solid wastes

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Hazardous waste

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SUMMARY

Among the various types of waste produced by society, particular attention needs to be paid to that proportion which is potentially hazardous. Poor management of such waste can endanger public health and give rise to public concern.

Local authorities are generally directly responsible for the collection and treatment of hazardous municipal waste. They can also indirectly influence, through regulation and promotion activities, the management of hazardous materials mixed with industrial waste. Owing to its quantity and concentration, this latter category generally represents the greatest threat if mis-managed.

The transport of hazardous waste should be strictly monitored to ensure compliance with national regulations and international agreements.

Treatment facilities are needed to avoid hazardous waste being unsafely disposed of. When considering the establishment of a new facility, or the operation of an existing one, particular attention should be paid to a dialogue with industry, as well as to the enforcement of regulations and to communication with the public.

Principal advisers:
Dr Philip Rushbrook and Mr Emmanuel Briand

There is no worse treatment of hazardous waste than illegal and uncontrolled dumping

Among the various types of waste generated by our societies, particular attention must be paid to waste that is potentially harmful to health and the environment, usually known as hazardous waste. Handling, storing, transporting, treating and disposing of this type of waste without special precautions can endanger the health of people living nearby and give rise to large and justified protest movements. Such waste needs handling and treatment which is appropriate for its composition and the level of hazard.

The steps that local authorities can take to ensure safe management of hazardous waste depend on the waste producer. In most countries, local authorities are responsible for managing municipal waste and institutional and commercial waste, while industry itself has to manage the disposal and treatment of its own waste. Most often, therefore, local authorities can exert only an indirect influence on the management of industrial waste in the form of enforcement of national, international or regional regulations, building and development permits, tax measures and financial incentives.

In addition, a local authority may be involved in overseeing the establishment or the operation of a hazardous waste treatment facility. Such facilities are needed to avoid illegal and inappropriate dumping, which is the most dangerous practice, and the local authorities must be prepared to facilitate their development and operation. The local authority must also satisfy the local community that the risks to the health of those living nearby and to the wider environment are controlled. While complying with the laws and regulations in force, procedures can also be put in place to involve the public in discussions over the setting up and management of such a facility.

Hazardous waste: Definitions, risks and quantities

Definitions

There are several international and national definitions of hazardous waste. In most countries, waste is regarded as hazardous either because of its inherent qualities or because it requires special handling to limit its impact on health or on the environment. For example, the Basel Convention, signed in 1989 under the auspices of UNEP[1], and regulating the export of hazardous goods, lays down categories of waste and defines a list of characteristics which render waste hazardous.

For the purpose of this document, the following definition is proposed: "Hazardous waste is waste whose physical, chemical or biological characteristics necessitate special handling, treatment or disposal in order to avoid elevated risks to health or adverse impact on the environment". Hospital or health care waste and radioactive waste are covered by this definition. However, their management is dealt with in separate WHO pamphlets entitled *Health care waste* and *Radioactive wastes*.

Health and environmental risks

Depending on its constituents, hazardous waste may entail short-term and long-term health risks. In the short term, the risk may be one of poisoning by ingestion, inhalation or contact absorption, of corrosive action on the skin or eyes, or of fire or explosion. Long-term risks may include chronic poisoning as a result of repeated exposure or carcinogenicity (the ability of a component to induce development of a cancer).

(1) UNEP: United Nations Environment Programme

The environmental risk may also be important in the short or long term. Chemical contamination of underground or surface water is particularly troublesome, but flora and fauna may also be threatened by hazardous waste.

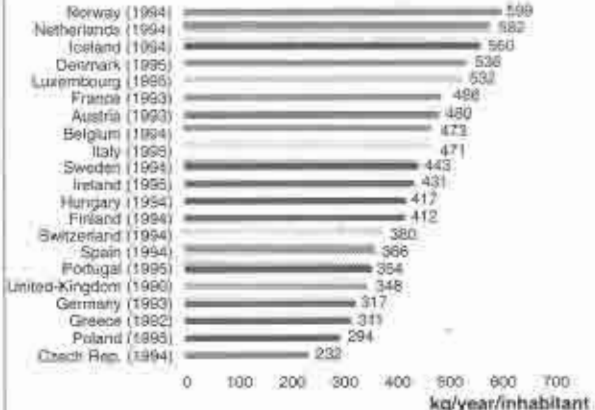
The highest risk for health and the environment often comes from the handling or disposal of hazardous waste without sensible precautions. Proper treatment usually allows these risks to be alleviated.

It is particulary important that hazardous products are not disposed of through the sewerage system. Water pollution by certain types of liquid waste (such as strong acids, pharmaceutical residues, bleaches, caustic solutions, phenols and other industry wastes) may constitute a serious hazard to sewerage personnel and the staff at wastewater treatment plants, following contact with toxic products or inhalation of chemical vapours and aerosols, as well as making the water harder to clean.

Quantities

Hazardous waste generally accounts for less than 5% of the total weight of industrial waste. In municipal solid waste (i.e. waste produced by households, businesses and institutions), typically only around 1% is potentially hazardous. Nevertheless, owing to the considerable quantities of waste to be treated, the amount of hazardous waste produced is not negligible, and therefore its safe disposal should be considered carefully.

Amount of municipal waste generated in Europe (OECD - latest year available)



Source: OECD Environmental Data Compendium 1997

Hazardous Waste production in Europe (all types)

These data reflect the industrial production of hazardous waste throughtout Europe. There is no comprehensive survey at European level providing data on the production of hazardous household waste. It can be estimated at between 1% and 5% of the industrial production

Source: OECD Environmental Data Compendium 1997

The responsibilities of local authorities

Local authorities should manage the hazardous waste found in the municipal collection system (from households, commercial waste from shops and offices, and from public services and institutions). They are directly responsible for collecting and treating hazardous waste in these waste streams.

Local authorities may also decide to establish a separate collection of small amounts of hazardous waste from these sources, to limit risks. Public co-operation is then a decisive factor in securing an effective collection arrangement that reduces the environmental impact from uncontrolled disposal, the costs of treatment, and the health risk for waste collection personnel and staff at treatment facilities.

Companies should be responsible for organising the handling, treatment and disposal of the hazardous waste they generate. Nevertheless, there is a need for strong enforcement of the legislation and waste regulations by local or public authorities.

The EU Hazardous Waste Directive

The European Union Hazardous Waste Directive covers the controlled management of hazardous waste, excluding domestic waste.

The definitions for hazardous wastes are based on a definitive list of substances where a substance has one or more properties such as: explosive, oxidising, flammable, irritant, toxic, carcinogenic, corrosive, infectious, teratogenic and mutagenic.

The Hazardous Waste Directive was published in December 1993 and includes the following requirements.

- *Each Member State must develop a waste management plan, including methods for recovery and disposal.*
- *Waste has to be properly packaged and labelled by companies for collection, transport and temporary storage.*
- *The competent authority for each Member State must be identified and records about dumping and storage must be maintained.*
- *The Commission must be informed about recovery and/or disposal facilities, including the names and addresses of these facilities.*
- *The mixing of different kinds of waste by the waste generator is prohibited.*
- *Manufacturers must participate in a hazardous waste management programme in accordance with Member State law.*

Municipal hazardous waste

Only a small part of municipal waste is usually hazardous. Sorting of waste before collection, in order to remove hazardous domestic waste, is therefore generally hard to justify in cost terms, given the level of benefit to public health and the environment. By definition, setting up a selective collection system will lead to a concentration of hazardous materials and will thus increase the risks of harm to the environment as well as to the personnel required to handle them, unless they are sorted for delivery to a specialised treatment facility. In the absence of such a facility, it is realistic to take advantage of the "natural" dispersal of hazardous household waste in landfills.

