Department of Trade and Industry

REGIONAL FACILITIES FOR DEALING WITH HAZARDOUS WASTE

A Report for

DTI Environment Directorate

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1 INTRODUCTION

The UK government has the policy of only permitting imports of hazardous wastes for disposal where the exporting countries do not have and/or cannot reasonably acquire the ability to dispose of the wastes concerned in an environmentally sound manner. The most frequent requests for shipments of hazardous wastes for disposal into the UK are:

- Poly-Chlorinated Biphenyl (PCB)
- Persistent Organic Pollutants (POPs) such as Hexachlorobenzene (HCB), DDT, chlordane, toxaphene, dieldrin, aldrin, endrin, hepachlor, mirex and dioxins and furans
- Other harmful pesticide substances not mentioned above.

To implement this policy it is essential that reliable information is available on:

(a) The technical ability of those countries making requests to export hazardous wastes to the UK for environmentally sound disposals, and

(b) What access is available to these countries to facilities within their own regions for such disposals.

Whilst the most widespread technology for disposing the above wastes in an environmentally sound manner is by high temperature incineration, the UK government is interested in ascertaining what alternative technologies exist and where such facilities are located.

This report presents the results of a study carried out by NEL to identify alternative technologies for the destruction of wastes containing PCBs and other harmful substances and the existence and location of these facilities, including high temperature incinerators, in the various regions of the world.

2 BACKGROUND

PCBs and some of the now banned pesticides are a subset of the synthetic organic chemicals known as chlorinated hydrocarbons are the best known POPs. They are persistent when released into the environment because they resist metabolic processes that would break them down to simpler chemical compounds. Their low water solubility means that they accumulate in fatty tissues of exposed animals and humans and are known to cause chronic reproductive effects, gastric disorders, and skin lesions in laboratory animals and are probable human carcinogens.

Between 1926 and 1977, PCB-containing products were manufactured for applications requiring stable, fire-resistant, and heat-transfer properties. The most extensive use of PCBs occurred in dielectric fluids. PCBs were also used as plasticisers and additives in lubricating and cutting fluids. However, during the 1970s, US Federal legislation demanded the elimination of PCBs from distribution in commerce but allowed its use in existing equipment, for economic reasons, for the useful or normal life of the equipment.

Before the Federal Regulations limited PCB production and use they were commonly used in a variety of commercial products such as:

- Adhesives
- Transformers
- Large, high- and low-voltage electrical capacitors
- Microwave ovens
- Electronic equipment
- Liquid-cooled electric motors
- Liquid-filled power cables
- Switches and voltage regulators
- Fluorescent light ballasts
- Electromagnets
- Hydraulic systems and heat-transfer systems
- Gasketing and dampening materials
- Microscopy mounting media and immersion oil
- Vacuum pumps.

Pesticides[1] are defined as:

" Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during, or otherwise interfering with, the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies."

" The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. "

In 1997, the governing council of the United Nations Environment Programme (UNEP) concluded that international action was required to reduce the risks to human health and the environment arising from the release of POPs, including PCBs and pesticides.

[1] References at the end of report

3 SCOPE OF THE STUDY

This study gives an overview of (a) the types of facilities and technologies available for the disposal of the above-mentioned hazardous wastes and (b) what facilities exist, if any in the following regions of the world:

- Northern and Southern Africa: particularly South Africa, Nigeria, Mozambique, Egypt, Yemen and Mauritania
- South and Central America: particularly Argentina, Brazil, Chile and Costa Rica
- Asia: particularly the Philippines, Pakistan, India, Saudi Arabia, Kuwait and Thailand
- Eastern Europe: particularly Slovakia and Slovenia
- UK Overseas Territories, including Anguilla, Bermuda, British Antarctic Territory, British Indian Ocean Territory, British Virgin Islands, Cayman Islands, Falkland Islands, Montserrat, Pitcairn Islands, St Helena and Dependencies and Turks and Caicos.

The information contained in this report will assist the UK Environment Agency's decision process on whether to allow the waste concerned to be imported into the UK or not and provide a useful tool for targeting opportunities for relevant UK industry overseas.

For the purpose of this study, it was agreed at the start that no contact would be made with the governments of the countries or their Agencies to obtain the required information.

