Minamata Convention: Initial Assesment of Turkey

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Lecture 9

Waste treatment and recycling

Production of recycled metals („secondary“ metal production
Waste incineration
Waste deposition/landfilling and waste water treatment
Crematoria and cemeteries

Method of POPs and mercury contaminated wastes disposal

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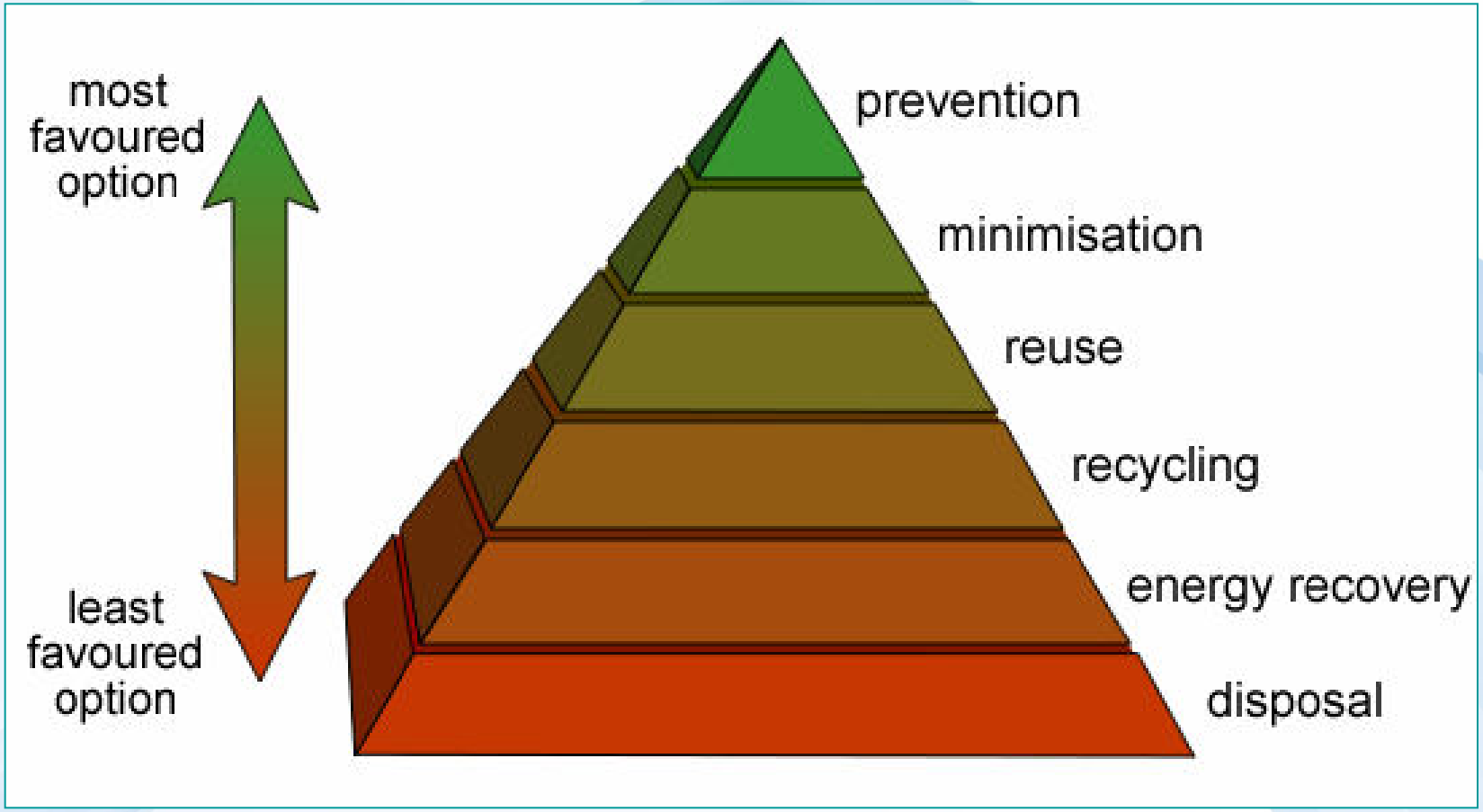
The waste management hierarchy



Production of recycled metals ("secondary" metal production)

This category covers the following main sub-categories:

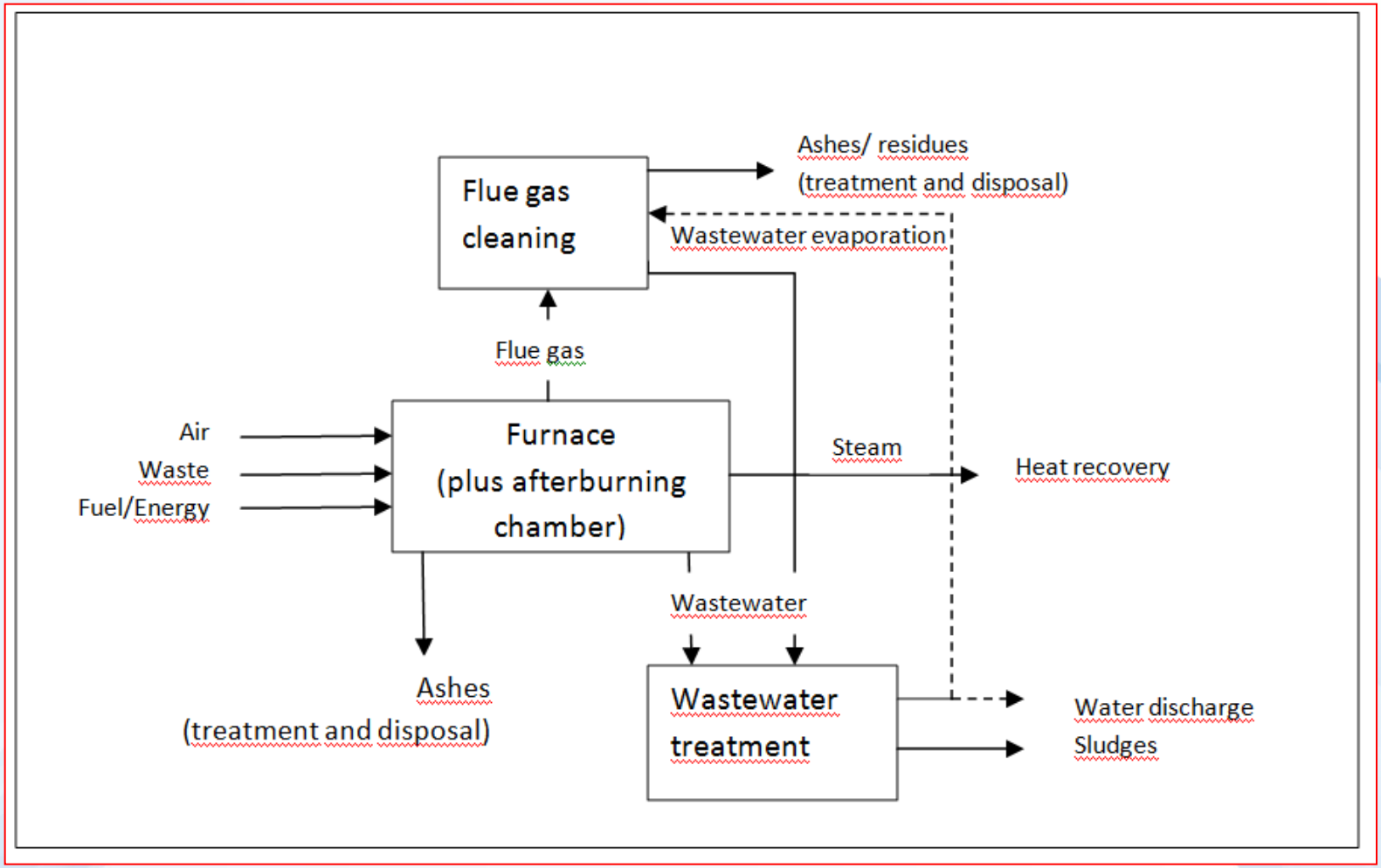
- Production of recycled mercury ("secondary" metal production), including the collection and processing involved in recycling of mercury;
- Production of recycled ferrous metals (iron and steel), including the collection and processing involved in recycling of iron and steel (such as scrap yard handling, scrap auto smelting, shredder, re-melting furnace).
- Production of other recycled metals.