However, there is a tendency of national and international regulations to become more and more stringent. Eventually, this way could lead to the development of separate municipal collection

The collection of waste paints is an interesting way to start the separate treatment of hazardous waste

throughout Europe. France passed a law in 1992 [2] requiring that a way be found before 2002 to put into landfills only so to called "final" wastes, those which cannot be treated any further. On the other hand, a proposed EU directive is under discussion, which if approved, might require the separate collection of household hazardous waste (HHW) and other municipal hazardous waste. The proposal arises in part from concern that the presence of some hazardous materials in municipal waste could cause incinerators to breach their emission limits, as laid down in the Directive to Control the Emissions from Municipal Waste Incinerators [3].

Hazardous materials in municipal solid waste

- **Paint and paint-related products**
  Emulsion and gloss paints, varnishes, paint strippers and thinners, wood treatments and preservatives
- **Garden products**
  Pesticides, pest repellents, herbicides and fungicides, fertilisers
- **Motoring products**
  Engine oil, brake fluid, antifreeze, waxes and polishes, fillers and body repair materials
- **Household cleaners**
  Cleaning products, bleaches, disinfectants, air fresheners and deodorisers
- **Pharmaceutical products**
  Medicines, toiletries and cosmetics, medical wastes such as syringes
- **Water treatment chemicals**
  Water softeners and hardeners, swimming pool and garden pond chemicals
- **Other items**
  Fluorescent light fittings, batteries, smoke alarms

(2) Law of July 13th 1992 on waste elimination
(3) EC 89/369 and EC 89/429

Hazardous household waste

By informing people about the potential risks, encouraging them to use less toxic products and to dispose of them appropriately, local authorities can be effective in reducing the risks. Such information campaigns, linked to the existence of a safe and efficient separate collection scheme, can help enhance the local authority's public image as an authority concerned by public health and the protection of the environment.

Even where separate hazardous household waste collection is not carried out, there are a number of instances where the public should be encouraged to hand in certain types of hazardous waste (used engine oil, batteries, etc.), provided the local authority has arranged a safe disposal route and is not simply stock-piling. Requiring such items to be separated by the public has many advantages:

- people actively participate in protecting the environment and the health of their fellow citizens;

C A S E S T U D Y

Copenhagen : A comprehensive separate collection scheme taking into account hazardous household waste.

The municipalities of Copenhagen and Frederiksberg, convinced of the necessity to tackle the management of hazardous household waste (HHW), have set up a scheme for its separate collection and treatment. All HHW ends up in the unique national specialised treatment plant - "Kommunekemi" - situated in Nyborg, where it is registered, and then pre-treated before being incinerated on site or disposed of in a special landfill.

Regarding collection, three solutions are offered to the inhabitants to dispose of their hazardous waste.

1. *Some communal warehouses and commercial shops (such as paint shoppers, chemists) , are able to store HHW brought to them by local residents. These shops then send the waste in bulk to the Kommunekemi.*
2. *Citizens can use a service consisting of two specially equipped trucks, called "environment cars", which come round the different areas of the district every third month to gather HHW and provide advice and information to the population. A brochure is sent in advance to the inhabitants to advise them of the next collection dates, and to explain which waste to set aside. At the given date, a rattling sound gives people the signal that the truck is close. This popular service collects 120 tonnes/year of HHW, that is 0.04% of the total weight of domestic refuse. It has necessited the purchase of two special vehicles and the creation of four "environment drivers" posts. These staff have received special training to provide the population with the best advice.*
3. *The inhabitants of Copenhagen can go to the communal sorting area, where they can dispose of their different waste in separate containers (HHW, paper, plastic, glass etc.). The waste is frequently transported directly from this place to the Kommunekemi.*

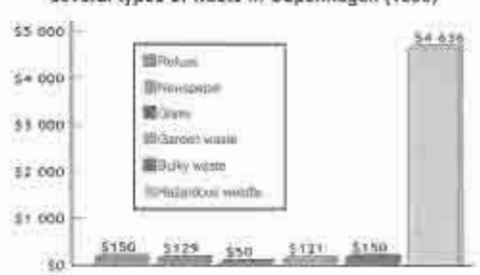
Much effort has been needed to inform the population properly and to involve them in the HHW collection system. A good example of communication is the wide distribution of a card game ("memory"), comprising pictures of the main hazardous waste produced at home.

A special scheme has also been put in place for the collection and treatment of old refrigerators in Copenhagen : one back-loading truck with a loading platform has been purchased, as well as a CFC extraction unit and a cutting machine. The collection and pre-treatment are run by six staff : the freon gas (dangerous for the upper ozone layer) is extracted from old refrigerators, the latter are dismantled before being sent for recycling or destruction. Between 12 000 and 15 000 old refrigerators are received by the contractor each year, of which 90% are treated in the above described way. The collection and treatment of each refrigerator costs around $40.

The cost of management of HHW in Copenhagen and Frederiksberg is US $ 4650/tonne, compared to US $ 130/tonne for newspapers or US $ 150/tonne for common domestic waste (incinerated). In total, the treatment of household hazardous waste represents 3-4% of the cost of household waste collection and treatment in Copenhagen.

Collection cost in Copenhagen in 1996

Collection and treatment cost per tonne for several types of waste in Copenhagen (1996)



- people get used to handing in sorted waste, which will be useful if the local authority wishes to start reuse or recycling operations;
- the collected hazardous components are eliminated from the municipal waste stream, reducing its hazard potential.

With these benefits in mind, local authorities may consider launching children's education and/or public information campaigns designed to improve the recognition of hazardous waste and promote its safe handling, storage and disposal.

CASE STUDY

Flanders (Belgium): regulations oblige local authorities to collect hazardous household waste separately

Flanders, one of the three regions in Belgium, incinerates most of its municipal solid waste. In 1991, in response to growing concerns for public health and safety and pollution control, the Flemish government passed progressive legislation on the collection and treatment of hazardous waste. All 308 Flemish jurisdictions were given until the end of 1993 to implement household hazardous waste (HHW) programme. The legislation targeted ten categories of HHW which include: paints; inks; glues; resins; oils and greases; solvents; acids; bases; cleaning products; household batteries; and items containing mercury.

The Flemish Waste Agency (OVAM) provided a guide to local authorities on how to set up HHW collection schemes and provides continuing technical support. It also created a publicity campaign on billboards and posters across the region. Each local authority was responsible for distributing boxes, designing and promoting the programme within its own jurisdiction. More than 2 million special collection containers (called milieu boxes) were distributed to all households in Flanders. Each box, costing US$ 12, holds about 50 litres and has a child-proof locking lid. A cardboard liner costing US$ 0.27 protects the milieu box and makes the unloading easier.