4 METHODOLOGY

Bearing in mind the constraint placed by the scope of the study described above, the methodology used to obtain the required information involved a combination of the following:

- A United Nations Environment Programme (UNEP) Report[2] of the inventory of world-wide PCBs destruction capacity was obtained and studied.
- A computerised literature search through relevant key words using NEL's library services was carried out.
- Numerous Internet searches covering relevant UK and international sites were carried out initially using keywords such as PCB disposal techniques, pesticides disposal, hazardous waste, Basel, high temperature incineration, POPs destruction, etc.
- High temperature incinerator manufacturing companies world-wide were identified and which some were contacted to establish whether they had exported to any of the above listed countries.
- A pesticides technical specialist from the United Nations Food and Agriculture Organisation (FAO) was contacted by e-mail.

5 DESTRUCTION TECHNOLOGIES

One of the leading principles of waste management, hazardous or otherwise, is by source reduction, by which the generation of waste should be reduced to a minimum in terms of quantity and/or hazard potential. Thereafter wastes that are nevertheless generated should be reused, recycled or recovered and only where none of the above are feasible should final disposal options be considered.

For hazardous wastes such as PCBs and other POPs it is not usually possible to reuse, recycle or recover and so they must be destroyed or neutralised in an environmentally sound manner. It is no longer considered environmentally sound practice to recover PCBs although this has been done in the past.

In addition to high temperature incineration there are a number of technologies available or being developed at present. However, communication with the FAO suggests that incineration is still the preferred means of destruction of pesticides for the moment by FAO, World Health Organisation (WHO) and the United Nations Environment Programme (UNEP).

Other disposal alternatives such as landfill or burial are not acceptable because of further likely chance of contamination of the environment. FAO cites an example of the negative effect of burial in Yemen Republic, where a total of 30 tonne of various types of POPs were buried in the early 1980s. However, the total quantity that has to be disposed now of is 1 540 tonne. Through seepage and underground migration, the contaminated area was found to be far beyond the original burial site. Burial is not considered a solution but only a means of delay of the problem that, eventually will become a hazard to the environment. It is also suggested that burial doesn't work in developing countries particularly where there is little or no awareness but in any case an increasing number of developing countries no longer allow burial.

The following sections give a brief summary of some of the more modern technologies available for the disposal of PCB, POPs and pesticides.

5.1 Gas Phase Chemical Reduction (GPCR)

This method involves hydrogen reacting with chlorinated organic compounds, at high temperatures, yielding primarily methane and hydrogen chloride. Destruction efficiencies of GPCR are high and all residues and emissions are captured for assay and reprocessing if needed. Eco Logic International in Canada has patented this process where chlorinated hydrocarbons such as PCBs are reduced to methane and hydrogen chloride at 850 degrees Centigrade. In this process non-chlorinated organic contaminants such as polycyclic aromatic hydrocarbons (PAHs) are reduced to minor amounts of light hydrocarbons and methane.

5.2 Electrochemical Oxidation

Carbon dioxide, water and inorganic ions are formed when electrochemically-generated oxidants react at low temperature with organochlorines. Once again destruction efficiencies are high and all residues and emissions are captured for assay and reprocessing, if needed. The Dounray Electrochemical Silver (II) process was initially developed for high efficiency conversion of a wide range of radioactive organic wastes into environmentally acceptable waste streams. The American Department of Energy believes this technology to be proven and ready to be commercialised for the destruction of a variety of organic materials.

5.3 Molten Metal Pyrolysis

In the Molten Metal Pyrolysis process organochlorines and other materials are oxidised in a vat of molten metal, yielding hydrogen, carbon monoxide, ceramic slag and metal by-products. This technology has been used by Molten Metal Technology (MMT) in the US to develop Catalytic Extraction Process (CEP) in which molten metal acts as both solvent and catalyst. Waste and selected co-reactants are introduced into a refractory-lined, metal-filled vessel. Typically, outputs include (a) a metal product that may be recycled, (b) slag that contains oxidised metals, (c) gases consisting of products of volatilisation, oxidation and decomposition and (d) particulates and metals entrained in the released gases.

5.4 Molten Salt Oxidation

The molten salt process has been used on a small scale since 1950. In this process, a bed of alkaline molten salt, usually sodium carbonate, oxidises organic materials at a temperature of 900 to 1 000 degrees Centigrade. Any chlorine, sulphur, phosphorus or ash products in the feed are converted to inorganic salts and retained in the salt bed. This process cannot be used to treat soils and other materials with a high content of inert material.

