C6890 Technologie ochrany prostředí

2. Vývoj přístupů k technologii OŽP

Ivan Holoubek

RECETOX, Masaryk University, Brno, CR

holoubek@recetox.muni.cz; http://recetox.muni.cz

evropský sociální fond v ČR

EVROPSKÁ UNIE

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

OP Vzdělávání pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Sylabus přednášky

Č	Název přednášky	Obsah přednášky	
1	Historie ochrany životního prostředí	Vývoj ochrany ŽP od dávnověku do současnosti. Vývoj prevenčního přístupu, USV	ZH 11.10.
2	Vývoj přístupů k technologii OŽP Technologie čistění spalin I.	Srovnání vývoje, BAT, BREF Hlavní technologie znečisťující ovzduší (tabulkový přehled), legislativa	IH 27.9.
3	Technologie čistění spalin II.	Technologie čistění spalin – odsiřování, denitrifikace, odlučování tuhých částic, úprava paliv. Moderní trendy.	IH 25.10.

Sylabus přednášky

Č	Název přednášky	Obsah přednášky	
4	Úprava a čistění vod Odpadové hospodářství	Hlavní technologie znečisťující vody (tabulkový přehled), legislativa Hlavní technologie produkující odpady (tabulkový přehled), legislativa	IH 27.9.
5	Úprava a čistění vod z měst a obcí	Úprava vody pro pitné účely, ČOV pro velké aglomerace (mechanický, chemický, biologický stupeň), malé ČOV, kalové hospodářství	ZH 22.11.
6	Úprava a čistění vod pro průmyslové a speciální účely	Dialýza, reverzní osmóza, membránová filtrace, iontoměničové postupy. Moderní trendy.	ZH 22.11.

Sylabus přednášky

Č	Název přednášky	Obsah přednášky	
7	Exkurze do úpravny vody a ČOV v Brně		ZH 13.12.
8	Tok odpadů	Původci odpadů, flow stream, sběr a svoz odpadů, předúprava odpadů	ZH 11.10.
9	Technologie odpadového hospodářství	Skládkování, spalování, stabilizace, technologie pro BRO, linky pro kapalné odpady	ZH 8.11.
10	Nespalovací technologie pro likvidaci nebezpečných odpadů	Chemické a fyzikálně-chemické nespalovací technologie pro likvidaci persistentních, nebezpečných látek a odpadů s těmito látkami, srovnání se spalovacími technologiemi	IH 25.10.

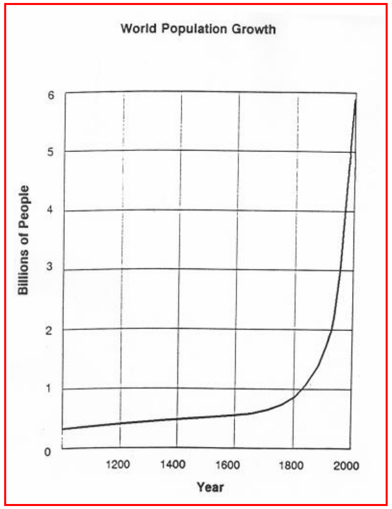
Sylabus přednášky

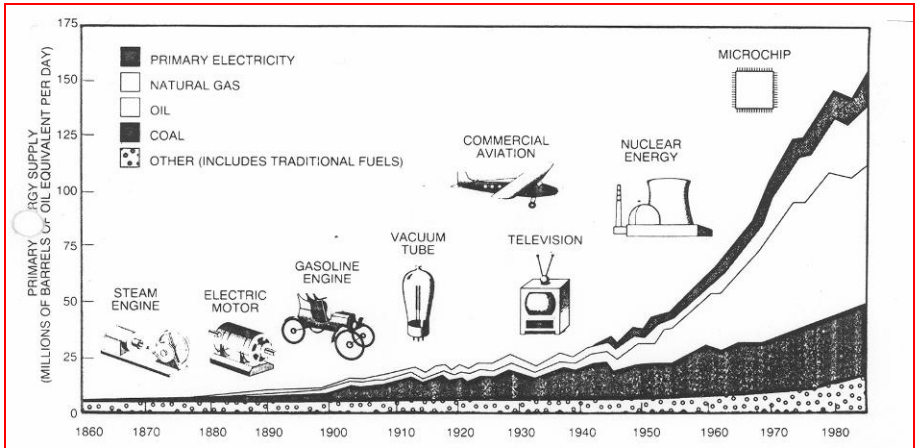
Č	Název přednášky	Obsah přednášky	
11	Speciální techniky v odpadovém hospodářství	Sanace, havarijní připravenost, recyklace a využití odpadů, řešení speciálních druhů odpadů	ZH 8.11.
12	Moderní trendy v odpadovém hospodářství	Očekávaný vývoj v oblasti odpadového hospodářství, materiálové a energetické využití odpadů	ZH 6.12.
13	Exkurze do logistického centra a kompostárny v Brně		ZH 13.12.