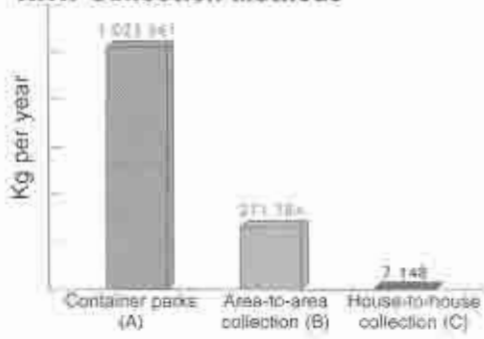
To encourage effective programmes, each local authority receives approximately US$ 0.25 for every kilogram HHW collected. In order to earn the subsidies for the region, local authorities are required to provide a minimal level of service: house-to-house collection twice a year; area-to-area collection four times a year; and container parks once a month.

House-to-house and area-to-area collections have proven to be the most expensive system, often with scheduling difficulties (for instance for people at work). Container parks are reportedly the simplest and cheapest type of collection system to establish and operate. Container parks also collect the most HHW. ATV, the firm in charge of treating

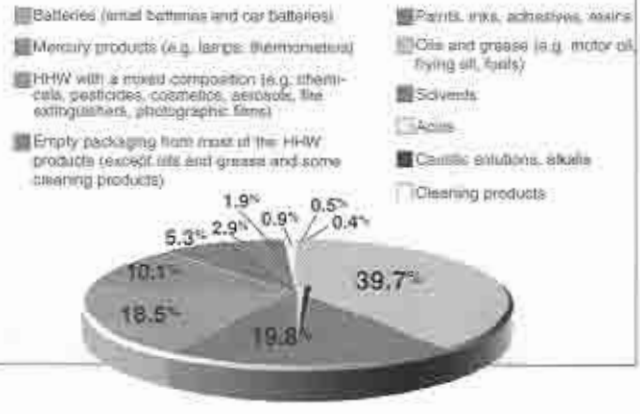
HHW in Flanders, reports an average treatment cost of US$ 0.70 to 0.83 per kilogram including amortized capital, land lease and operating costs. One third of these costs was spent on security measures specified by the local community.

From an environmental perspective, Flemish officials believe that this cost was justified. The increasing number of local composting plants would in any case oblige the collection operators to conform to more stringent standards of waste, particularly avoiding the hazardous components.

HHW Collection Methods



Composition of HHW 1996



Collection of waste oils should start in garages

Other municipal wastes

Commercial waste generated in shops, offices and markets will contain only a small percentage (1-2%) of hazardous items. As its collection and treatment is typically the responsibility of local authorities, they can require from the producers a substitution of materials, a separate collection (provided that treatment facilities exist), and even transport of hazardous waste to a centralised collection point.

Public services and institutions, such as public offices, schools, hospitals, road cleaning and park management, also produce hazardous waste. These typically account for larger proportions of hazardous waste than found in domestic waste. Local authorities are responsible for managing, or promoting the management of, such waste at three levels:

- first, by minimising its production in institutions they directly control. (for instance, a local authority could impose restrictions on its cleaning contractors in public buildings, on the types of cleaning products used);
- second, by discussions with commercial producers not directly under local authority control, to identify those categories of hazardous waste which can be reduced or substituted;
- lastly, by ensuring appropriate training of their own staff, and requiring the same of their contractors.

An internal hazardous waste management policy is important because it sets an example to domestic and industrial waste producers and explains the measures that may be taken to reduce hazardous wastes being produced by offices and institutions.

By introducing a policy of minimisation and substitution of hazardous waste, local authorities gain credibility when they ask the public to make similar efforts. In addition, by operating a collection system or treatment process for hazardous municipal waste, local authorities build up the competence they need to issue workable regulations and to negotiate with industry about the desirable level of treatment for its hazardous waste.

When a new policy on the management of hazardous municipal waste is introduced, it is important to mount a communication campaign at the same time. Local authorities will benefit from this in terms of an enhanced image of competence and political will.

Hazardous waste management in Latvia

The management of hazardous waste in many eastern European countries was not a priority issue in the past. However, many of these countries have been addressing this issue lately by drafting legislation and starting to implement appropriate strategies. In Latvia a law on hazardous wastes was adopted in 1993, and later amended in order to improve co-operation between Baltic countries. A subsequent law on natural resources taxes (1995) set out three different tax rates for hazardous waste. At the same time Latvia began to develop a national hazardous waste management strategy.

The first phase of this strategy was the collection of unwanted and obsolete pesticides. In 1996, a special company for hazardous waste management was established (BAO) and a year later, started to collect the pesticides, in co-operation with local authorities. They are stored at 420 sites and the total amount to be collected is approximately 800 tonnes. They are being transported to interim storage in a reconstructed military site. The second phase of the strategy will concentrate on the incineration and disposal of hazardous waste.

Some hazardous waste is exported for treatment in co-operation with the other Baltic states. For example, Latvia has exported 454 tonnes of scrap accumulators to Estonia, and 77.4 tonnes of mercury-containing light bulbs to Lithuania.

Hazardous industrial waste

Local authorities are justified in concentrating their efforts on hazardous waste produced by industry. These waste producers generate the largest quantity of hazardous waste and the most likely to cause potential health and environmental risks. Although local authorities are not directly responsible for hazardous industrial waste collection and treatment, it is important that industrial firms act responsibly to protect public health and to preserve the quality of the natural environment.

All industries are, to differing degrees, producers of hazardous waste. The largest quantities are generated by major industrial manufacturing sectors such as:

- chemicals and pharmaceuticals
- metalworking and metal finishing
- oil- and coal-based products
- leather tanning, dying and textiles.

Smaller quantities of hazardous waste (but frequently of complex compositions) are produced by other industrial processes such as timber preservation.

Large companies often have their own facilities to handle wastes, while those produced by small- and medium-sized firms are most often handled, treated and disposed of by public or private contractors. Local authorities should ensure that management operations are properly controlled in factories, and should also monitor the way in which treatment and disposal services are managed, for instance, when legally possible, by licensing contractors and waste treatment operations.

An industrial waste producer, faced with the requirement to dispose of its hazardous waste, will choose the type of treatment in the light of the regulations in force, realistic economic considerations and, possibly, a concern to improve the firm's image. Constructive dialogue between the industrial firm and the local authority should take these three elements into account.

Unfortunately, there are numerous instances of serious pollution by industry, and local authorities should therefore do their best to help avoid such occurences (even though they may not have the formal responsibility). Action can be taken at several levels:

- by offering fiscal or other economic incentives to purchase new and less polluting equipment which use less hazardous raw materials;
- by adopting local regulations (in the absence of national ones) restricting discharges of hazardous substances (in order to obtain tangible results, the realistic financial possibilities available to the industry must be taken into account when drafting local regulations);
- by encouraging the setting up of markets in waste products where companies can exchange, sell or give free their waste for reuse by another company as raw materials when possible;
- by mounting information campaigns.

Optimising the management of hazardous waste

The ranked approach given below describes the possible options for managing hazardous waste. It may be of use to industry when considering the various possibilities available; to local authorities as a basis for planning and public information; and to the general public to improve the understanding of the risks and benefits of better management of hazardous wastes. Clearly, a wide range of actions are possible, from not producing a particular form of waste, to ensuring its permanent final disposal.

A hazardous waste management hierarchy

Avoidance and reduction

'Waste avoidance', 'waste reduction', 'waste minimisation', 'source reduction' and 'waste prevention' are just some of those terms used to describe the process of avoiding the generation of waste. It is a very important aspect of improved hazardous waste management.

