Name of Process:
Hazardous waste incineration

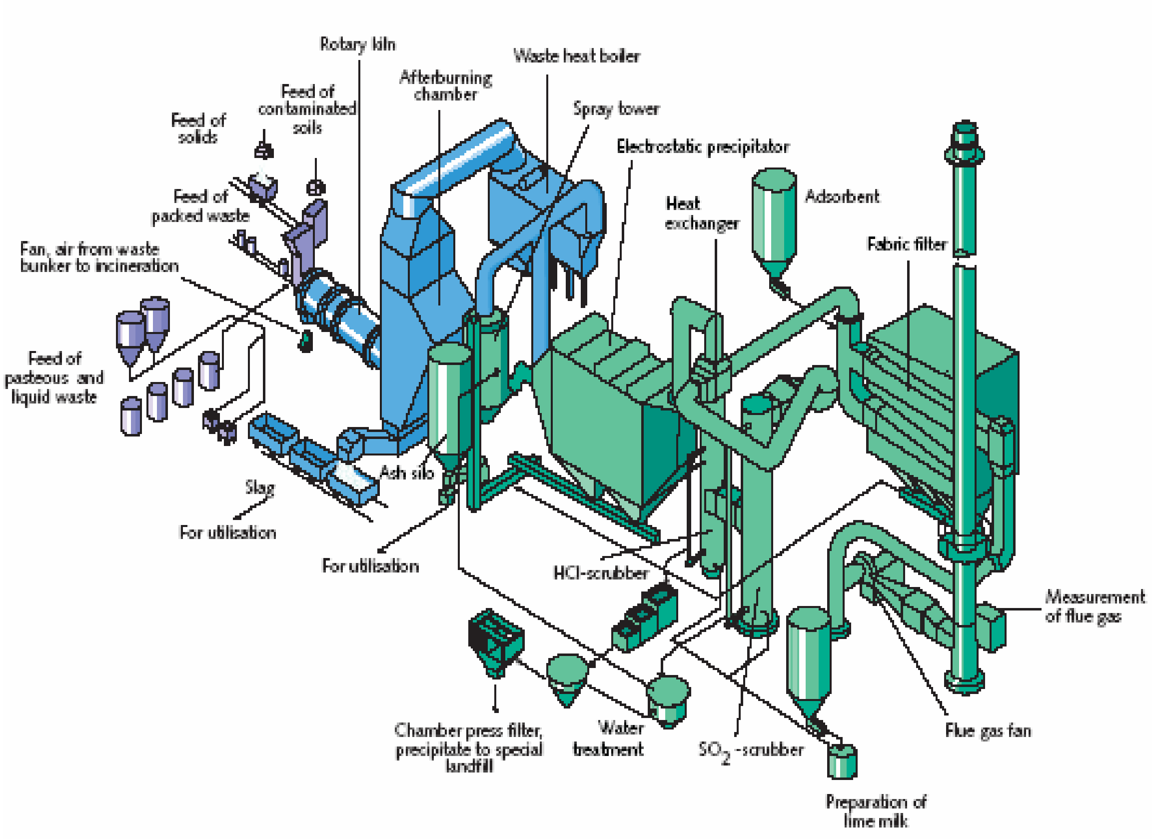
Vendors include:
A number of existing hazardous waste incineration facilities are identified within the inventory of worldwide PCB destruction capacity.(UNEP, 2001 and Draft 2004)

Applicable POPs wastes:
hazardous waste incinerators are capable of treating wastes consisting of, containing or contaminated with any POP. Incinerators can be designed to accept wastes in any concentration or any physical form, i.e., gases, liquids, solids, sludges and slurries.(UNEP, 1995c)

Status:
There is a long history of experience with hazardous waste incineration. (UNEP, 2001, UNEP Draft 2004)

Technology description: Hazardous waste incineration uses controlled flame combustion to treat organic contaminants mainly in rotary kilns. Typically a process for treatment involves heating to a temperature greater than 850 °C or, if the chlorine content is above 1 %, greater than 1,100 °C, with a residence time greater than 2 seconds, under conditions that assure appropriate mixing. Dedicated hazardous waste incinerators are available in a number of configurations including rotary kiln incinerators, static ovens (for liquids only). High-efficiency boilers and light-weight aggregate kilns are also used for the co-incineration of hazardous wastes (See Brunner, 2004).