Sylabus přednášky

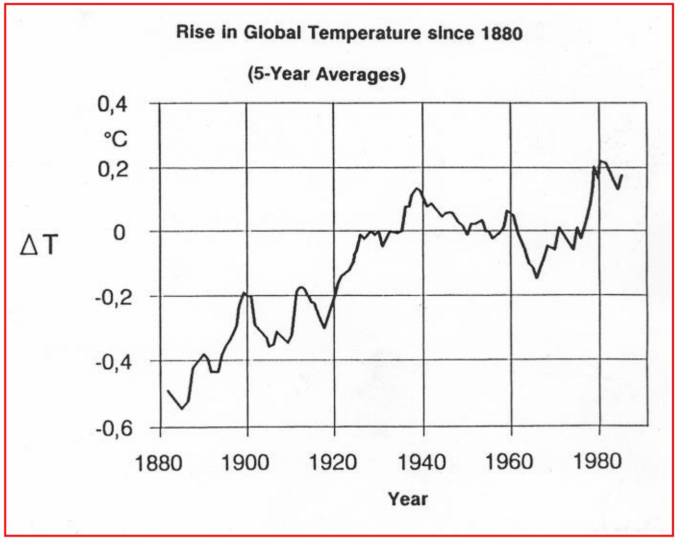
Č	Název přednášky	Obsah přednášky	
1	Vývoj přístupů k technologii OŽP	Srovnání vývoje, BAT, BREF Hlavní technologie znečisťující ovzduší (tabulkový přehled), legislativa Hlavní technologie znečisťující vody (tabulkový přehled), legislativa Hlavní technologie produkující odpady (tabulkový přehled), legislativa	

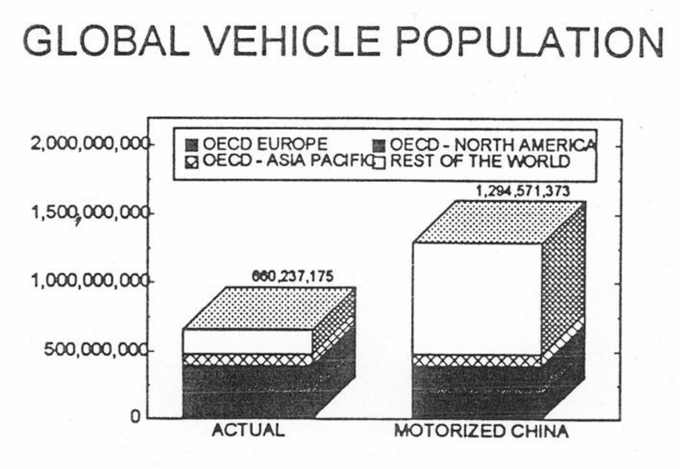
Globální důsledky znečištění prostředí





RATE OF PRIMARY ENERGY USE and the relative contributions of different sources reflect the evolution of technology as well as the growth of the human population. The rapid rise of oil after World War II, for example, is indicative of the rise of mass transportation and industry. Similarly, the growth of electricity in the late 1960's parallels the rise of a services-oriented economy. Although fossil fuels still dominate the primary energy supply, coal's share peaked around 1920, when it provided more than 70 percent of all the fuel consumed; oil's share peaked in the early 1970's at slightly more than 40 percent. Natural gas, which is less polluting than either oil or coal, is expected to contribute more to global energy use.