One hazard of the process is potential superheated-vapour explosions when liquid wastes are introduced. Gaseous emissions may require filtering due to the entrapment of very fine salt particles and the total salt requiring disposal may be several times the weight of the wastes destroyed.

5.5 Solvated Electron Process

Solvated Electron Technology (SET) uses an alkali or alkaline earth metal dissolved in a solvent such as ammonia, or certain amines or ethers to produce a solution containing free electrons and metal cations. Chlorines and other halogens are selectively stripped from organic halides by free electrons to form salts. For example, a PCB molecule can be converted to biphenyl in a rapid reaction at ambient temperatures.

This technology has been developed by Commodore Applied Technologies Inc., of the US and has resulted in a proprietary reagent known as Agent 313. The technology has been demonstrated in the destruction of a wide variety of halogenated organic compounds including PCBs, dioxins, pesticides and chlorofluorocarbons (CFCs). Information on the possibility of the formation of other POPs has not been identified in this process at present.

5.6 Supercritical Water Oxidation

This process is a high temperature and pressure technology that uses the properties of supercritical water in the destruction of organic compounds and organic wastes. Carbon is converted to carbon dioxide, hydrogen to water, chlorine atoms to chloride ions, nitro-compounds to nitrates, sulphur to sulphates and phosphorus to phosphates.

Process residues are contained and consist of water, gas and solids if the waste contains inorganic salts or organics with halogens, sulphur or phosphorous.

5.7 Plasma Arc

Plasma Arc treatment involves directing an electric current through a low-pressure gas stream to create a thermal plasma field. Plasma arc fields can reach 5 000 to 15 000 degrees Centigrade. The high temperature dissociates waste into its atomic elements by injecting the waste into the plasma, or by using the plasma arc as a heat source for combustion or pyrolysis.

The waste streams from the plasma arc destruction have been described as ‘essentially the same as those from incineration’, such as combustion by-products and salts.

Three main plasma arc systems have been considered by Environment Australia in its review of the following appropriate technologies for the destruction of hazardous wastes:

- PACT (Plasma Arc Centrifugal Treatment)
- PLASCON (In-Flight Plasma Arc System)
- STARTECH (Plasma-electric waste converter)

5.8 Catalytic Hydrogenation

The potential destruction of chlorinated wastes by hydrogenation over noble metal catalysts has been recognised for many years. However, these catalysts are particularly susceptible to poisoning by a range of elements, thus limiting the applicability of this technology.

The Commonwealth Science and Industry Research Organisation (CSIRO) Division of Coal and Energy Technology has developed a process for the regeneration of PCB contaminated of transformer fluids using hydrogenation catalysts based on metal sulphides, which are extremely robust and tolerant of most catalyst poisons.

There is insufficient information available publicly to determine the limitations or risks associated with this process.

5.9 Based Catalysed Dechlorination (BCD)

The US Environmental Protection Agency developed a process called Based Catalysed Dechlorination (BCD) to remediate soils and sediments contaminated with chlorinated organic compounds, especially PCBs, dioxins and furans.

The original BCD process involved the addition of sodium bicarbonate to the contaminated medium, which was then heated to 330 degrees Centigrade in a reactor to partially decompose and volatilise the contaminants, which then require separate treatment. Further development of this process incorporated an alkaline polyethylene glycol (APEG) reagent as the base. Gaseous emissions are also very small compared with combustion systems.
The process has been successfully demonstrated at the Wide Beach Superfund site where 42 000 tonne of soil contaminated with PCBs, mainly Arochlor 1 254 was treated.

6 DESTRUCTION FACILITIES

The Inventory of World-wide PCB Destruction Capacity report referred to above was prepared under the United Nations Environment Programme by UNEP Chemicals in co-operation with the Secretariat of the Basel Convention (SBC). This inventory identified a total of 94 facilities available for PCB destruction spread around 36 countries world-wide. The information was obtained via a questionnaire sent by the Secretariat of the Basel convention to the 125 countries' focal points nominated to receive and submit information.

Additional information for this study was obtained from general Internet searches and from websites of waste management companies.

However, despite the existence of facilities in some of the countries, these facilities are not universally available. Where suitable facilities are not available close to the location of the wastes, transporting them may represent the Best Practical Environmental Option (BPEO), if transport distances are minimised and safe transport conditions are adhered to.

