes in their manufacturing processes. Although the toxic spigot cannot be turned off entirely, hazardous wastes can be recycled and reused or destroyed. Dumping should not be a policy, but a last resort. Such steps are necessary if the world is to continue to enjoy the benefits of modern technology, while avoiding the consequences of a poisoned environment.

Edited by the Steering Committee Taiwan 2000 Study, Taipei, Taiwan, Republic of China.

This material has been assembled with permission from the following previously published reports:

1. International Institute for Environment and Development/World Resources Institute. World Resources 1987 (New York: Basic Books, 1987), for the overview of Western experience;
2. U.S. Congress, Office of Technology Assessment, Serious Reduction of Hazardous Waste (Washington, D.C.: U.S. Government Printing Office, 1986), for the U.S. assessment; and
3. Warren R. Muir and Joanna D. Underwood, "Promoting Hazardous Waste Reduction: Six Steps States Can Take," INFORM, Inc., New York, 1987).