Globální produkce

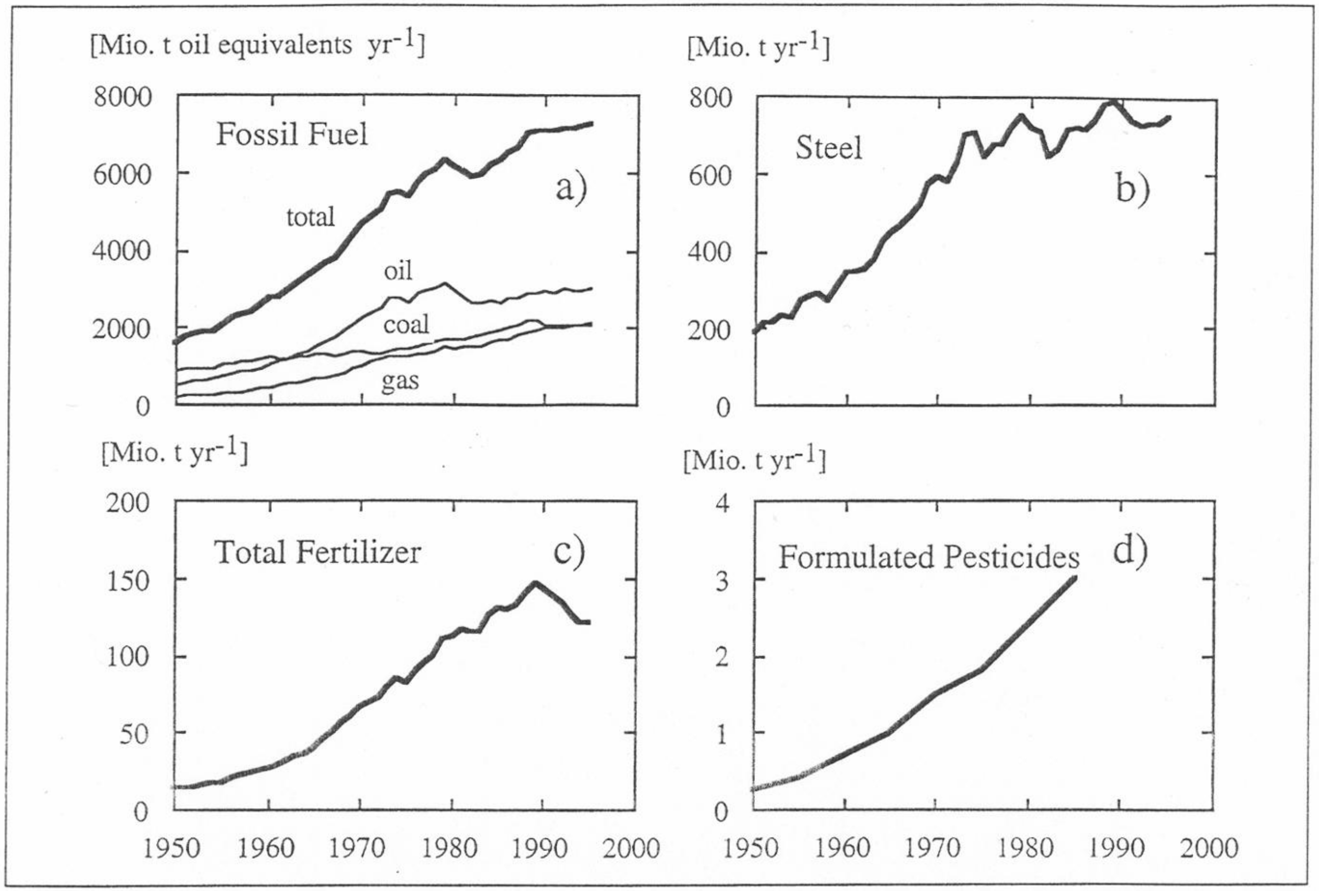


Fig. 2. *Global trends of fossil-fuel consumption and production of steel, total fertilizer and pesticides* [1]

Globální důsledky

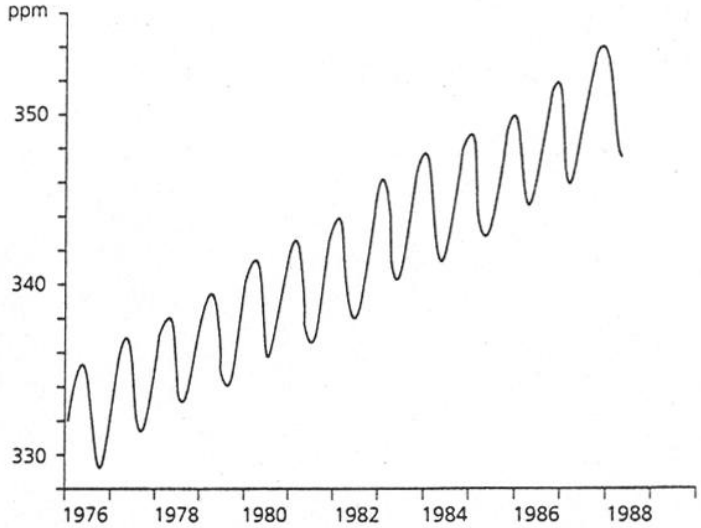


Figure 7.14 Rising levels of carbon dioxide in the air over Mauna Loa observatory, Hawaii, 1976–1988. The graph shows a strong seasonal pattern superimposed on a steadily rising background level of carbon dioxide at this site far removed from industrial sources of air pollution. After page 1 in Natural Environment Research Council (1989) Oceans and the global carbon cycle. *NERC, Swindon*