The following sections of the report detail the PCB, pesticides and POPs destruction facilities around the world distributed by the appropriate regions such as Africa, South and Central America and the Caribbean, Asia and the Middle East including Australia, Europe and North America and Canada. This report does not purport to be an exhaustive survey of facilities in place as of Autumn 2000, but is nonetheless as complete as possible.

6.1 Africa

The main countries of interest in this region at the start of the study were South Africa, Nigeria, Mozambique, Egypt, Yemen and Mauritania.

The UNEP inventory report identified a total of three facilities in the whole of the African continent, i.e., two in Cameroon and one in Rwanda.

Cameroon's facilities highlighted are:

(a) A static kiln incinerator for handling all incinerable liquid wastes in batches of 220 tonne, and
(b) A landfill site for emptied capacities and electrical transformers.

Both the facilities are government operated and form two of the parts of the Douala-Makepe Waste Facility.

In addition to the above two facilities, larger privately operated facilities using different technologies were reported to UNEP with a high potential for recycling. However, it was not possible to obtain detailed information on these facilities.

The facility in Rwanda is a landfill site, which is apparently used for all PCB wastes and other equipment although it is not licensed to accept PCB wastes.

Angola, Burkina Faso, Madagascar, Niger, Central African Republic and Togo reported to the Basel Convention that no facilities for PCB treatment or disposal existed in these countries.

Mauritius identified one landfill site, however it is not licensed for PCBs.

Apart from a number of privately owned and dedicated small incinerators, no significant incineration of industrial and hazardous waste is taking place in South Africa. Hospitals and clinics run their own small incinerators for medical wastes.

SD Myres Inc. of Ohio, a transformer consultancy company bought over Fluidex engineering in South Africa in 1995. Fluidex has a unique oil regeneration technology and builds chemical PCB destruction plants in South Africa for export.

6.2 South and Central America and The Caribbean

The main countries of interest in this region were Argentina, Brazil, Chile and Costa Rica. The UNEP report highlights a total of three facilities in Brazil and one in Mexico. The website of Tredi, the French waste management company indicates that they have an incinerator in Buenos Aires, Argentina but no details are available.

CETREL SA in Camaçari operates two of these in the North Eastern state of Bahia. CETREL is a very environmentally conscience company, which was awarded the prime quality award Prêmio Nacional de Qualidade (PNQ) after the implementing and optimising an Environmental Management System (EMS) within the company. The CETREL facilities are a liquid injection incinerator plant built in 1991 and a rotary kiln incinerator built in 1998 with capacities of 1 200 and 500 tonne per annum respectively. The rotary kiln system will accept solid wastes. CETREL was originally intended to treat the waste from its own petrochemical complex but has now evolved to take a wider role.

The third facility is a rotary kiln incinerator capable of handling 2 500 tonne per annum located in Rio de Janeiro operated by a company called Incinerador Rotativo (IR). Since the commissioning of this incinerator in 1992 by IR, the company provides an integrated waste management system, including a physical-chemical and a biological treatment station and a doubly protected landfill site.

Chile, Colombia, Paraguay and St. Kitts and Nevis have no facilities for the disposal of any hazardous wastes, neither are there any facilities in any other country in this region.

There are no reports of any facilities for PCB destruction in UK Overseas Territories, including Anguilla, Bermuda, British Antarctic Territory, British Indian Ocean Territory, British Virgin Islands, Cayman Islands, Falkland Islands, Montserrat, Pitcairn Islands, St Helena and Dependencies and Turks and Caicos.

Mexico has a 9 000 tonne per annum capacity rotary kiln incinerator at Tepetlacalco, Naucalplan. The incinerator was commissioned in 1998 to treat a range of liquid and solid wastes and to decontaminate transformers and recycle metals. The same company reconditions transformers by replacing PCB contaminated (levels ranging from 50 to 10 000ppm) dielectric fluids, where the PCBs are treated by Base Catalysed Dechlorination in a mobile plant (PCB Gone process is also available in Mexico – see next section for details).

6.3 Middle East, Asia Pacific and Australia

The main countries of interest in these areas were the Philippines, Pakistan, India, Saudi Arabia, Kuwait and Thailand. However, other countries in this region are also covered in this section.

Kuwait has a facility at Safat, which is operated by the Environment Public Authority of Kuwait, where a rotary kiln incinerator, landfill and de-chlorination plant exist but no details are available for these facilities.