Methods to avoid and reduce hazardous waste include reformulating or redesigning products, amending processes, modifying equipment, substituting a hazardous raw material for a more benign or easily managed one, as well as simple changes in housekeeping and improved inventory control procedures. Frequently, the techniques designed to avoid waste production are profitable in the short or medium term.

Any initiative to avoid producing hazardous waste, either by industry or by households, should be encouraged. For industry, this may require investing in new equipment and in training people. Even simple measures, such as the appropriate storage and management of raw materials, may be worth consi-dering. The experience shows that substantial and easy gains can be obtained when carefully analysing activities involving the use of solvents. A good example is the reduction of heavy metal emissions by photographic companies through the installation of closed cycles for the use of developing solutions, and the extraction of silver to be sold and reused.

Local "green business clubs" are one way of encouraging the exchange of information on the possibilities of reusing or recycling hazardous waste. For further details, see also WHO pamphlet *Waste minimisation*.

Reuse

Reuse of waste as a raw material offers a dual advantage: savings can be made in the cost of raw materials, and an expensive waste treatment and disposal operation can be avoided. A good example is the re-refining and reuse of oils and solvents. Many companies now have experience in processes for reusing production waste or wastewater, and their example should be used to encourage other industries to make similar investments.

Recycling

If hazardous waste material cannot be re-used as such, it can often be recycled into a manufacturing process, for example to produce a new raw material that can be used externally. Sophisticated technologies now allow the recycling of many types of hazardous waste, such as solvents which become suitable for equipment cleaning; ferric chloride waste from titanium dioxide manufacture which find a new function as wastewater conditioners in water treatments; or galvanic sludge loaded with heavy metals which can be recycled into bricks for building construction.

One excellent way for local authorities to promote recycling is to facilitate the setting up of a marketplace or waste exchange where industrialists can obtain raw materials at attractive prices.

Picardy (France): a market for recycling industrial waste

The Picardy Chamber of Commerce and Industry has set up a body to encourage local firms to exchange and recycle their waste. The Picardy industrial waste exchange gives member companies access to a list of wastes available to them, often at very competitive prices. They can also sell their own waste through the exchange. This service is free for companies in the region and uses modern, accessible telecommunications media such as Minitel (French digital server accessible to everyone by telephone) or the Internet.

Croatia : recycling of galvanic sludge into bricks

Galvanising processes produce wastewater which is highly loaded with metal by-products, in particular metal hydroxides. Among the most predominant are iron (III) and chromium (VI) hydroxides, although other metal hydroxides can be present in lesser quantities.

Since these components are only shightly water soluble, galvanic sludges have, until recently, been disposed of in landfills. However, due to their high persistence in the environment and possible adverse impact on health if leached from poorly managed landfill sites, there has been an increase in concern about such disposal. This has led to the search for an alternative treatment.

In 1995, a co-operation between the University of Chemical Engineering and Technology in Zagreb, and the Croatian Hazardous Waste Management Agency (APO), a study was undertaken to determine the optimal conditions of use of galvanic sludge in the manufacture of bricks. Their impact on the environment was also studied. The main findings were:

1. *the addition of 1.5% galvanic sludge to brick making materials does not alter, but improves, the physico-mechanical characteristics of clay;*
2. *their burning did not lead to the emission of increased heavy metal concentrations in the exhaust gases.*

This method was therefore deemed efficient and safe for the environment, and recommended by the APO as a suitable treatment for galvanic sludges, in accordance with Croatian law. During the last two years, the use of this process has become an established practice in the country.*

Brickyards	Treated quantities of galvanic sludges (in tonnes)	Present status
Near Zagreb	*60*	*Everyday practice*
Near Osijek	*30*	*Everyday practice*
Near Pula	*2*	*Pilot project*

* In the absence of additional elements on their impact on health, these bricks should be used only for outside buildings, or inside walls, provided that they are covered with cast or paint.

Recovery and treatment

Much waste, whether hazardous or not, can generate heat when it is incinerated. When practicable, incineration has the advantage of safely disposing of many types of hazardous waste while generating energy. Limiting factors on the use of incinaration are the discharge of gaseous emissions, which may be toxic unless suitable equipment is installed for their capture and cleaning, and the residual ash which may be toxic and require separate disposal. Depending on the constituents and form of the hazardous waste, it may not be possible to use the same installation to incinerate household and hazardous wastes together, since the latter often require a far higher temperature or special equipment to ensure proper destruction (see WHO pamphlet *Waste Incineration*).

Apart from energy-generating treatment processes, there are many possible ways of treating hazardous waste, depending on the type of waste to be treated. Some treatment processes are briefly described in the technical annex. Treatment may be chemical (e.g. neutralisation by a strong acid or base), physical (e.g. solidification) or biological (e.g. biodegradation, stabilisation). Typically, a waste-generating company subcontracts waste treatment to a specialist operator, with the local authority having a monitoring and regulatory role. However, owing to the small amounts involved, it is advantageous for local authorities to centralise data on waste production and to promote joint handling of "compatible" waste types. When necessary, local authorities can also have a role to play in encouraging the establishment of a hazardous waste treatment plant, taking care to scrutinise the economic and social aspects of such a project.

Disposal

When all possibilities of treatment have been exhausted, so-called "final" waste disposal becomes necessary. This must be undertaken in a way that is safe, both for people's health and for the environment. Methods include soil injection, soil

treatment (for instance, biodegradation of sludge in soil), sludge lagoons, permanent deep storage (e.g. in salt mines), and specially engineered landfill disposal sites (For further details, see WHO pamphlet *Landfill*). However, one should be aware that not all of these methods are permitted in all countries and are not all suitable for every type of waste.

Costs of hazardous waste treatment and disposal

The costs of treatment and disposal of hazardous industrial waste are highly variable from region to region, partly because of strong competition between private sector providers and partly because of the specific legally imposed requirements on subsidies, collection methods and treatment techniques. In addition to the treatment and disposal costs, the overall cost of collection (including transport) must be taken into consideration, since this aspect is equally important.

The main factors affecting the costs of treating hazardous industrial waste are the following:

• National or local standards

In France, for instance, an act prohibits the land disposal of any waste that is not "final", whereas the United Kingdom has embraced the concept of co-disposal to land (where difficult industrial wastes are jointly disposed of with biodegradable wastes). These differences in approach lead to different levels of costs for treatment and disposal.

• The quality of the waste collected

If hazardous industrial waste is widely dispersed, the process of collection and sorting is obviously expensive. In France, for instance, identification of small quantities at the sorting point cost between US$ 2 000 and US$ 4 500 per tonne in 1994, while the cost of treatment itself ranged between US$ 270 and US$ 2 000 per tonne. Excessive treatment costs can be avoided or at least reduced if waste is clearly identified and correctly sorted.