Production of recycled metals ("secondary" metal production)

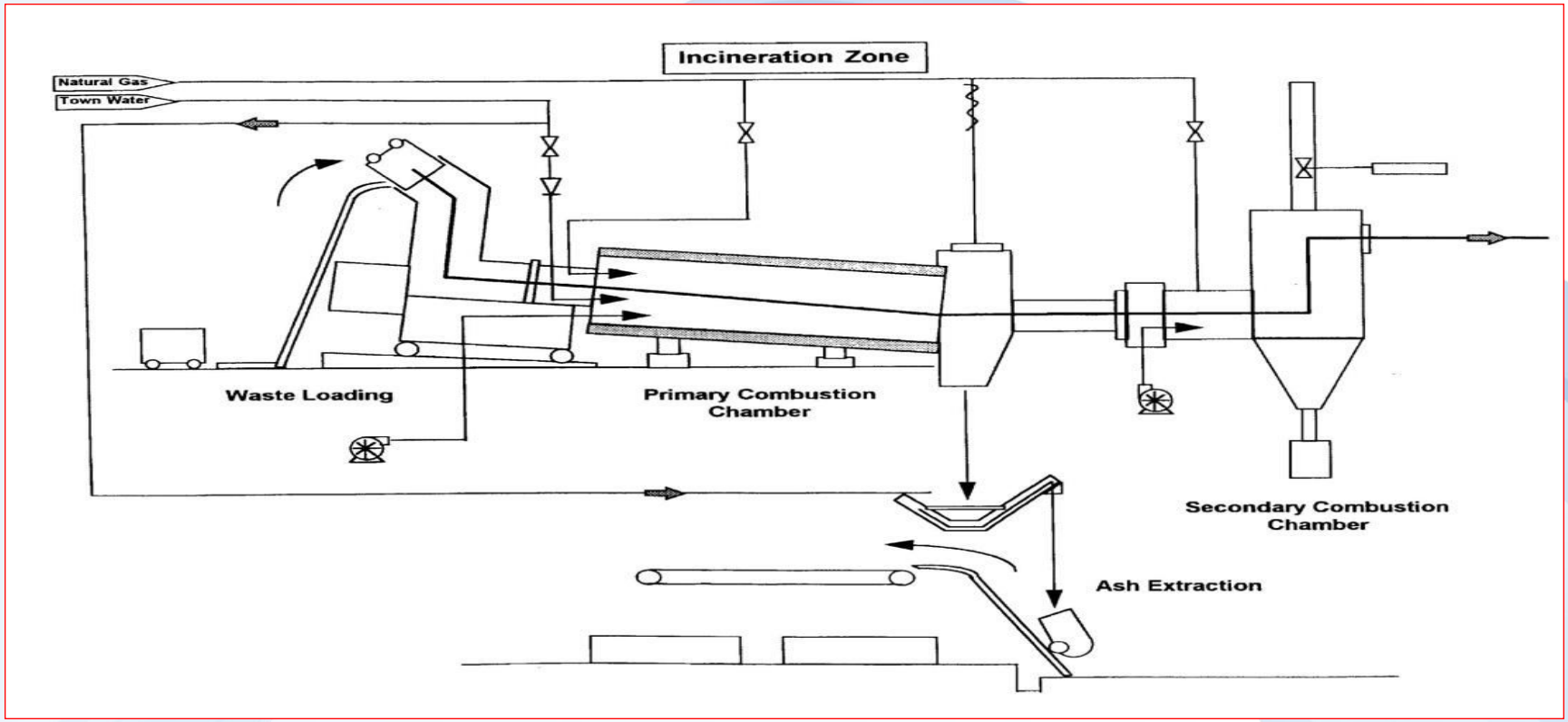
Main category - Production of recycled metals							
Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main inventory approach
5.7.1	Production of recycled mercury ("secondary production)	X	X	X	X	X	PS
5.7.2	Production of recycled ferrous metals (iron and steel)	X	x	x		x	PS
5.7.3	Production of other recycled metals	X	x	x		x	PS

Notes: PS = Point source by point source approach; OW = National/overview approach;
X - Release pathway expected to be predominant for the sub-category;
x - Additional release pathways to be considered, depending on specific source and national situation.