Process diagram:



Example: Incineration plant in Finland

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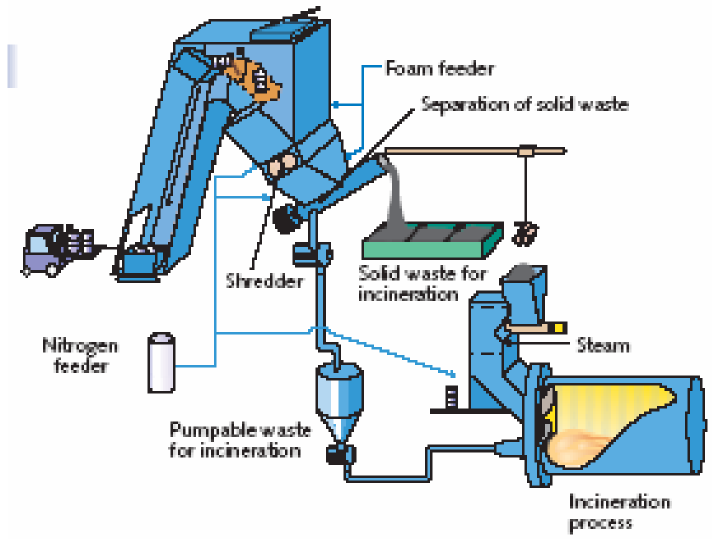
PART I: Criteria on the Adaptation of Technology to the Country

A. Performance:

1. Minimum pre-treatment:
Depending upon the configuration, pre-treatment requirements may include blending, dewatering, screening and shredding of wastes (UNEP, 1995c; UNEP, 1998b, UNEP, 2004c)



Example: Pre-treatment in Finland

2. Destruction efficiency (DE):
DREs of greater than 99.9999 percent have been reported for treatment of wastes consisting of, containing or contaminated with POPs. (FRTR) 2002; Rahuman et al., 2000; UNEP, 1998b and UNEP, 2001) DEs of greater than 99.999 and DREs of greater than 99.9999 per cent have been reported for chlordane and HCB (Ministry of the Environment of Japan, 2004, HIM, 2004), while DEs between 83.15 and 99.88% have been reported for PCBs (U.S. Environmental Protection Agency, 1990) and > 99,999 % in Germany (HIM, 1983-84) and > 99,99992 % (HIM, 1995)

3. Toxic by-products:

4. Uncontrolled releases:

5. Capacity to treat all POPs:
Capable of treating wastes consisting of, containing or contaminated with any POP and can be designed to accept wastes in any concentration or any physical form, i.e., gases, liquids, solids, sludges and slurries.(UNEP, 1995c)
Compounds treated:

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6. Throughput:

6.1 Quantity [tons/day, L/day]

Hazardous waste incinerators can treat between 30,000 and 100,000 tons per year.
Full-Scale Plants Example Germany: 2 rotary kilns with a total capacity of 110 000 t/year for solid, fluid, paste, gaseous and in drums packed hazardous wastes

Semi-Mobile Plants:

Portable Plants: one is applied in Estonia with a capacity of annual capacity of the plant is 1620 tonnes and it works continuously. The reconstruction works were finished at the beginning of 2006 and now the plant measures up to legislation in Estonia and EU directive 2000/76/EC on the incineration of waste. In the plant, at the same time, it is possible to treat waste in three states: liquid, solid, jellied. Very different kinds of hazardous waste are treated: waste from colours/coatings and lacquers; medicines and infectious waste, contaminated packages and other materials; oilfilters; contaminated soil, chemicals, PCB-oil, pesticides etc. (See also Annex, Table 6: Official Summary of Resulting Emissions)

In Latvia a container-based Incineration system (CIS) with a capacity of 2000-4000 t/y depending on calorific value of waste. Waste can contain to 2.5 % Sulphur and to 10% halogen (mostly chlorine).

6.2 POPs throughput : [POPs waste/total waste in %]
max 10% Chlorines or halogens

There are also specific hazardous waste treatment plants that can deal with high chlorine contents. Most of them are integrated in the plants of the chemical industry and recycling their own waste and are often not accepting production from the market. However there are a number of plants accepting high chlorinated waste from the external market (See Annex, Table 1). Treatment of solid and liquid waste is possible. Some are treating liquid organic high Cl-containing waste. Experiences have been made with liquid POPs waste such as PCB-oils (liquid) and other high chlorinated non-POPs waste like Methylene-chloride, Perchloorethylene, Trichloorethylene. In the process listed in the Annex, PCBs have been treated and the chlorine is recuperated as the product HCl and can be used in a wide variety of applications. High processing temperature (>1450 °C) guarantees destruction of all PCB's.