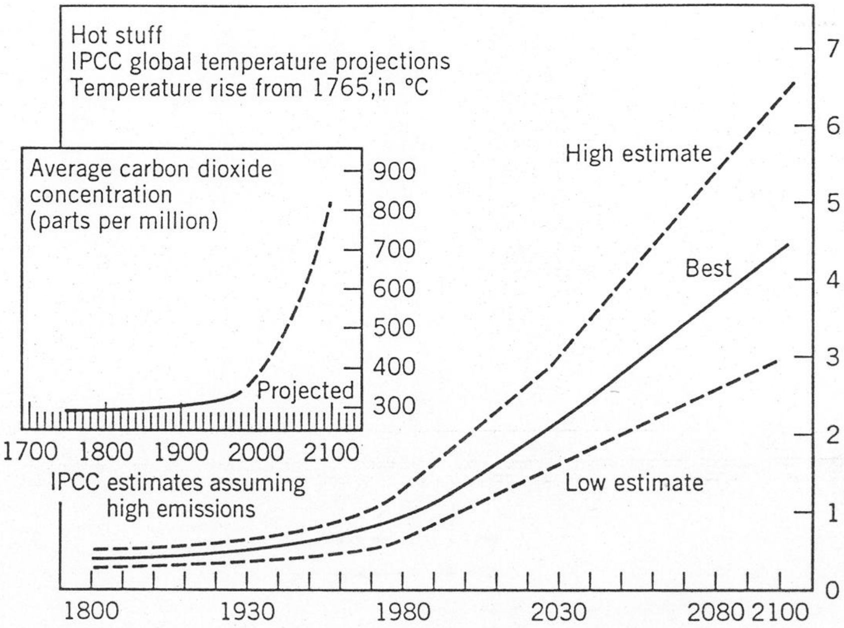


Figure 3.6 CO_2 levels in the atmosphere from the eighteenth to the twenty-first centuries. Projections beyond 1990 are based on computer models of an Intergovernmental Panel on Climate Change, using different estimates for the effects of cloud cover. (From *The Economist*, May 26, 1990, p. 93.)