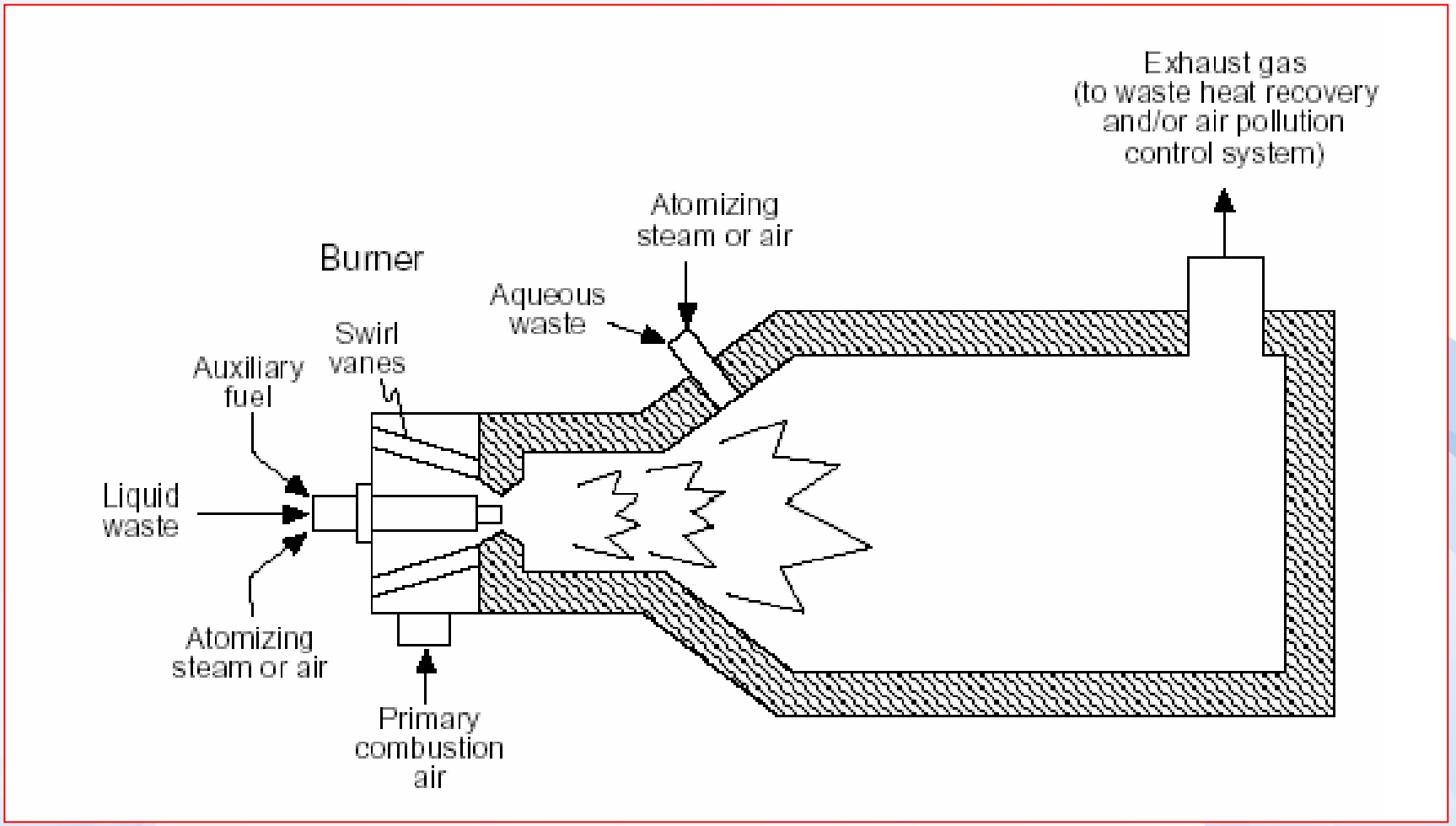
Simplified flow scheme of an incinerator



Rotary kiln incineration system (www.hitemptech.com)

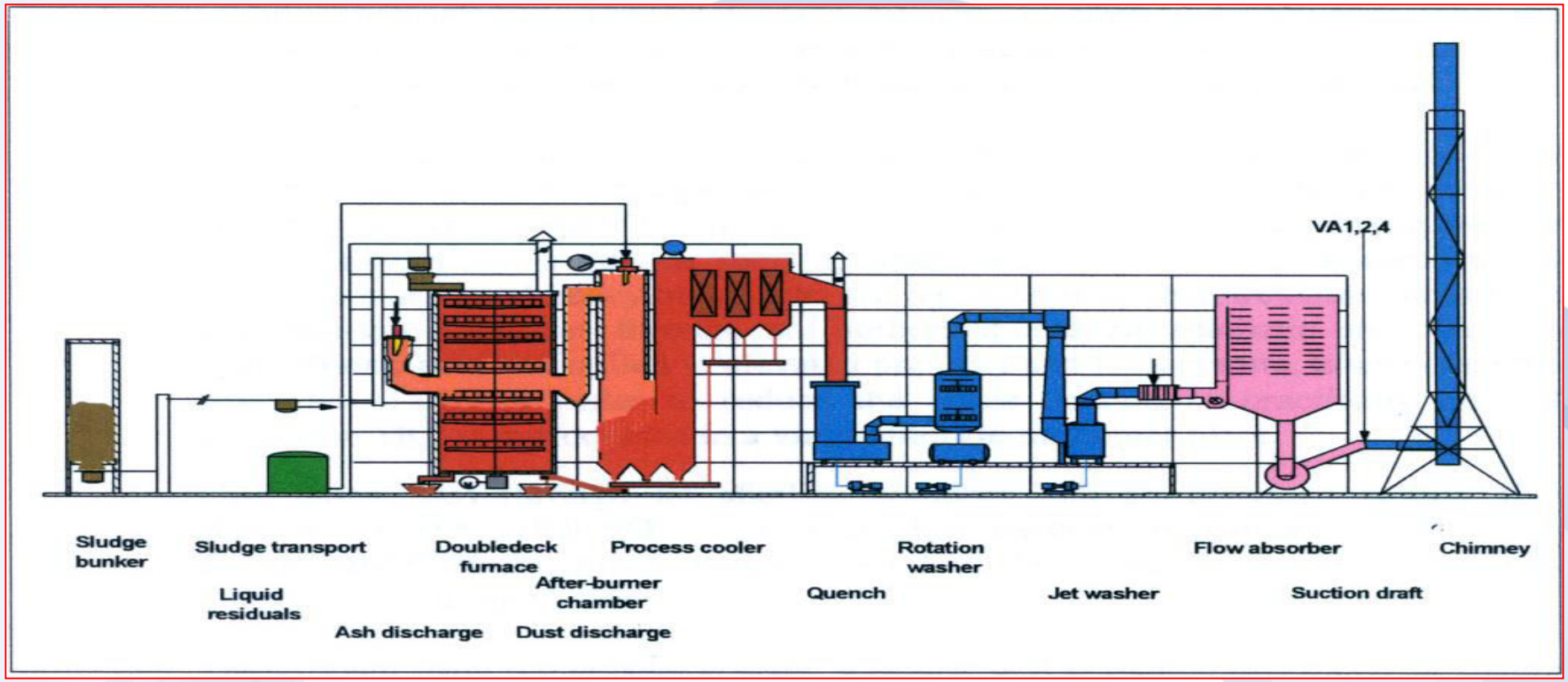


Typical liquid injection incinerator



Typical municipal solid waste incinerator (Source: European Commission 2006)