The Republic of Korea has a rotary kiln incinerator operational from August 1998 with a capacity of 200 tonne per annum. Here transformers are drained, solvent cleaned and steel recycled. The facility is operated by the Waste Treatment Division of the Environmental Management Corporation (EMC), a non-profit affiliated body of the Ministry of Environment.

A cement kiln is reported to be in Indonesia where PCBs flushed from equipment are burned with diesel until the PCB concentration level in the flushing liquid is below 500 ppm. The equipment is then land filled.

Fiji has two landfill sites which accept PCB waste without restriction. At one of these, PCB wastes are placed in a segregated area of landfill and covered with 150 to 200 mm of soil.

Thailand, the Philippines, Bangladesh, Federated States of Micronesia, India, Pakistan, Japan and Singapore have no facilities for the disposal or processing of PCBs. However, the Basel Secretariat reports that other technologies are being developed, including chemical de-chlorination, supercritical water oxidation process, ultraviolet radiation and biological decomposition in this region. No additional details are available.

Incinerator Database, which operates in Asia, reports on their website that there are plans for four incinerators in Thailand. However, there is considerable opposition by Greenpeace to the building of these and indeed any incinerators anywhere in the World. Ecological activists from 12 Asian nations, the US and the UK have formally launched 'Waste Not Asia', Asia's first alliance against the proliferation of waste incineration technologies.

There are seven facilities in Australia, which the countries in this region can have, access to. These are:

- Oil regeneration facility using a new reactivable Fullers Earth Process, in Virginia Queensland, where oils containing up to 500 ppm PCBs are collected in a 30 000-litre tank for treatment. There is a storage facility for 90 000 litres at this facility. The process is similar to the PCB Gone process[3]. The same location also has a heat treatment plant of 570 tonne per annum. This method is also used in Saudi Arabia.
- A chemical de-chlorination (BCD) facility and a plasma arc process (PLASCON) facility is located at Narangamba also in Queensland. The PLASCON unit is used to treat liquid PCBs, which are not ideally suited to the BCD process.
- A de-chlorination facility is located in Melbourne where Haz-Waste uses solvent extraction to treat PCB-containing equipment, with the metal being recycled. The contaminated oil and other wastes are de-chlorinated in a second facility at the same location.
- A hydrogenation (Chemical de-chlorination) facility built in 1995 is located in Kwinana in Western Australia run by ELI Ecological.

The region has a known total capacity of around 8 000 tonne per annum of which 1 000 tonne per annum is for heat treatment and solvent extraction, not destruction.

There are two facilities in China built in 1995 with a total capacity of 300 tonne per annum. These are a static kiln and a liquid injection incinerator located in Shengyang.

In Malaysia there are no specific comprehensive hazardous waste treatment and disposal facilities – apart from unsuitable disposal sites. Many industries are storing their waste both raw and partially treated, within factory compounds, warehouses or temporary storage sites.
Tredi Taiwan a subsidiary of Tredi, France highlight through their websites that they operate (or plan to operate soon) high temperature incineration facilities in Taiwan, however no details were available at the time of writing.

6.4 Europe

The main countries of interest in this region were Slovakia and Slovenia, however, Western Europe is also covered in this section since waste could be transported to the countries in this region.

There are two facilities in the Czech Republic: a cement kiln and a dechlorination plant, the first one in Mokrã and the second one operated by Recetox, the latter with a capacity of 300 tonne per annum.

Slovenia has a licensed and a closed landfill which was built for the waste remaining when a factory at Semic ceased production of electrical equipment containing PCBs in 1985. The waste deposited consisted mainly of polluted soil plus some condensers and transformers.

Armenia has a landfill site but it is not authorised to accept PCB wastes.

In the rest of Europe the following situation exists:

- Austria has a rotary kiln incinerator and a fluidised bed incinerator.

- Denmark and Finland have one rotary kiln incinerator each, latter with a capacity of 30 000 tonne per annum PCB destruction capacity, the largest one in Europe.

- France and Germany have seven facilities each, including static and rotary kiln incinerators, solvent extraction plants and a liquid injection incinerator and former salt-mines used as landfills.

- The Netherlands has five facilities, including two rotary kiln incinerators, a solvent extraction, dismantling and recycling plant, a liquid injection incinerator and a chlorine circular unit.

- Norway and Sweden have a cement kiln and a rotary kiln incinerator respectively with a total of 2 400 tonne per annum.