Globální antropogenní cyklus

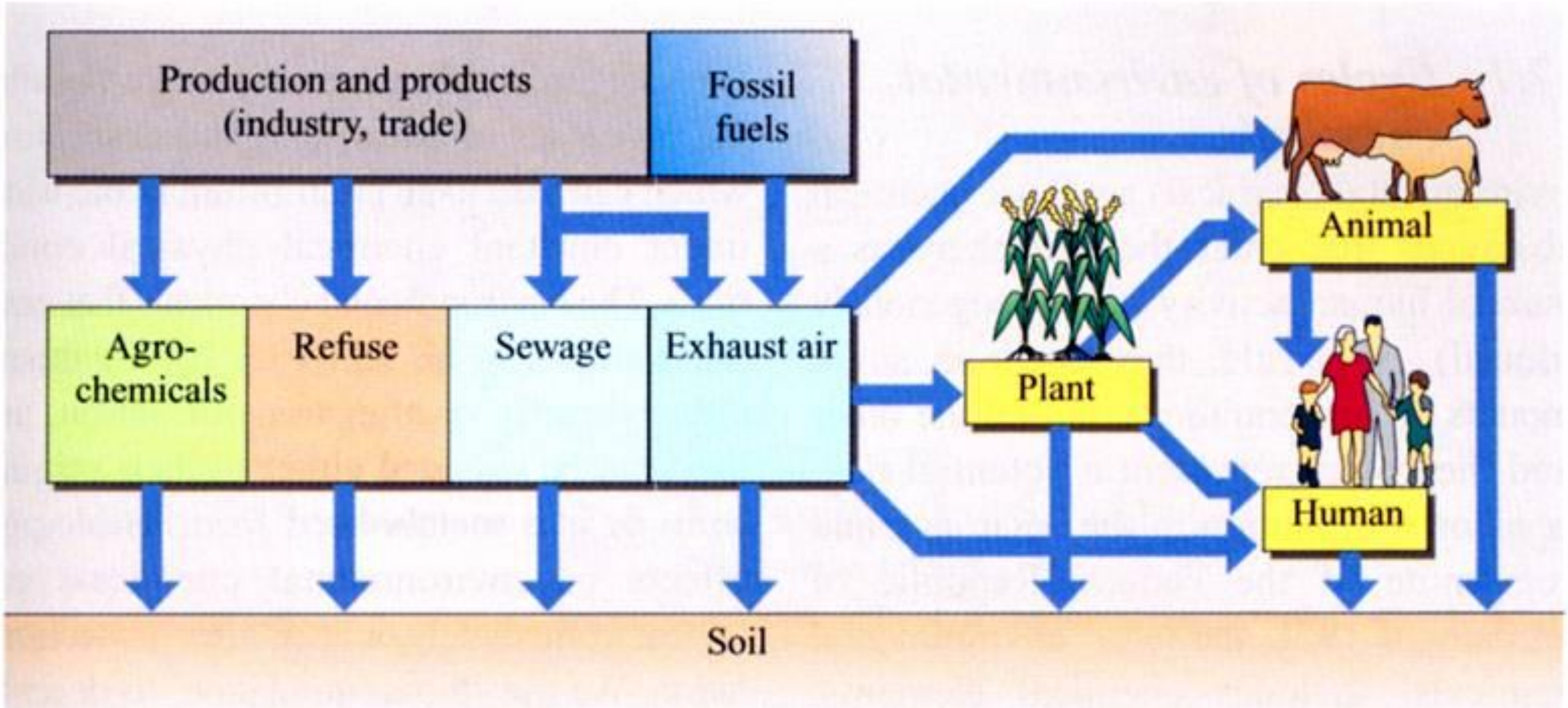


Figure 1.6.1 The global anthropogenous cycle

Hodnocení dopadu antropogenních činností

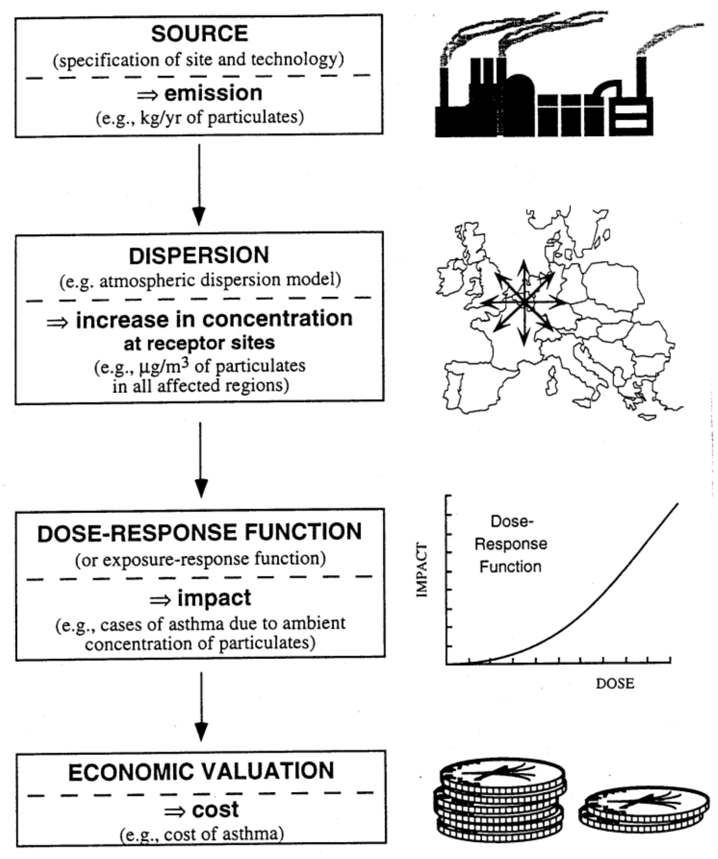
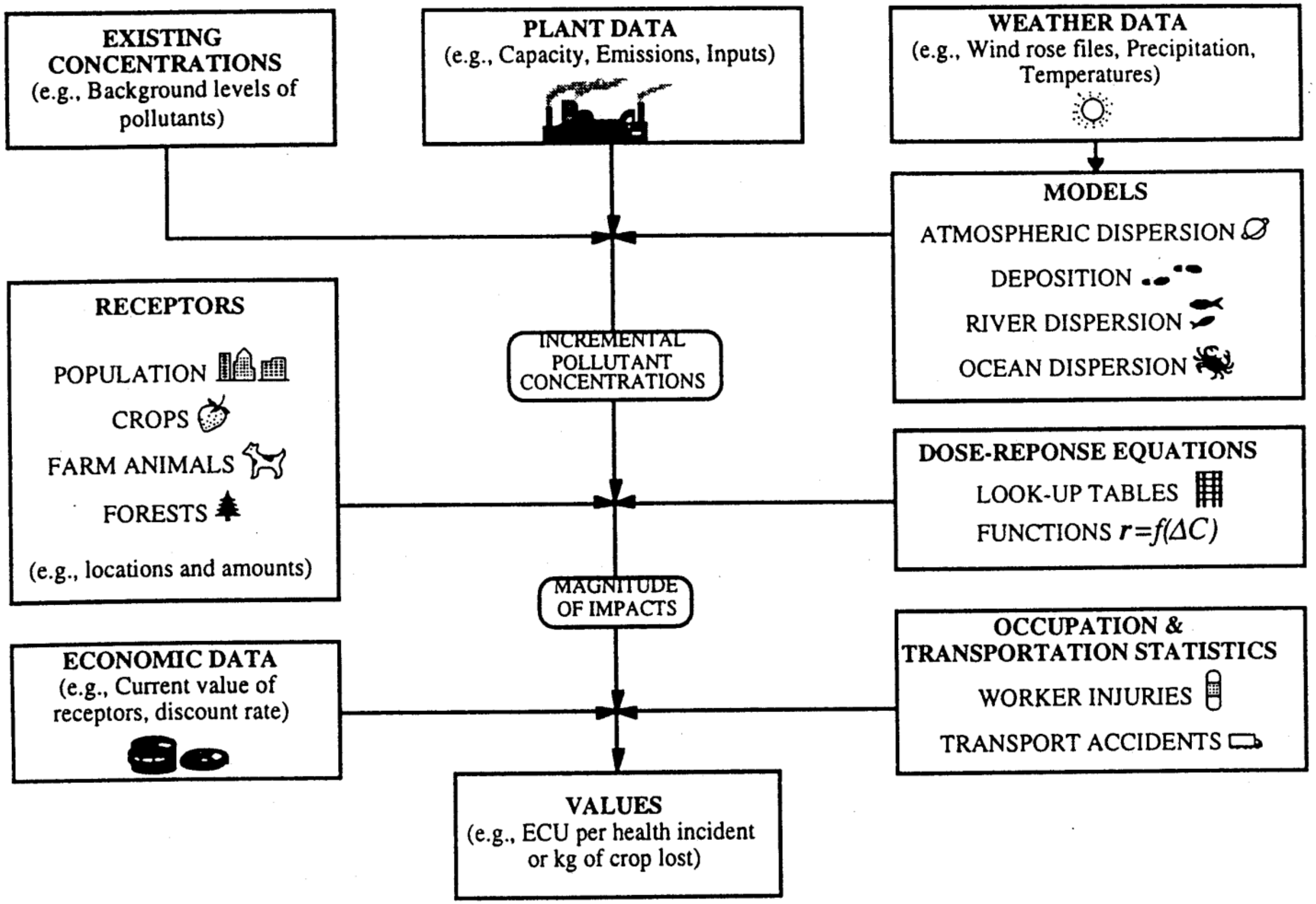