Example of a multiple hearth sewage sludge incinerator (European Commission, 2006)



Waste incineration

This category covers the following main sub-categories:

- Incineration of municipal/general waste - mainly domestic (household and institution) waste, which may contain mercury from both intentional uses of all kinds as well as from impurities in various high volume materials);

- Incineration of hazardous waste - usually combustible wastes collected separately, which may contain mercury from intentional uses (e.g. pesticides, paints, pharmaceuticals, organic mercury compounds) as well as general mercury impurities;

Waste incineration

- **Incineration of medical waste** – usually waste representing hygienic risk from hospitals, etc., which may contain mercury from intentional uses in the medical sector (thermometers, batteries, pharmaceuticals, dental material with fillings etc.) as well as general mercury impurities.

Medical waste is sometimes incinerated in separate incinerators, sometimes in selected municipal waste incinerators equipped for the purpose;

Waste incineration

- Sewage sludge incineration - much of the mercury in wastewater (originating from all sorts of mercury uses, but often dominated by dental amalgam wastes) ends up in the sewage sludge.

If not spread on farmland as fertiliser, sewage sludge may sometimes be incinerated in separate incinerators, sometimes in municipal waste incinerators;

- Informal waste burning - private or local informal waste burning in open fire, barrels, domestic heating ovens, etc.

Waste incineration

It should be kept in mind that the original input of mercury to waste incineration is the mercury present in products with intentional use of mercury and production wastes containing mercury, as well as other products with mercury impurities (virtually "all materials" contain trace amounts of mercury).

Mercury contributions to waste from intentional product and process uses, as well as certain other waste types, are sought estimated under the respective product and use sub-categories of this Toolkit.

The waste disposal step does, however, for many such products and materials represent a potentially major mercury release activity in their life-cycle.

Waste incineration

Main category – Waste incineration							
Chapter	Sub-category	Air	Water	Land	Product	Waste /residue	Main inventory approach
5.8.1	Incineration of municipal/ general waste	X	x	x	x	X	PS
5.8.2	Incineration of hazardous waste	X	x			X	PS
5.8.3	Incineration of medical waste	X	x			X	PS
5.8.4	Sewage sludge incineration	X	X			X	PS
5.8.5	Informal waste burning	X	X	X			OW

Notes: PS = Point source by point source approach; OW = National/overview approach;
X - Release pathway expected to be predominant for the sub-category;
x - Additional release pathways to be considered, depending on specific source and national situation.

Waste deposition/landfilling and waste water treatment

This category covers the following main sub-categories:

- Controlled landfills/deposits, i.e. deposition of waste under controlled procedures (based on risk assessments), and retention of pollutants in the waste, including:
  - Domestic (household and institutional) waste,
  - Medical/hazardous waste,
  - Solid combustion/incineration residues,
  - Wastewater sludge;
- Diffuse deposition under some control, such as deposition of incineration residues and other solid residues under roads, in constructions, etc. under controlled procedures (based on risk assessment) and with some retention of pollutants from wash-out, etc.;

Waste deposition/landfilling and waste water treatment

- **Informal local deposition of industrial production waste,** such as chlor-alkali production waste, chemicals production waste, and other waste (on production site or elsewhere);

- **Informal dumping of waste,** i.e. uncontrolled, informal dumping of general waste diffusely or at informal waste dumps;

- **Waste water system/treatment,** - where any mercury in wastewater (originating from all sorts of mercury uses, but often dominated by dental amalgam wastes) ends up in the sewage sludge, and to a lesser degree in the output water.

Waste deposition/landfilling and waste water treatment

It should be kept in mind that the original input of mercury to waste is the mercury present in products with intentional use of mercury, products with mercury impurities ("all products"), and production wastes containing mercury.

The waste disposal step does, however, for many such products and materials represent a major mercury release activity in their life-cycle.

Waste deposition/landfilling and waste water treatment

Main category - Waste deposition/landfilling and waste water treatment							
Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main inventory approach
5.9.1	Controlled landfills/deposits	x	x	X		X	OW
5.9.2	Diffuse deposition under some control	x	X	X		X	OW
5.9.3	Informal local deposition of industrial production waste	X	X	X			PS
5.9.4	Informal dumping of general waste	X	X	X			OW
5.9.5	Waste water system/treatment		X	X		x	OW/PS

Notes: PS = Point source by point source approach; OW = National/overview approach;
X - Release pathway expected to be predominant for the sub-category;
x - Additional release pathways to be considered, depending on specific source and national situation.

Crematoria and cemeteries

This category covers the following main sub-categories:

- Crematoria;
- Cemeteries.

Main category - Cremation and cemeteries							
Chapter	Sub-category	Air	Water	Land	Product	Waste/ residue	Main inventory approach
5.10.1	Crematoria	X				x	OW
5.10.2	Cemeteries			X			OW

Notes: PS = Point source by point source approach; OW = National/overview approach;
X - Release pathway expected to be predominant for the sub-category;
x - Additional release pathways to be considered, depending on specific source and national situation.

Data collection

Source sub-category	Input data types and units	Possible data sources
Production of recycled mercury ("secondary production")	Mercury produced, kg/y	**This may be reflected in some national production statistics, but generally it is needed to contact the recycling companies or consult resource persons with insight in the sector.**
Production of recycled ferrous metals (iron and steel)	Number of vehicles recycled/y	**See advice above;**
Waste incineration		
Incineration of municipal/general waste	**Waste incinerated, t/y**	**For these data, contact the ministry responsible for waste management. Some waste data may be available from existing studies, for example from national inventories for dioxins and furans (UN Environment Toolkit), or from waste management planning activities. If aggregated national data does not exist, municipalities' departments for waste management or the waste management companies may have these data.**

Data collection

Source sub-category	Input data types and units	Possible data sources
Incineration of hazardous waste	Waste incinerated, t/y	Incineration plants dedicated for hazardous waste are few, and may be identified through the ministry responsible for waste management. If they do not have data, identify and contact the waste management facilities. Hazardous waste may be incinerated along with general waste or in cement kilns (for destruction of hazardous properties). In such cases, contact facilities for data; see also cement sub-category in Section 3.