7. Wastes/Residuals:

7.1 Secondary waste stream volumes:
very low PCDD and PCDF discharges to water.(UNEP, 1995c; UNEP, 1998b; UNEP, 2004c) PCDDs and PCDFs are mainly found in fly ash and salt, and to some extent in bottom ash and scrubber water sludge

Example German installation: ashes 237 kg/t, filter ashes, filter dust 51 kg/t

Emissions include carbon monoxide, carbon dioxide, HCB, hydrogen chloride, particulates, PCDDs, PCDFs and PCBs and water vapour. Incinerators applying BAT, i.e., inter alia, designed for high temperature and equipped with prevention of reformation of PCDD/F and dedicated PCDD and PCDF removal (e.g., activated carbon filters), have led to very low PCDD and PCDF emissions to air (UNEP, 1995c; UNEP, 1998b; UNEP, 2004c).

7.2 Off gas treatment:
Process gases may require treatment to remove hydrogen chloride and particulate matter and to prevent the formation of and remove unintentionally produced POPs. This can be achieved through a combination of types of post-treatments, including cyclones and multi-cyclones, electrostatic filters, static bed filters, scrubbers, selective catalytic reduction, rapid quenching systems and carbon adsorption (UNEP, 2004c). Depending upon their characteristics, bottom and fly ashes may require disposal within a specially engineered landfill (US Army. 2003).

7.3 Complete elimination:

Detailed information and treatment examples:
Table 1: Technology Overview – Summary Technical Details
Table 2: Overview Project Experience per Technology Supplier
Table 3: Client References Overview project experience per technology suppliers
Table 4: Utilities Required for Hazardous Waste Treatment
Table 5: Overview flue gas emission annual averages in 2006 for incineration line 1, 3 and 2, Finland
Table 6: Official Summary of Resulting Emissions (from Estonia)

See UNEP, 2001 and Draft 2004

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PART II: Criteria on the Adaptation of the Country to the Technology

Part II is not applicable for Hazardous Waste Incineration (HWI) Plant is not specifically designed for POPs and under normal circumstances present in a country. Its presence is based on national or regional waste management plans and deals with the issue of hazardous waste management and only marginally with POPs. Therefore the data given in this Annex cannot simply be compared with the data for technologies which are specifically designed to treat POPs! This typical and state of the art Hazardous Waste Incineration (HWI) Plant with the combination of rotary kiln and secondary combustion chamber, followed by a boiler and sophisticated effective flue gas cleaning installations is able to dispose of continuously all kinds of hazardous waste: solid, liquid, gaseous, pasteous and materials in drums. The part of pesticides, packed in drums, is normally less than 1 %. Together with other POPs waste like PCB it can be sometimes up to 5 % and are often negligible compared to the total waste treated.
Questions on energy use are not relevant, as most of the plants have energy recovery and deliver energy to the public network. Therefore only a limited number of issues have been dealt with in this part.
Note: This part has to be filled in every time the "suitability" of the technology has to be examined for a certain country situation!!

A. Resource needs: Example Germany: 2 rotary kilns with a total capacity of 110 000 t/year taken per year
All numbers are given per tonne

1. Power requirements :
170 KWh/t. The installation produces in one turbine the energy itself. One part is supplied to the public Electricity network, being ca 15 % of the generated energy

2. Water requirements:
1.7 m^3/t/year and the water is drawn from its own water supply well

3. Fuel volumes:
Only 4.4 kg/t combustion oil is used during heating up of installation after standstill. Normally the installation runs completely by means of the waste provided

4. Reagents volumes:
40 kg/t of 50% NaOH is used for the neutralisation of acid gases in the wet scrubber and is very much dependent on the Halogen and sulphur content of the wastes.