- Switzerland has four facilities, of which three are rotary kiln incinerators and no details of the fourth are available with a total destruction capacity of nearly 40 000 tonne per annum of all organic wastes.

- The United Kingdom has three facilities, two that are run by Shanks Chemical Waste and one by Cleanaway Limited. Shanks Chemical Waste have two rotary kiln incinerators and a static hearth incinerator, the latter with a PCB destruction capacity of 5 000 tonne per annum. The first facility is capable of destroying 30 000 tonne of organic waste. Cleanaway's facility is a rotary kiln incinerator with a capacity of 60 000 tonne per year including 48 000 tonne of liquid.

- There are no facilities in Croatia, Ireland and Belarus and it is not known how PCBs are disposed of in these countries.

- According to their New Zealand website Tredi (NZ), Tredi has subsidiaries in Hungary, Spain, Italy and Portugal where they appear to have disposal facilities however details were not available at the time of writing this report.

Europe as whole has a total capacity of 697 000 tonne per annum for the destruction of organic waste of which 88 000 tonne per annum is suitable for PCB destruction.

6.5 North America and Canada

USA and Canada have the largest number of facilities for the disposal of organic waste and PCBs, with a total of 40 sites between them, with 12 in Canada and 28 in America. The facilities include:

- Rotary kiln incinerators
- Mobile and alternate thermal systems
- De-chlorination systems
- Static incinerators
- Chemical de-chlorination plants
- Physical separation systems.
- Pipelines and compression systems decontamination units.
- Recycling Centre.
- Landfill sites
- Metal and electrical cable recovery sites.

All facilities in Canada are under provincial jurisdiction.

It would be possible for the countries in the Caribbean and Central and South America to have access to these facilities provided Prior Informed Consent (PIC) guidelines agreed by the Basel Convention are followed. PIC guidelines have been developed by the Basel Convention whereby the country receiving any waste for disposal/destruction has to give consent to the exporting country before it sends the waste to it. The exporting country has to give to the receiving country full details about the amount and the nature of the waste.

7 SUMMARY OF THE FACILITIES

Table 1 shows a summary of the distribution of PCB and other hazardous waste destruction facilities in the various regions of the world that have been identified in the above sections of this report.

REGION	COUNTRIES WITH FACILITIES
Africa	Cameroon & Rwanda
Middle East, Asia & the Pacific	Kuwait, Saudi Arabia, Mauritius, Korea, Fiji, Thailand, Australia, P.R. China, Taiwan, Australia, Indonesia & New Zealand
Europe	Armenia, Austria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Portugal, Italy, Spain, Ireland, The Netherlands, Norway, Romania, Slovenia, Sweden, Switzerland & United Kingdom
South & Central America & The Caribbean	Brazil, Mexico & Argentina
North America	USA & Canada

Table 1 World-wide PCB destruction facilities

Table 2 lists the facilities cross-referenced against the technologies described in Section 5 of the report in various regions of the world.

REGION	TECHNOLOGY EMPLOYED
Africa	Cameroon - Landfill and incineration (static kiln) Rwanda – Landfill (unlicensed)
Middle East, Asia & the Pacific	Kuwait – Rotary Kiln Incinerator (RKI), Landfill & Chemical Dechlorination (no details available) Saudi Arabia – Transformer oil regeneration (PCB Gone) Mauritius - Landfill (unlicensed) Korea – RKI Fiji – Landfill Thailand – RKI Australia – BCD, Catalytic Hydrogenation Plasma Arc, Solvated Electron Process, PCB Gone and Incineration P.R.China – Static Kiln Incinerator (SKI) Taiwan and New Zealand – Incineration Indonesia - Cement Kiln
Europe	Armenia – Landfill (unauthorised for PCBs) Austria – RKI & Incinerator (Fluidised bed) Czech Republic – BCD Denmark – RKI Finland – RKI France - Solvent Extraction (SET), BCD, Liquid injector incineration Germany - RKI, Landfill (salt mine), Static Kiln Incineration Hungary – Incineration Portugal – Incineration Italy – Incineration Spain – Incineration The Netherlands – Solvent Extraction (SET) Norway – Cement Kiln incineration Romania – no details Slovenia – Landfill Sweden – RKI Switzerland – Details not known United Kingdom – Rotary & Static Hearth Incineration, PCB Gone (in-house use by National Grid)
South & Central America & The Caribbean	Brazil – Incineration Mexico – BCD, PCB Gone Argentina – Incineration
North America	Canada – SET and Incineration, Mobile BCD GPCR, PCB Gone USA – Incineration, SET, ACD, MMP, GPCR Plasma Arc, Chemical Waste Landfill