Fig.2.1. The main steps of the impact pathways methodology.
Impacts and costs are summed over the receptors of concern (e.g., total population).

Hodnocení dopadu antropogenních činností



Overview of data requirements for fuel cycle analysis.

Sound management of POPs by-products

Sound management of POPs by-products
= sound management of their release sources
PROCESS SPECIFIC MANAGEMENT

Basic possible approaches:

- **Alternatives (alternatives with similar usefulness but avoiding POPs releases)**
- **Primary measures (targeted onto the process-BAT, BEP, cleaner technologies)**
- **Secondary measures (end-of-pipe- BAC**
- **Management of releases targeted to a particular pollutant will influence releases of other pollutants**

BAT/BEP- available guidance

- In the Stockholm Convention
  - Annex C: General guidance on prevention and release reduction measures
  - Guidelines on BAT/BEP: Draft guidelines available at http://www.pops.int/documents/meetings/bat_bep
  - UNEP Toolkit (overview of technologies from obsolete to BAT)
- In the UNECE CLRTAP POPs Protocol
  - Annex V: BAT to control emissions of POPs from major stationary sources

  http://www.unece.org/env/lrtap
- EU/ BAT Reference Documents (BREF)

  http://eippcb.jrc.es

BAT/BEP - Definitions

Best available techniques (BAT)

means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for release limitations designed to prevent and, where that is not practicable, generally to reduce releases of chemicals listed in Part I of Annex C and their impact on the environment as a whole. In this regard:

BAT/BEP - Definitions

- **Techniques** includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

- **Available** techniques means those techniques that are accessible to the operator and that are developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; and

- **Best** means most effective in achieving a high general level of protection of the environment as a whole;

BAT/BEP - Definitions

Best environmental practices (BEP)

means the application of the most appropriate combination of environmental control measures and strategies

The concept of best available techniques is not aimed at the prescription of any specific technique or technology, but at taking into account the technical characteristics of the installation concerned, *its geographical location and the local environmental conditions*

Stockholm Convention, Article 5 paragraph (f)

Stockholm Convention, Annex C, Part V, section B.