Activated carbon/chalk mixture is 1.5 kg/t (in the last step of the gas cleaning for traces of Dioxins and mercury

5. Weather tight buildings:
Yes

6. Hazardous waste personnel requirement:
Plant workers have been required to be trained in hazardous waste operations

7. Sampling requirements/facilities:

8. Peer sampling:
Continuous flue gas monitoring according to air pollution regulations and drainage water sampling. In some cases samples from the stack gas are taken in a discontinuous mode and analyzed by independent laboratories. In case of POPs/PTS releases it is possible to return components to the process. Fly ash tests and slag tests. All sampling according to regulations.
Some facilities monitor their gaseous releases monthly/annually to verify compliance with air discharge permit and some facilities hold and test solids and effluents prior to discharge for total organic chlorine (TOCl), total organic carbon (TOC), pH, temperature, turbidity, and heavy metals concentration.(UNEP, 2004)

9. Laboratory requirements:
A broad variety of spectroscopic, colorimetric and chromatographic techniques are used for monitoring, such as gas chromatography (GC), mass spectrometry (MS), GC/MS, inductively coupled plasma spectrometry (ICP), ion chromatography (IC), poly urethane foam (PUF) air monitoring, infra red (IR) spectroscopy, standard dust monitors, fly ash tests, slag tests, wipe tests, titrimetric methods, and mass balance analysis (UNEP, 2004).

10. Communication systems:

Mobile network:

Fixed network:

On site requirements:

11. Number of personnel required:

11.1 Number of Technicians required (skilled labour):

11.2 Number of Labourers required (unskilled labour):

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B. Costs:

Rough calculation of a new plant in a country based on existing standards in Germany:
-throughput 2 x 50,000 t/Year treating solid, liquid, pastes, drums
- thermal capacity (with boiler) 2 x 22 MW
-buffer capacity for waste 5 days
would require investment ca. 50 mio US $
plus 85 people personnel

1. Installation and commissioning costs [US Dollars]:

2. Site preparation costs [US Dollars]:

3. Energy & Telecom installation costs:

4. Monitoring costs:
Amount of monitoring dependent on regulatory requirements

5. Complying costs:
Amount of compliance testing, oversight, etc., will depend on regulatory requirements

6. Reporting costs:
Amount of monitoring dependent on regulatory requirements

7. Running costs with no waste:

8. running costs with waste:

9. Decommissioning costs:
Not applicable

10. Landfill costs:
Depending on the local situation – Should be filled in by the concerned country

11. Transport costs of residues:
Depending on the local situation – Should be filled in by the concerned country

C. Impact:

1. Discharges to air:
See Table 2 of Annex

2. Discharges to water:
The incinerator data listed here has an effluent free process. Others often have a specific treatment of the effluents.
See Table 4 of Annex

3. Discharges to land:
See under F.2.

4. Soil impact (noise etc):

D. Risks

1. Risks of reagents applied:
50% NaOH applied is corrosive but does not create a specific risk

2. Risks of technology:
Risk are well-known and many safety reports have been made conform the Seveso II Directive

3. Operational risks:

E. Constructability:

1. Ease of installation/construction of plant:
Installation of the plants is complex works which only can be done by real specialists, having in-depth experience in the construction and installation of these plants.

2. Ease of shipping/transit:
Not applicable

3. Ease of operation:

4. Ease of processing :

F. Output/generation waste

1. Generated waste (% of input waste):
ca. 30% (ashes, filter dust and active carbon)

2. Deposited waste at landfill (% of input waste)
28.8 % (consisting of ashes, filter dust and active carbon) is deposited at special landfill (Saltmines) with max dioxin content 33ng TEQ/kg for ashes and 1200 ng TEQ/kg filter dust (Recovery operation R5).

3. Waste quality properties (pH, TCLP):
See under 2.

**Note: This Technology Specification and Data Sheet (TSDS) does not certify any particular technology, but tries to summarise the state of the art of the concerned technology on the basis of data delivered by the company or other source, which have been made available to the author and refers the reader to original documents for further evaluation. Without the efforts below listed technology suppliers it would not have been possible to set up this TSDS. Date: 18.06.2008*

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Technology suppliers that have contributed to this TSDS:

Akzo NobeL, the Netherlands
AVG Abfall- Verwertungs-gesellschaft mbH, Hamburg, Germany
Currenta GmbH & Co. OHG, Germany
Ekokem, Finland
HIM Hessische Industriemüll GmbH, Germany
SAVA Sonderabfallverbrennungsanlagen GmbH, Brunsbüttel, Germany
Trédi, Séché Environnement, France
Veolia Environmental Services, United Kingdom
AS EPLER & LORENZ, Estonia

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