TABLE 2: TYPES OF TECHNOLOGIES IN VARIOUS REGIONS

8 OTHER RELEVANT DEVELOPMENTS

In addition to commissioning the inventory of destruction facilities, the Basel Convention is implementing and monitoring a capacity building activity relating to the environmentally sound management of hazardous waste. Activities have been initiated under this activity in the following regions:

- Cape Verde supported by Canada.
- Paraguay supported by France.
- The Caribbean supported by the UK.

Plans for an incineration facility in Mozambique, supported by Denmark, were abandoned in October 2000, following action by international pressure groups against the project.

Work is going on in assisting in the development of national legislation and regulation on topics covered by the Basel Convention in waste management in Armenia, Republic of Moldova, the Gambia, Romania, Ukraine and Vietnam.

The Convention is also helping to:

(a) Identify the main hazardous waste streams.
(b) Strengthen national capacity for waste destruction.
(c) Prepare work programmes to implement the Basel Convention.
(d) Prepare national plans for waste management.
(e) Undertake pilot activities concerning the environmentally sound management of hazardous and other wastes

The above is being done presently in The Republic of Benin, Côte d'Ivoirie, Gambia, Guinea, Madagascar, Mauritius, Caribbean Region, Trinidad and Tobago, Vietnam and Zambia.

According to Greenpeace, the World Bank is involved in financing projects involving incinerators (small medical waste and large industrial waste incinerators) in many countries. Lebanon, Mauritius, Brazil, China, Lithuania, Nepal, Botswana, Kenya, Tanzania, Fiji, Nicaragua, Algeria, Kenya, Chad- (Cameroon), Argentina, Comoros, Dominican Republic, Egypt, India, Indonesia, Malawi, Mexico, Nigeria, Senegal, South Africa, Sri Lanka, Turkey, Vietnam, Western Samoa and Zimbabwe have been named as countries where these projects are being funded. Greenpeace is against incinerators anywhere in the world because, it states, the existence of other (safer) technologies.

The Basel Convention has established regional Centres for Training and technology transfer. The main goals and objectives of the centres are to strengthen the capacity of the regions for the implementation of the Basel Convention to comply with the technical requirements of the environmentally sound management of hazardous wastes and legal and institutional aspects of the implementation of the Convention. Twelve regional or sub-regional centres have been established.

For Latin America and the Caribbean, Uruguay is selected as co-ordinating centre with three sub-regional centres: Argentina for South America; El Salvador for Central America including Mexico and Trinidad and Tobago for the Caribbean.

For Africa, Nigeria has a co-ordinating centre, with three sub-regional centres: Egypt for Arabic-speaking countries, South Africa for English-speaking countries and Senegal for French-speaking countries.

For Central and Eastern Europe, Slovak Republic is selected for Central Europe sub-region, the Russian Federation for Eastern Europe sub-region and possibly a third sub-regional centre in Estonia.

For Asia and the Pacific, China and Indonesia are selected as regional centres.

More information can be obtained on these regional centres on the Basel Convention website www.basel.int/centers/regionalV2.html.

9 CONCLUSIONS

The results of the study presented above provide information on the technologies and the availability of the facilities for the destruction of PCB, pesticides and POPs in various regions of the world. Where suitable facilities do not exist locally in the country the nearest available facilities in the region can be used to minimise the risks associated with long distance transportation. Few facilities have been identified in Africa, the Caribbean and Latin America, however it is doubtful if many more would have been identified if a more detailed study were carried out.

Incineration is still by far the most common method of waste destruction, either in purpose built hazardous waste incinerators or in cement kilns but there is a great deal of public opinion against incineration. Other methods of destruction are established commercially, especially in Canada, USA and Australia but are not available in any other regions. The major problem in dealing with hazardous waste is often not the lack of technology or facilities, but identifying the waste and planning and financing their destruction.

The Basel Convention is involved in a number of initiatives to eliminate or at least minimise the trans-boundary transportation of all hazardous wastes. These include an increase in local awareness, capacity build-up and technology transfer as well as setting up of regional centres in various parts of the World.

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