Data collection

Source sub-category	Input data types and units	Possible data sources
Incineration of medical waste	Waste incinerated, t/y	Two overall principles may be applied for controlled incineration of medical waste: Large scale facilities similar to hazardous waste incineration (see above), or small low- tech incineration chambers (focusing on sanitisation of the waste only) placed at individual hospitals. In the last case, the number of incinerators may be large, and data must be collected from the hospitals. Estimates can be formed by getting waste data and bed numbers from selected hospitals and extrapolate via the total number of hospital beds in the country (or similar). Report such assumptions and calculations in your inventory report.
Sewage sludge incineration	Waste incinerated, t/y	In some countries, sewage sludge is incinerated in dedicated facilities. The number of such facilities is likely low, and the most effective may be to contact the facilities individually. The ministry (or municipal departments) responsible for waste water treatment may be helpful in identifying relevant facilities.

Data collection

Source sub-category	Input data types and units	Possible data sources
Open fire waste burning (on landfills and informally)	Waste burned, t/y	Open waste burning will generally be hard to quantify precisely, but as the mercury releases directly to the environment may be substantial, it is important to try and make a rough estimate for mercury release quantification. Some waste data may be available from existing studies, for example from national inventories for dioxins and furans (UN Environment Toolkit), or from waste management planning activities. Otherwise try (maybe with help from resource persons) to estimate expected waste amounts generated per person in the country and compare to quantified waste amounts landfilled or incinerated under controlled conditions, and consider remaining waste amounts dumped and burned informally. Note that open burning of waste in municipal landfills is practised in many countries. This can be hard to estimate, but attempts can be made to interview personnel on selected major landfills on the applied practices and extrapolate to the national situation. Report your assumptions and calculations.

Data collection

Source sub-category	Input data types and units	Possible data sources
Waste deposition/landfilling		
Controlled landfills/deposits	Waste landfilled, t/y	See incineration of municipal/general waste above.
Informal dumping of general waste	Waste dumped, t/y	See open fire waste burning above.
Waste water treatment	Waste water, m3/y	For these data, contact the ministry responsible for waste water management. Some waste data may be available from existing studies on waste water management planning activities. If aggregated national data does not exist, municipalities' departments for waste water management may have these data. You may use data from major city facilities and extrapolate to the whole population. Report such assumptions and calculations.

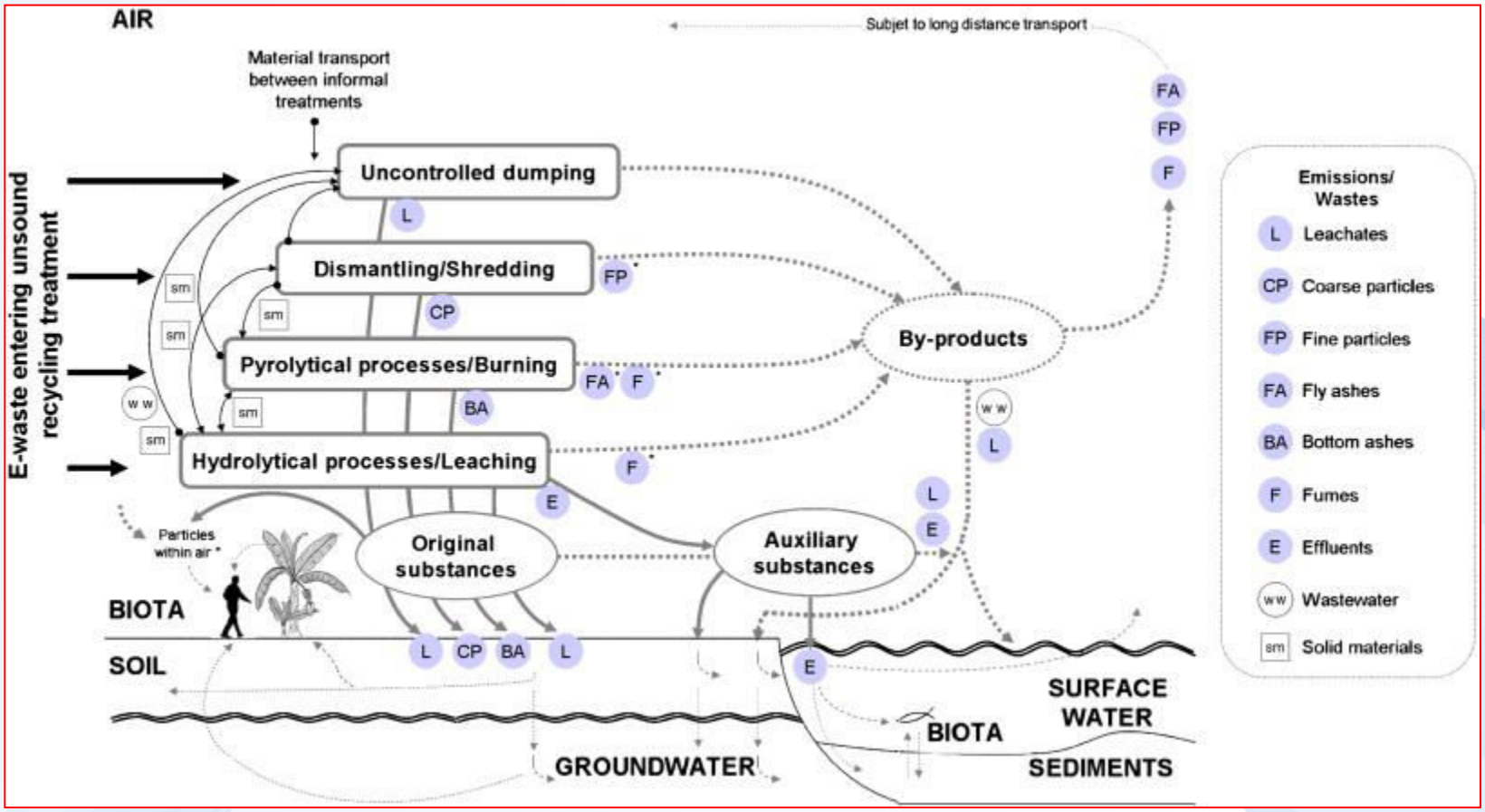
Relevant mercury controls

Source sub-category	Mercury control name in IL1 spreadsheet	Explanation
Incineration of municipal/ general waste / Incineration of hazardous waste / Incineration and open burning of medical waste	No emission reduction de- vices	
	PM reduction; simple ESP, or similar	**Particle filters such as simple electrostatic precipitators (ESP) or others**
	Acid gas control + high efficiency FF or ESP PM retention	**Acid gas filters (usually wet, dry or semi-dry scrubbers) + high efficiency fabric filters (FF; also called bag filters) or electrostatic precipitators (ESP)**
	Mercury specific absorbents + FF	**Activated carbon injection (or fixed beds) + fabric filters (FF)**