Examples of costs of hazardous waste treatments

Country	Waste containing PCB	Waste containing chlorinated solvent	Typical industrial wastes	Landfill	De-toxication/ physico-chemical treatment	Solidification/ stabilisation
UK [1] (1998)	5% PCB: US$2900	10% conc. US$2150	Sludge containing 1% of metal: US$2450	General waste: US$29.5 Soil: US$5.5 Asbestos bonded: US$54 Asbestos fibrous: US$97 Secured landfill: US$54		
France [2] (1994)	US$600-1450	US$290-2140	US$140-670	US$680-1800 (1994- Salt mines)		US$285
Germany [3] (1994)			Solids: US$100-2800 Liquids: US$50-1460 Small quantities up to US$0.5-28	Special disposal: US$100-1100	Oil emulsions: «US$150-1300 Acids: US$50-5000	
Netherlands [4] (1998)	10-50 ppm: US$405 > 50 ppm: US$1550			US$145-190		
Denmark [1] (1998)	US$3570	Pumpable: US$645 1st tonne, then US$520 Non pumpable: US$960 1st tonne, then US$860		US$65-80		
Austria [5] (1994)	30-500ppm: US$400 500-1000ppm: US$820	2-5%: US$650 5-10%: US$1200 Halogenated: 1000-2000ppm:US$700	US$650	General waste: US$30-200 Soil: US$5-20 Asbestos bonded: US$100-200	US$50-300	US$50-300
Italy [6] (1998)		US$470	Solid: US$350-500 Liquid: US$140-230	General waste: US$80-85 Soil: US$65 Asbestos: US$1100-1400		
Spain [6] (1998)	US$1675	50% Cl_2: US$3000		Asbestos bonded: approx. US$200/$m^3$ Asbestos fibrous: approx. US$200/$m^3$	US$50	US$300

Sources: (1) ECOTEC, Birmingham, UK
(2) ADEME, Angers, France
(3) BDE, Cologne, Germany
(4) EBS, Mainz, Austria, and VOEB, Wien, Austria
(5) ASEGRE, Italy
(6) Cámara Argentina y Mercantil de Vizcaya, Bilbao, Spain

- **The quantity of waste produced, as compared with treatment capacity**

In Germany, for example, the sharp reduction in the quantity of hazardous waste, achieved as a result of the efforts made to avoid using certain raw materials or to recycle them, has led to considerable over-capacity in treatment facilities and continuing price instability.

- **The type of waste**

While materials containing PCBs or halogens need specialised installations for their treatment, other wastes such as non-chlorinated solvents, present fewer difficulties and mean that less expensive technologies can be used.

It is therefore difficult to obtain an accurate picture of the cost of waste treatment across Europe. The prices indicated in the table opposite are only indicative and may vary rapidly, depending on the economic situation.

Hazardous waste treatment and disposal facilities

Hazardous waste treatment plants must be in sufficient numbers and of appropriate size. National and regional governments and local authorities are often responsible for ensuring that such plants operate under conditions which protect public health and the environment.

Where none exists, a local authority may consider promoting the establishment by the private sector of a centralised specialised treatment or disposal facility in its area. The local authority may also have to oversee the management of an existing plant or, in a few cases, may actually be responsible for managing a plant. Establishing such a plant should be the result of a deliberate policy, which must include a careful consideration of the technical aspects and secure public support for the facility and its siting.

Establishing the need for specialised facilities

If hazardous waste production increases significantly in a region without its own facility, consideration must be given to the setting up of a treatment plant and very often also of a disposal facility. Even small-scale facilities are preferable to none at all: uncontrolled dumping leads to health and environmental risks as well as to substantial clean-up and even compensation costs. Furthermore, the Basel Convention controls the export of hazardous waste and also recommends that their treatment be made as close to the source of generation as possible.

Consensus agreement must be reached before a new facility of this type is planned and constructed. Generally speaking, this will be a lengthy and delicate process, but could be made easier if the following points are taken into account.

- Enough hazardous waste must be available to supply the facility. Estimating the quantity of hazardous waste, and forecasting its physical and chemical characteristics and any treatment required, is an important initial phase in the process. Many factors can affect this forecast, including the amount of waste "attracted" from neighbouring regions, economic trends, the need to treat and dispose of certain types of waste not officially categorised as "hazardous", etc.
- The hierarchy of approaches described above must be carefully worked through. From an accurate assessment of the quantities of waste produced, it is possible to identify where certain wastes can be avoided, reused or recycled rather than treated. Reducing the amount of hazardous waste produced is almost always cheaper than treating it.
- The general public and the mass media have to be informed at a very early stage of these forecasts of the amount of hazardous wastes to be treated, and it is always worth taking the time to explain the underlying technical considerations and any conclusions reached about the need for a treatment plant.

Kommunekemi - a hazardous waste management facility for Denmark's local authorities

Site selection

In both economic and social terms, it is essential for the population to be informed at a very early stage in the selection process for suitable sites and to be fully involved in the sub-sequent site selection procedure. Of course, the site must be technically appropriate, but a project will not be successful unless the social and economic aspects are also carefully considered. These aspects should include, when necessary, arrangements for compensating communities near the proposed facility.

Site selection includes:

- specification of criteria for exclusion of sites, based on environmental engineering, and health factors;
- study of potential sites, including assessment of the risks to the environment and the health of people living nearby, study of the possible repercussions from accidents or emergencies, and study of transport arrangements and their impact; and
- selection of the site in agreement with the partners involved.

During this process, public agreement should be constantly sought through meetings and clear and comprehensive information. In technical terms, it is unlikely that a site will meet all the expected requirements and therefore an environment and health impact assessment will be of great benefit.

Health hazards at hazardous waste treatment facilities

Although the potential risks posed by some chemical components in hazardous waste have been demonstrated in the laboratory, very few detailed field studies have been made of their effects on the health of personnel in waste treatment plants or populations living near such facilities. Often, other environmental factors obscure the possible health effects from hazardous waste. Uncontrolled disposal of hazardous waste may be extremely damaging to people's health and the environment, in both the long and short terms. Conversely carefully managed waste disposal facilities are not likely present large risks. So far, the main environmental nuisances shown to be related to such facilities are those of smell, noise and hazards related to transport.

Whilst the risks to public health and the environment are negligible if hazardous waste is properly managed, Risks are increased when good practice is not complied with. Such situations occur if:

- the financial and institutional investment is not appropriately distributed to meet the needs in the area;
- treatment plants or disposal facilities have not been properly managed in the past, leading to contamination of soil, water tables or catchment areas. (See WHO pamphlet *Contaminated Land*); and
- institutional monitoring and control is inadequate, and proper management of hazardous waste is not given high priority by the local and national authorities.

The potential health and environmental risks of treatment plants or disposal sites must be assessed by impact studies carried out before such facilities are constructed. Many factors must be taken into account and the mechanisms involved are complex, so the services of highly qualified technical personnel are required. In general, three categories of health effect should be considered...

1. direct physical risks (explosion, fire, suffocation, accidents during transportation of wastes, etc.);
2. microbiological risks arising from contamination by infectious agents. (direct transmission is mainly a risk for personnel working in these facilities. The general public are also exposed to risks related to contamination of water supply networks); and
3. risks associated with chemical contaminants, which may be further divided into several subgroups such as cancers, genotoxicity, or allergies.

Social aspects of facilities

Setting up and operating a waste treatment plant should not be considered unless there is a process in place for involving the public in the necessary decision-making. The NIMBY (not in my back yard) syndrome, which is characteristic of the opposition generally expressed to this and most other types of engineering project, can only be overcome by providing full information and ensuring that the public and local associations feel they are genuinely involved in decision-making.

In order to ensure constructive public participation in planning a new plant, or managing an existing one, five obstacles have in general to be overcome.

- The first obstacle is anxiety about the project's impact on the environment. People are constantly exposed to dramatic images of the harm done to the environment, and they will associate the project with the worst cases they have seen on television and in newspapers.
- The second obstacle is the feeling people have that they must stand up against an external threat (an economic threat, a threat to health, to maintain the coherence and continuation of the community, etc.). This point underlines the need to set up the structures required for a community to participate in decision-making.