Economic and social implications

- Economic and social conditions in a country will determine what are "best" available techniques and "best" environmental practices

- Large scale processes (cement kilns, sinter plants, power plants…) BAT/BEP will be similar world-wide

- Small scale processes (crematoria, home heating/cooking, motor vehicles, waste burning…) technologies vary from country to country

- Determining what is "BAT/BEP" needs to include analysis of economic feasibility

"Best" = best option that is economically feasible under the socio-economic conditions present

Timetable for POPs by-products

- Establish an action plan within 2 years after entry into force of the Convention for the Party;
- A review of the strategies in the action plan to achieve the goals every 5 years;
- Phase in the requirements of BAT identified for new sources as soon as possible but not later than 4 years after entry into force
- These dates are part of the Convention and not negotiable
- Linkage to Article 7 on National Implementation Plans

Environmental management - general principles

- Sustainable development
- Sustainable consumption

- Development and implementation of environmental management systems
- Precautionary approach
- Internalizing environmental costs and polluter pays
- Pollution prevention
- Integrated pollution prevention and control
- Co-benefits of controlling other pollutants
- Cleaner production
- Life cycle analysis and management

Proposed requirements for sound disposal of POPs

Destruction and/or irreversible transformation of POPs wastes must achieve a destruction efficiency (DE)/ destruction and removal efficiency (DRE) of 99.9999%

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CONVENTION ON THE CONTROL OF
TRANSBOUNDARY MOVEMENTS OF
HAZARDOUS WASTES AND
THEIR DISPOSAL
First session
Geneva, 28 April to 2 May 2003

Item 5 (d) of the provisional agenda*

DRAFT TECHNICAL GUIDELINES ON THE ENVIRONMENTALLY SOUND
MANAGEMENT OF PERSISTENT ORGANIC POLLUTANTS AS WASTES

POPs formation mechanisms

Understanding the POPs formation mechanisms is a key to sound unintended POPs by-product management:

- **Gas phase formation from precursors at T= 300 – 800 °C (rearrangement, de-chlorination, free-radical condensation...)**
- **Solid-phase de-novo synthesis at T=200 – 500 °C (residual carbon, HCl, O_2, H_2O, metals)**
- **Undestroyed "pass through" POPs originally in the raw material (due to inefficient combustion)**

Management of releases targeted to reduction of CO and particulate matter releases will reduce also POPs releases

Key considerations to manage POPs by-products

- Good burning conditions (3t-temperature, time, turbulence; oxygen …) result in minimum PIC, hence low CO and POPs releases ⇨ improve burning conditions
- Preventing of de-novo synthesis ⇨ avoid reformation window 200 - 500 °C
- POPs do adsorb in the flue gas on the surface of solid particles with preference of the smallest fraction ⇨ dust removal
- POPs are micro-contaminants; reducing macro-contaminants usually takes care also for POPs reduction ⇨ synergic effect of measures to control other pollutants

BAT/BEP Guidance

GUIDELINES ON BEST AVAILABLE TECHNIQUES AND PROVISIONAL GUIDANCE ON BEST ENVIRONMENTAL PRACTICES RELEVANT TO ARTICLE 5 AND ANNEX C OF THE STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS, DECEMBER 2006