Relevant mercury controls

Source sub-category	Mercury control name in IL1 spreadsheet	Explanation
Waste water system/ treatment	No treatment	
	Mechanical treatment only	**Mechanical treatment (filtering of solid materials) only**
	Mechanical and biological treatment; no land application of sludge	**Mechanical treatment (filtering of solid materials) + biological treatment (reduction of organic substances with biological digestion in the waste water)**
	Mechanical and biological treatment; with >40% of sludge used for land application	**Mechanical treatment (filtering of solid materials) + biological treatment (reduction of organic substances with biological digestion in the waste water), where a substantial part (above 40%) of the waste water sludge is applied (as fertiliser) on land.**

WEEE recycling activities in China and India



Principal WEEE recycling activities in China and India, types of produced emissions and general environmental pathways. Ovals: types of substances contained within emissions. Continuous bold lines: fate of original and auxiliary substances. Dotted bold lines: fate of by-products such as dioxins and furans. Black arrows with a bold dot: material transport fluxes between treatments. Fine dashed arrows: general environmental pathways. Environmental fluxes are driven by processes as atmospheric deposition (dry/wet), leaching, adsorption–desorption, complexation (by which heavy metal and cyanide secondary products can be formed), uptake, degradation (chemical/biological) and volatilization. In addition, the environmental fate of pollutants depends on the physico-chemical properties of the media.

Emerging techniques for waste incineration facilities - High efficiency activated carbon adsorber

A high efficiency activated carbon adsorber, trade-named "JFE-Gas-Clean-DX," has been developed, in which activated carbon is packed in an activated carbon cartridge with a fixed bed and lateral flow-type structure, thereby realizing efficient contact between the flue gas and the activated carbon.

Figure 1 provides a schematic illustration of the appearance of the device and Figure 2 the activated carbon cartridge. The device consists of an activated carbon cartridge, of a compact size, which can be easily detached and installed in the device housing. High efficiency contact between the flue gas and activated carbon is realized by adopting a fixed bed and lateral flow type structure.

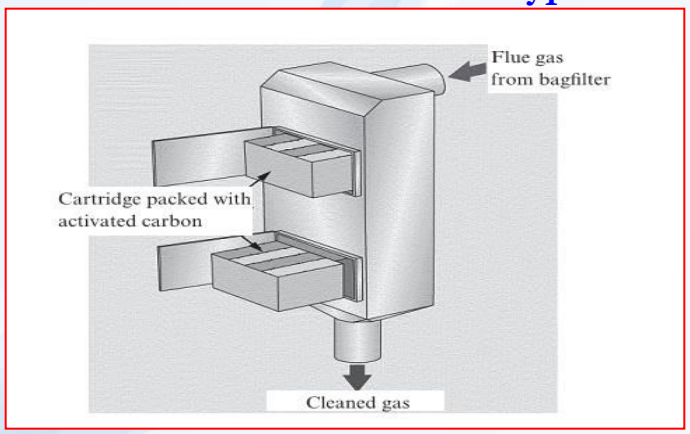


Fig. 1: Activated carbon adsorber

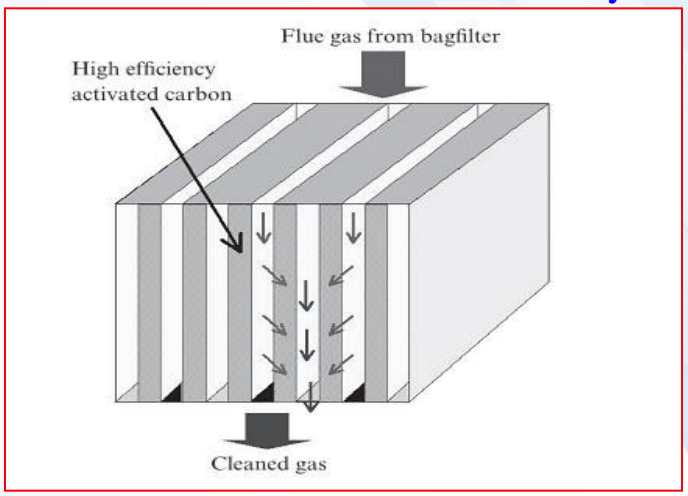


Fig. 2: Cartridge packed with activated carbon

RECETOX, Masaryk University / SUEZ

Research centre
for toxic compounds
in the environment

Mercury problem in Spolana Neratovice

History

- Industrial area – Spolana Neratovice – 1898
- Amalgam electrolysis - 1948

Sixties

- Production of OCPs – component of Agent Orange
- Chlorine production

Results

- Serious ills of employees
- Site contamination (POPs, Hg, Cl compounds..)

POPs problems in Spolana - Ghost of the past

Spolana Neratovice

- 1961 – production of HCHs (13% γ) → pesticides + production of TrCBz → production of TeCBz and HCB
- HCB → pentachlorophenolate Na → PeCP
- TeCBz → trichlorophenolate Na → 245-T → Agent Orange
- High contents of PCDDs/Fs

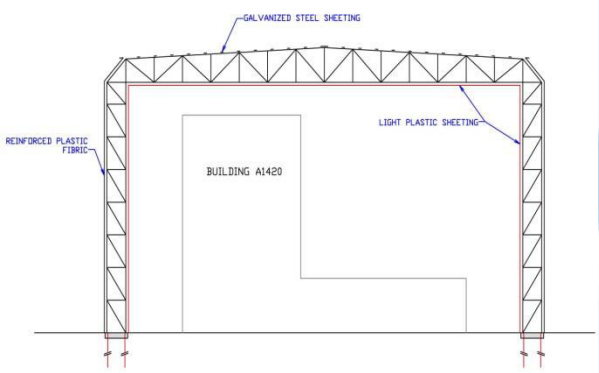
Floods 2002

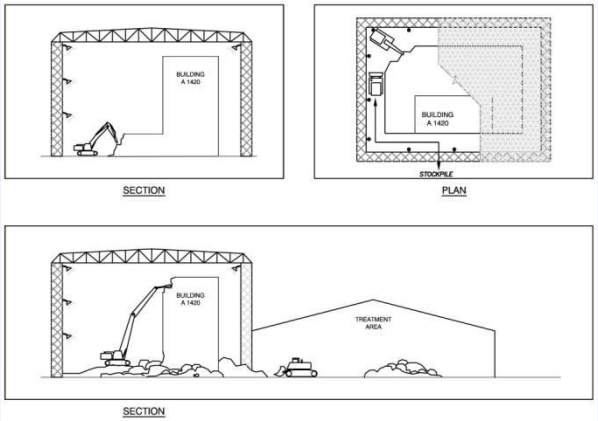
In 2001, the activities concerning to the decontamination and decommission production building operations contaminated with dioxins and mercury.