Rules of risk communication

Environmental health professionals and decision-makers often discover that the public perception of an environmental health risk differs widely from that of specialists. The "outrage" that the public feels towards a hazard plays a major role in the acceptability of the risk associated with the hazard.

Disseminating information without relying on some communication principles can lead to ineffective messages regarding risk and control of hazards.

The US Environmental Protection Agency articulated 7 cardinal rules of communication.

- *Accept and involve the public as a legitimate partner.*
- *Plan carefully and evaluate your efforts.*
- *Listen to the public's specific concerns.*
- *Be honest, frank and open.*
- *Co-ordinate and collaborate with other credible sources.*
- *Meet the needs of the media.*
- *Speak clearly and with compassion.*

When it comes to communication with the media, the following rules should be followed to ensure that the right information is passed on to the public:

- *Do not take the questions personally. If you sound defensive the media will pick that up and push to find out "what you are hiding".*
- *Never say "no comment". This is often interpreted by journalists as an admission of guilt. Instead, say why you are unable to comment (e.g. "We are currently investigating the situation and are unable to comment on our findings at this time").*
- *Always tell the truth. If there is a problem for which you share the responsibility (e.g. errors of judgement were made), explain it, but remember to list many positive aspects so that the negative will be outweighed.*
- *Never speculate. Only comment on the facts; the rest is "under investigation", "unconfirmed" or "not known".*
- *Do not speak off the record. Unless you have good reasons to believe you can trust the journalist to honour an agreement to allow you to speak off the record, you should consider any comments you make to be fair game in the pursuit of a good story.*

Source: WHO, Geneva

- Thirdly, people do not have confidence in technology and science. There is a tendency to believe that the engineers cannot really control the hazards related to a treatment plant, especially in the long term. Indeed, there is always a risk and it is this risk which must be explained.
- Fourth, people rarely believe long-term political promises. They tend to believe that, for financial reasons or simply out of greed, operating regulations will not be complied with and that an accident is still possible, despite the guarantees given at the outset.
- Fifth, when a community is faced with a proposal for a plant of this type, it often expresses strong feelings of loss of control over its own destiny, and especially over the quality of its environment.

These anxieties are frequently encountered and it would be foolish not to acknowledge them. Processes which ensure representation and communication must be established at a very early stage, so that the general public feel sufficiently informed about, and involved in, the setting up and operation of such facilities.

It is essential that people are convinced that all the hierarchical stages of avoidance, reduction, reuse and recycling have been considered and that the plant really is necessary. Some of this can be achieved by the creation of a local committee made up of elected representatives, local residents, environmental groups and others. Once the plant is in operation, regular open days which allow public access to the facility and demonstrate the professional care which is undertaken, can help maintain good relations with neighbours.

The Montchanin disposal site - an example of poor communication

Montchanin is a French commune of 6 500 inhabitants in an old industrialised region. Up to 1960, a clay quarry was worked in the commune for the manufacture of tiles. It was then abandoned, and the decision was taken in 1977 to use it as a landfill site, initially for household refuse and then for hazardous industrial waste. The nearest houses are a few metres from the quarry.

Although a "defence group" was set up at the outset of the project to call for closure of the site, planning was completed and the project was authorised by the government in 1977. Complaints then began to flood in. The fact that the waste stored came from abroad, that the operator had a poor local reputation and secrecy surrounded the operating conditions all heightened the concern felt by people living near the site. Lastly, the local authority and the operator made many errors of communication. A rumour circulated that, without prior warning, people were even seen working on the site in the dead of night in protective clothing with full breathing equipment !

Pressure from the various associations led the mayor in 1988 to call for an inquiry by the local health services into the risks posed by the plant to people's health and to that of cattle watered from a nearby water source.

The conclusions from these studies were that two ponds were polluted and that nearby wells were also suspected of being polluted by solvents. In addition, several health disorders were observed and later confirmed by epidemiological surveys. These disorders were mainly pulmonary (excessive use of drugs and excess mortality due to chronic bronchitis) and psychiatric (related to anxiety caused by poor management of the disposal site and loss of property values). At that time, 70% of the waste disposed of consisted of paint waste (sludge from cleansing of painting cubicles, paint wastes, soiled material). These contained large quantities of solvents which evaporated either unchanged or after breaking down. The disorders seen corresponded to those described as related to solvents used in the work environment. All these considerations led the government to order closure of the site.

Site rehabilitation was carried out in an exemplary way, both technically and with regard to involving the population. An international call for tenders was issued. The bids were examined by representatives of the ministry of health, the ministry of the environment and the defence group. This board unanimously adopted a proposal which was then explained at a public meeting and carried out in an extremely open way.

Accidents can happen. It is important to be prepared to react

Transport of hazardous waste

A secure transport system is a key element in any system for proper management of hazardous waste.

Close monitoring of transport makes it possible to:

- retrace all the stages from production to disposal of a batch of waste;
- take precautions to reduce the probability of an accident occurring in a high-risk area, for instance through a better training of the staff and an improved design of the vehicles and routes.
- minimise the effects of any accident, among other things by drawing up emergency plans; and
- establish and enforce noise reduction policies

The international transport of dangerous goods (including industrial chemicals) has to comply with the recommendations contained in international agreements. Numerous national regulations are compatible with them. For instance, under Council Directive 94/55/EC, all Member States of the European Union are required to align their domestic requirements governing the transport of dangerous goods by road with the requirements of the European agreement on road transport of dangerous goods (ADR). In addition, many European transport firms use the TREM (TRansport EMergency) cards developed by the European Chemical Industry Council (CEFIC). This standard card, which is carried in the vehicle, gives effect to the legislative instructions in the ADR concerning the written documentation that must accompany dangerous substances being transported by road. The card is now well known by customs services and the police. (See technical annex for more details)

Conclusion

The collection, transport, storage, treatment and disposal of hazardous waste can entail real risks. The local authority role can be direct, when it concerns waste collected through the municipal collection system, or indirect, when companies must comply with regulations that oblige them to dispose safely of their hazardous waste.

The hierarchical approach to management proposed in this pamphlet encompasses most existing solutions, while keeping safety considerations to the fore and endeavouring to minimise treatment costs.

It is always better to take steps to avoid the production of hazardous waste, rather than to have to treat it. Whether a separate collection of hazardous household waste is suitable or not depends upon the prevailing economic, social and organisation arrangements in each locality. Sometimes, it can be preferable to take advantage of the "natural" dispersion for small quantities of hazardous household waste amongst the domestic waste.

So far as transport is concerned, there are international agreements in force which serve as guidelines for monitoring the movement of hazardous materials, both across frontiers and within countries. These can be used for hazardous waste transport too. Local authorities must ensure that rules such as these are complied with.

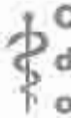
It is essential to have hazardous waste treatment plants and facilities for the disposal of final waste, in order to avoid unauthorised dumping of hazardous waste which may have serious effects on the environment and the health of people living nearby. One essential aspect of establishing and operating these plants is good communication with, and effective involvement of, the population. Unfortunately this aspect is often overlooked, a shortcoming which hinders efforts to achieve the smooth and safe handling of hazardous waste.

Recommendation 1

Inform stakeholders and foster participation.

Without hazardous waste treatment facilities, no safe management scheme can be set up. Aside from the need for technical inquiries to help identify and choose genuine sites, the involvement of the population at the earliest stage is a key factor to make a success of any hazardous waste scheme. The quality of the information given should be looked at carefully.

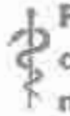
Recommendation 2



Collect complete and reliable data on the quantity and nature of hazardous waste generation.

This information, along with a clear identification of producers, is a prerequisite for a satisfactory hazardous waste treatment system. Full information on current methods of treatment of hazardous waste is also important to give an accurate picture of the present situation. Lastly, it is important that local and public authorities define the categories of waste they regard as hazardous and requiring specific treatment.

Recommendation 3



Follow a stepwise approach to consider hazardous waste management.

The approach described in this pamphlet is the basis for successful waste management. It is most likely to minimise controversy with professionals and the public and can be summarised according to the following hierarchy:

1	Avoid
2	Reduce
3	Reuse
4	Recycle
5	Recover
6	Treat
7	Dispose.

Hazardous waste

TECHNICAL ANNEX

Table of contents

Drafting a treatment strategy

Many different hazardous waste treatment technologies can be used prior to ultimate disposal. These technologies aim to reduce the volume, weight and toxicity of the components in different types of hazardous wastes. They also sometimes enable the recycling of some elements, such as solvents. The choice of the most practicable ways of treating an individual waste type depends on many factors, including the availability of facilities, safety standards and costs. In 1985, the State of Victoria, Australia, drafted an industrial waste management strategy which is summarised in the table below and gives an idea of how waste streams can be co-ordinated and recommendations can be made for their treatment at local level.

Waste type	Property			Recommended disposal *items in ( ) refer to treatment residue*							
	S	F	R	r	pc	s	l	l*	b	i	d
Abattoirs residues											
Acids and solutions *(inorganic)*											
Alkylation acid											
Boric											
Chromic											
Fluosilic											
Fluoboric											
Hydrochloric											
Hydrofluoric											
Nitric											
Perchloric											
Phosphoric											
Pickling acids											
Sulphurous											
Sulphuric											
Acids, organics											
Acetric											
Benzoic											
Butyric											
Formic											
Lactic											
Oxalic											
Sulphonic acids											
Trichloacetic											
Alkaline materials											
Ammoniacal solutions											
Caustic soda or sodium hydroxide											
Lime slurries											
Lime neutralised metal sludge											
Soda ash or Sodium carbonate											
Sodium phosphate or polyphosphate											
Sodium silicate											
Sodium sulphate											
Sodium peroxide											
Alkaline cleaners											
Alkali metals											
Animal residues											
Antimony compounds											
Arsenic compounds											
Asbestos wastes											
Bags - *previously contained hazardous materials*											
Barium salts											
Bleaching powders and solutions											
Boron (compounds of)											
Cadmium (compounds of)											
Cannery wastes											
Cattle dips and residues											
Carbonisation liquors *wood or coal*											
Chlorinated hydrocarbons											
Chloroform											
Carbon tetrachloride											
Ethylene dichloride											
Perchloretylene											
Trichloroethane											
Trichloroethylene											
Chromium compounds											
Copper compounds											

Key

S = toxic, carcinogenic
F = flammable
R = corrosive, highly reactive
r = recovery, recycle
pc = physical / chemical treatment
s = solidification
l = landfill (normal, licensed)
l* = landfill (impervious, licensed)
b = biological treatment
i = incineration
d = water / sewer discharge subject to agreement

Waste type	Property					Recommended disposal *items in ( ) refer to treatment residue*					
	S	F	R	r	pc	s	l	l*	b	i	d
Cyanides											
Plating residues	√		√	√	√			(√)			(√)
Heat treatment residues	√		√	√	√			(√)			(√)
Metal complexes	√			√	√			(√)			(√)
Organo cyanides	√	√	√	√	√			(√)			
Detergent	√			√	√			(√)			(√)
Disinfectants				√	√			(√)			(√)
Drugs - *see Pharmaceuticals and residues*											
Dyestuffs	√							(√)		(√)	
Explosives	√	√	√		√			(√)			
Fats, grease				√			√		√	√	
Fish residues				√			√		√	√	
Fluorides and compounds containing fluorine	√			√	√	√		√			
Fruits residues				√	√		√		√		(√)
Fungicides - *see Pesticides*											
Grease trap residues											
domestic							√		√		
commercial							√		√		
Hydrocarbons											
Lubricating oil		√		√						√	
Light oil		√		√						√	
Solvents (low flashpoint)		√		√						√	
Insecticides and contaminated containers - *see Pesticides*											
Isocyanates	√	√	√	√	√			(√)			
Lead compounds	√			√	√	(√)		(√)			
Lime slurries			√	√	√		√				
Lime neutralised metal sludges	√			√	√		√				
Manganese compounds	√			√	√	(√)		(√)			
Mercaptans	√	√		√	√						
Mercury and compounds	√			√	√	(√)		(√)			
Methacrylates	√	√		√	√					√	
Motor fuel additives and residues	√	√						√		√	
Nickel compounds	√			√	√			(√)			
Nitrates	√		√	√	√			(√)			(√)
Oils											
Cutting oils		√		√				(√)		(√)	
Cutting emulsions				√				(√)		(√)	(√)
Hydrocarbon		√		√				√		√	
Lubricating		√		√				√		√	
Organo-Nitrate	√	√	√	√	√			(√)			
Oxidising agents											
Chlorates	√		√	√	√			(√)			(√)
Chromates	√			√	√			(√)			(√)
Nitrates	√		√	√	√			(√)			(√)
Permanganates	√		√	√	√			(√)			(√)
Peroxides	√		√	√	√			(√)			(√)
Paint thinners (low flashpoint)		√		√						√	
Pesticides				√	√	(√)		(√)		√	
Peroxides	√	√		√	√			(√)			(√)
Pharmaceuticals and residues	√			√	√		(√)	√		√	
Phenol and phenolic compounds	√									√	
Phosphorus residues	√	√	√	√	√			(√)		√	
Pickling acids / solutions	√		√	√	√			(√)			(√)
Poisons - *any material which would be labelled under Schedules 1-7 of the Poison Act*	√				√			√			√
Polychlorinated Biphenyls (PCBs)	√				√					√	
Scallops shells	√						√				
Selenium compounds	√			√	√	√		(√)			
Sheep dips and residues	√				√		(√)	(√)			
Solvents, low flashpoint		√		√						√	(√)
Sulphides	√			√	√			(√)			(√)
Sulphites	√			√	√			(√)			√
Surfactants	√			√					√	√	
Tetraethyl lead residues	√	√					√		(√)	√	
Timber preservatives	√				√	(√)		(√)			
Thallium compounds	√			√	√	(√)		(√)			√
Triple interceptor Trap residues (TIT)					√		√				
Turpentine residues	√	√		√						√	
Vanadium compounds	√			√		√		(√)			
Vegetable wastes				√			√		√		
Waxes - animal and plant		√		√			√			√	
Weedicides - *see Pesticides*											
White spirits		√		√						√	
Zinc compounds	√			√	√			√			

Source : Environment Protection Authority of Victoria, Draft Industrial Waste Strategy for Victoria, 1985

Key

S = toxic, carcinogenic
F = flammable
R = corrosive, highly reactive
r = recovery, recycle
pc = physical / chemical treatment
s = solidification
l = landfill (normal, licensed)
l* = landfill (impervious, licensed)
b = biological treatment
i = incineration
d = water / sewer discharge
( ) = subject to agreement

Examples of treatment

Incineration

Specifically built incinerators along with three kinds of existing facilities can be identified.