In August 2002, during the catastrophic floods affecting the lower basin of the Vltava and Elbe Spolana site was inundated by overflowing Labe.

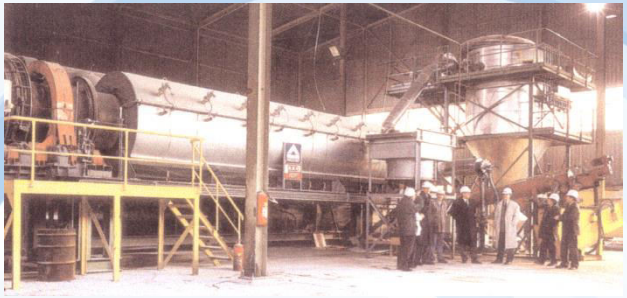
Spolana Neratovice – example of non-combustion technology application

Decontamination/demolition

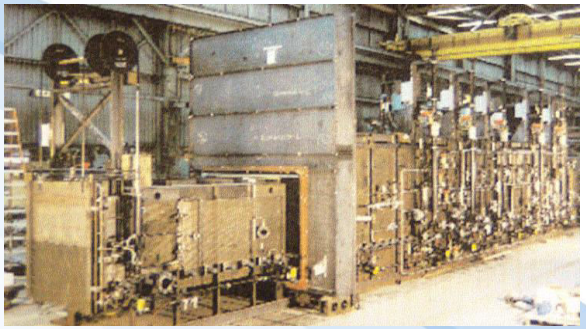




Indirect thermal desorption



Metal part furnace



Mercury waste in Spolana Neratovice









Disposal of old amalgam wastes

Waste from old amalgam electrolysis Spolana were weighed incinerator SPOVO Ostrava during the years 2010 - 2012.

For disposal of these waste the combustion part consists of a rotary kiln and secondary combustion chamber where the wastes are removed at 1 100 - 1 200 °C, was used.

Noncombustible leaving the rest in the form of slag.

Technology conditions

Providing the necessary combustion temperature during start, operation, and shutdown is achieved by additional gas burners.

Secondary afterburner chamber with a retention time of about 2 s to ensure total destruction of highly stable hazardous substances (eg. PCBs, CFCs).

Cleaning flue gas - a set of several technics allowing to remove pollutants from flue gases - electrostatic precipitator, two-stage wet scrubbing, dioxin filter, DeNOx catalyst.

Technology modifications

System to reduce dust – scrubber

Existing absorbent (activated carbon) - a new type TH90G, a large specific surface area for capturing mercury.

Modifications in connection with the disposal of mercury waste

Neutralization and precipitation of waste water – precipitant - sodium sulfid

Injection of hydrogen peroxide to the acidic flue gas cleaning to promote oxidation of residual mercury in metallic form on ionic form, which can be effectively captured in the scrubbing liquid - water.

Technology modifications

Existing absorbent (activated carbon) - a new type TH90G, a large specific surface area for capturing mercury.

Modifications in connection with the disposal of mercury waste

Neutralization and precipitation of waste water – precipitant - sodium sulfid

Technology modifications

Sorbent with PCDDs/Fs and Hg

Combustion

Hg(0) during the combustion with Cl-OCs is transfered to ionic form ($Hg^{(+/2+)}$)

Scrubbing in acidic gas scrubber

Waste water with Hg – precipitation to unsoluble sulphide

Drainage on the filter press

Landfill of hazardous wastes

Control measurements

For monitoring of mercury content in the working environment and in different parts of the technology was acquired portable spectrometer VM 3000 (Mercury Instruments GmbH Analytical Technologies).

Beyond the obligations arising from legislation was also taken to the incinerator continuous monitoring of mercury emissions in the SM-3 (Mercury Instruments GmbH Analytical Technologies) located in the highest part of the incinerator with the output directly into the incinerator control room.

Material characterisation

Wastes were, according to the load mercury content, divided into two groups, namely waste and bulk piece with the different content of mercury.

Overall, therefore, in the material contained an estimated 3 963 kg Hg, 6.5 g I-TEQ of 2,3,7,8-TCDD and about 30 kg of PCBs.

SPOVO technology without issue warrants listed POPs disposal, if we start from the above it can be assumed that up to around 3 600 kg Hg would be left in the form of vapor into the separator device, which must be captured.

Operational conditions

On the basis of the operating parameters of a hazardous waste incinerator SPOVO can assume that the device is completely satisfactory for the decomposition of the material present in the reporting of persistent organic pollutants.

Likewise, it is reasonable to assume that the mercury present will largely transferred to the gas phase and its disposal sufficient decides the effectiveness of cleaning of the incinerator.

Following these procedures can ensure appropriate disposal of such waste.

Continuous Hg measurements

- Putting into operation: 25/11/2011
- Type of the analyzer: VM 3000 (Mercury Instruments GmbH Analytical Technologies)
- Values per day: 1 440
- Hg emission limit: 0.05 mg Nm^{-3}
- Permitted quantity of Hg soil to be incinerated (IPPC): 0 – 350 kg hr^{-1}
- Evaluation period : 1 – 17 December 2011