Specifically built incinerators are, by definition, perfectly suitable for the purpose and can be equipped with the necessary gas and unburned products treatment devices.

Municipal solid waste or sludge incinerators may be used, although their operating temperature can in some cases be too low.

Cement and lime kilns, blast furnances and industrial boilers can be excellent solutions in some instances, especially for hazardous waste with a high calorific value, provided that risk assessments have been completed with satisfactory results. When such facilities are available, and when a contract between the operator and the waste producer can be made, this solution is both elegant, cheap and efficient.

Open-pit incinerators are a cheap option, but smoke will be produced. It can be acceptable in very specific situations such as emergencies or disasters, etc. The quality of the smoke usually cannot be controlled.

Blast furnace

Specific treatments for hazardous liquids

These range from simple sedimentation or skimming systems to sophisticated treatment processes including flocculation, precipitation and absorption of organic carbon. Such treatments can be extremely specific, for example emulsion breaking, or acidic or basic neutralisation.

Other treatments

There are hundreds of other specific treatments designed for chemically destroy a compound (through oxydation for instance), stabilise or solidify it (encapsulation, vitrification, cementation, etc.), or separate most hazardous phase from the waste and then treat separately both phases.

More detailed description of the treatments methods for hazardous waste can be found in the books listed in the bibliography.

The most hazardous components can be stabilised by solidification

Transport of hazardous waste

International regulations

Rather than governing the treatment and disposal of hazardous wastes at or near the point of generation, the international regulations on hazardous waste are chiefly intended to prevent or control the trade in hazardous wastes. In the past this has resulted in instances of dumping and poor disposal in developing countries. The United Nations' Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal calls for signatories to the Convention to transport and dispose of wastes only in participating countries which have given prior, informed consent. The Basel Convention recognises the right of any state to ban the entry or disposal of hazardous wastes in its territory, and encourages, as far as is compatible with environmentally sound and efficient management, the disposal of hazardous wastes in the state where they were generated. Annex I of the Convention lists the categories of waste to be controlled. In some countries the Basel Convention waste categories have been adopted within internal national regulations to define hazardous wastes.

Furthermore, several international regulations have been set up regarding the transport of dangerous goods (for example chemicals and manufactured products), including hazardous waste. They can be divided in two types.

• General provisions made for all forms of transport:

In this category are the recommendations of the United Nations Committee of Experts on Dangerous Goods, published in what is known as the "orange book". This book, which was published before the Basel Convention, covers a wide range of chemical substances, rather than specifically covering hazardous wastes, and for identification purposes assigns a four-digit number to each type of material. These four-digit numbers are often used as a means of identification on transport documents.

• Regulations applicable to individual modes of transport:

Maritime transport

The IMDG code (International Maritime Dangerous Goods Code) was prepared by the IMO (International Maritime Organisation).

Air transport

The IATA (International Air Transport Association) Restricted Articles Regulations seek to implement the UN recommendations in the field of air transport. In parallel, the specialised agency ICAO (International Civil Aviation Organisation) appointed a Dangerous Goods Panel to draw up technical instructions for the safe transport of dangerous goods by air, which resulted in the adoption in 1981 of Annex 18 to the Chicago Convention on International Civil Aviation.

Rail transport

Transport of goods by rail is regulated in Europe by an international convention (CIM), of which Annex I contains international regulation on dangerous goods by rail (RID). These are revised regularly by OCTI (Central Office for International Rail Transport) and UN-ECE (UN Economic Commission for Europe).

Road transport

A European Agreement for the International Carriage of Dangerous Goods by Road (ADR) has been developed jointly with the RID. The design of TREM cards (TRansport EMergency), carried on board the vehicles and used in case of emergency (see box), is based on the terms of this agreement.

Transport by inland waterways

The resolution 223 (ADN) of the Inland Transport Committee of the ECE is very similar to the ADR. Some rivers, such as the Rhine and Danube, are also subject to special regulations.

Rapid reaction in the event of a road accident

Vehicles should be fitted with a sign indicating their dangerous load, if possible using the international standard for precise identification of its contents. Vehicles should also carry details of the action to be taken in the event of an accident, depending on whether the contents are spilled or intact (TREM cards are a good standard tool on which such information can be recorded). An emergency telephone line should be manned round the clock, with the number displayed in the vehicle.

TREM (TRansport EMergency) cards

The European Chemical Industry Council (CEFIC) has developed a system of cards (translated into 24 languages) kept in vehicles for use in emergencies during road transportation of dangerous substances. These cards, which are in a standard format recognised by customs and police officers, include the following information:

- *CEFIC/TEC number*
- *ADR class*
- *a brief description of the substances transported*
- *the nature of the hazard involved*
- *basic measures to protect personnel*
- *action to be taken by the driver in the event of an accident*
- *advice about action by those rendering external assistance*
- *an emergency telephone number.*

Apart from meeting the legal requirements in the ADR directive about information on the consignment being kept in the vehicle, these cards have become a standard tool that is well known by the emergency and inspection services and which offers the authorities a useful check-list of the specific hazards related to the transport of dangerous goods.

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ICP/EUD/NEAP 04.01.02

Target 23
WASTE MANAGEMENT AND SOIL POLLUTION
By the year 2000, public health risks caused by solid and hazardous wastes and soil pollution should be effectively controlled in all member states.

(Local authorities, health and environment briefing pamphlet series; 29)
1- Hazardous waste; 2- Waste management;
3- Municipal government; 4- Environmental health

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Titles available or in preparation as of March 1996

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- Industrial air pollution
- Traffic and air pollution
- Air pollution from wastes and solvents
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- Monitoring of air quality
- Asthma
- Air and global issues
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- Road safety
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- Play and leisure
- Nursery and school safety

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- Kitchen and health
- Lead and housing
- Energy and housing

Radiation
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- UV rays
- Before, during and after a nuclear accident
- Electromagnetic fields
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- Pesticides and health
- Mercury and health
- Abestos and health

Hygiene
- Rodents
- Mosquitoes
- Birds
- Pets
- Cockroaches
- Cleaning the city

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The WHO Regional Centre for Environmental Health Activities (CEHA)

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CEHA serves as the technical arm and information exchange unit of the WHO Environmental Health Programme for the Eastern Mediterranean Region, which comprises of 22 countries, namely Afghanistan, Bahrain, Cyprus, Djibouti, Egypt, Iraq, the Islamic Republic of Iran, Jordan, Kuwait, Lebanon, the Libyan Arab Jamahyria, Morocco, Oman, Pakistan, Qatar, Republic of Yemen, Saudi Arabia, Somalia, Sudan, the Syrian Arab Republic, Tunisia, United Arab Emirates, as well as the Palestinian Self Governing Authorities.

CEHA's mandate is to promote Environmental Health through technical support for strengthening national capabilities and programs in the Member States of the Region through Human Resources Development; Information Management and Exchange; Technical Cooperation and Capacity Building; Applied Research and Special Studies; and Demonstration Projects.

CEHA operates within the framework of the Regional Environmental Health Programme which encompasses the following technical areas: Community Water Supply and Sanitation; Promotion of Healthy Cities, Villages and Communities; Environmental Health Risk Assessment and Management; Food Safety; Chemical Safety; and Environmental Health in Refugee Camps and Emergencies.

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