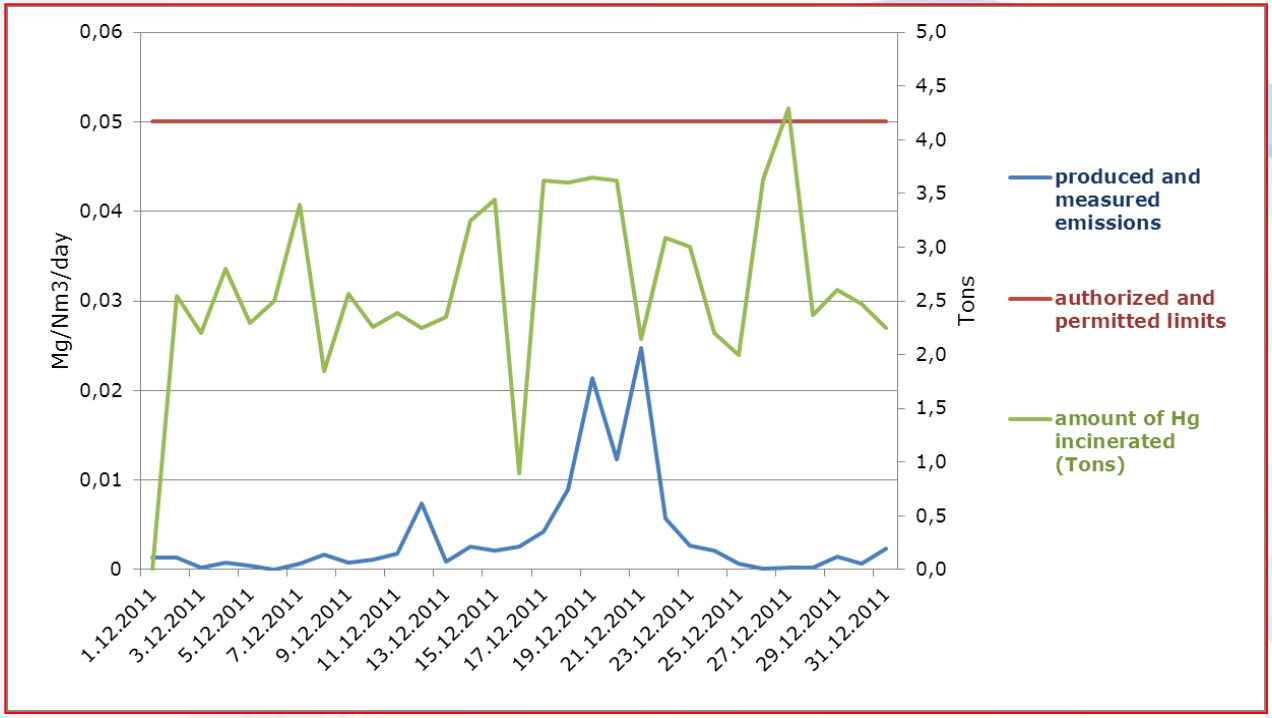
Data to be assessed (the chart)

- Wastes from the Spolana remediation project were incinerated in that period.

Quantities:

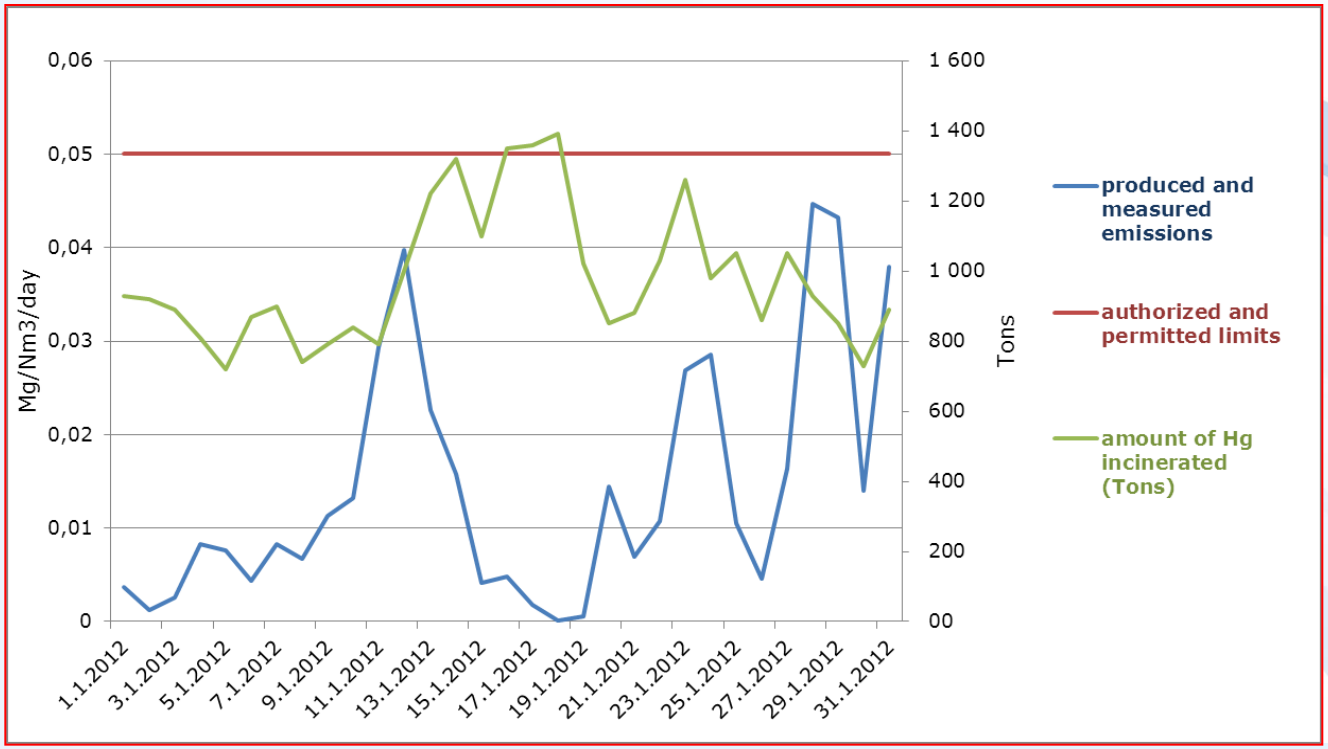
- 1 - 10 December: 60 kg hr^{-1}
- 11 - 17 December: 120 kg hr^{-1}
- Daily data (1 440) from the continuous analyser are processed to give a single average value
- The maximum daily limit for discharge of emissions into the air is 0.05 mg Nm^{-3}

Evaluation of SPOVO Continuous Hg measurements



- Type of Analyzer: SM 3
- Maximum Hg emission limit: 0.05 mg Nm^{-3} day^{-1}
- Evaluated period: December 2011
- Treated quantity: 81.6 t $month^{-1}$
- Conclusion: respected permitted limits, none disconformities

Evaluation of SPOVO Continuous Hg measurements



- Type of Analyzer: SM 3
- Maximum Hg emission limit: 0.05 mg Nm^{-3} day^{-1}
- Evaluated period: January 2012
- Treated quantity: 30.32 t $month^{-1}$
- Conclusion: respected permitted limits, none disconformities

Conclusion and assessment

In that period, the emission limits were within the specification with a sufficient reserve.

The average value was below 0.01 mg Nm^{-3} this being by 80 per cent less than the permitted limit.

On the basis of the operating parameters of a hazardous waste incinerator SPOVO can assume that the device is completely satisfactory for the decomposition of the material present in the reporting of persistent organic pollutants.

Conclusion and assessment

Likewise, it is reasonable to assume that the mercury present will largely transferred to the gas phase and its disposal sufficient decides the effectiveness of cleaning of the incinerator.

The collection efficiency regulation is necessary conditions on filters and it is necessary to choose the optimal temperature to capture gaseous Hg was the most effective and appropriate quantity and characteristics of dosing (sorbent) activated carbon.

It is also possible to use suitable oxidation catalysts.

Teşekkür Ederim