HTTP://CHM.POPS.INT/PROGRAMMES/BAT/BEP/GUIDELINES/TABID/187/LANGUAGE/EN-US/DEFAULT.ASPX

BAT/BEP Guidance

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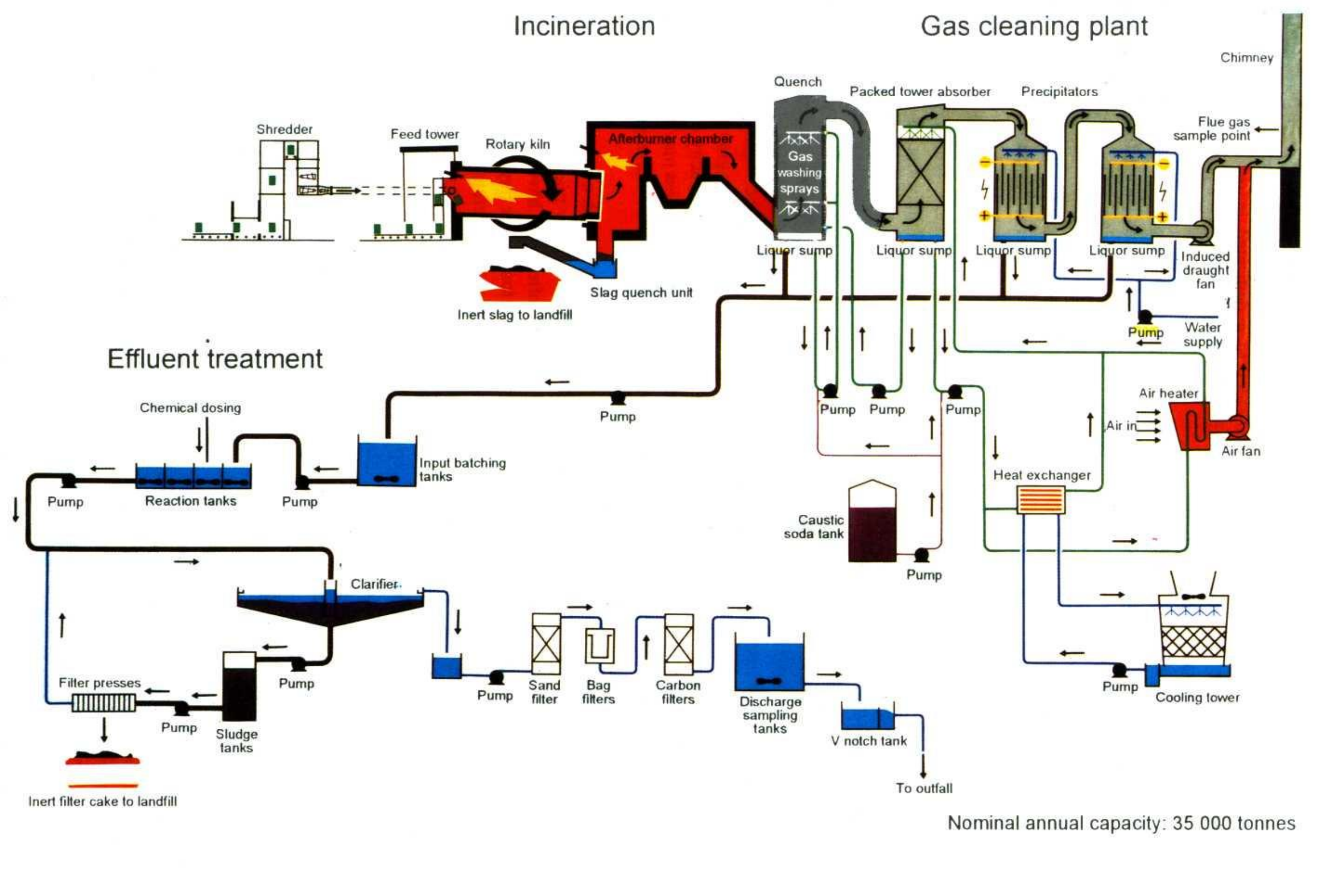
Waste incineration

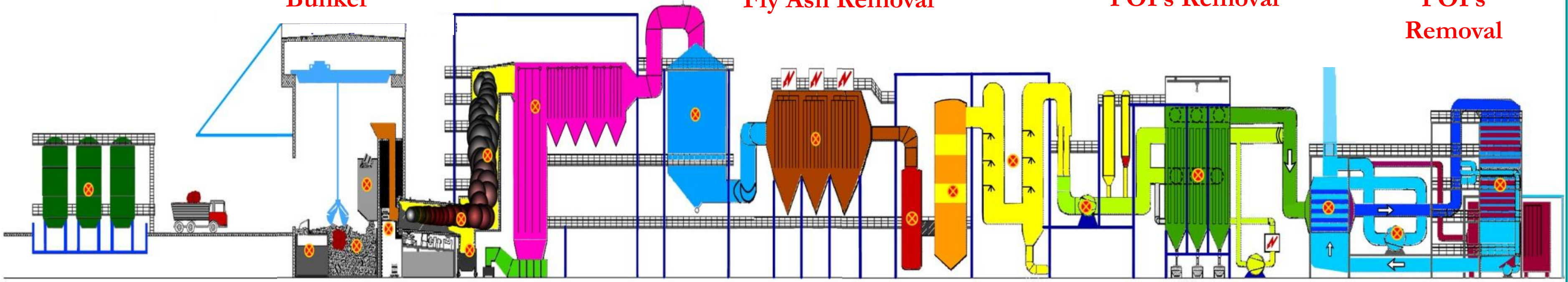
Municipal, hazardous solid waste and sewage sludge:

- **Alternatives: waste minimization including recovery, reuse, recycling, waste separation and cleaner technologies**
- **Purpose of waste incineration: volume reduction, energy recovery, destruction and minimization of hazardous constituents, disinfection, reuse of some residues**
- **BAT/BEP/BACT: prevent or minimize POPs releases, proper waste handling, ensure good combustion, avoid formation conditions, capturing POPs that are formed and handling residues appropriately**
- **Achievable performance levels: 0.1-0.1 ng TEQ.Nm^{-3}**

Hazardous waste incineration plant



Hazardous waste incineration plant



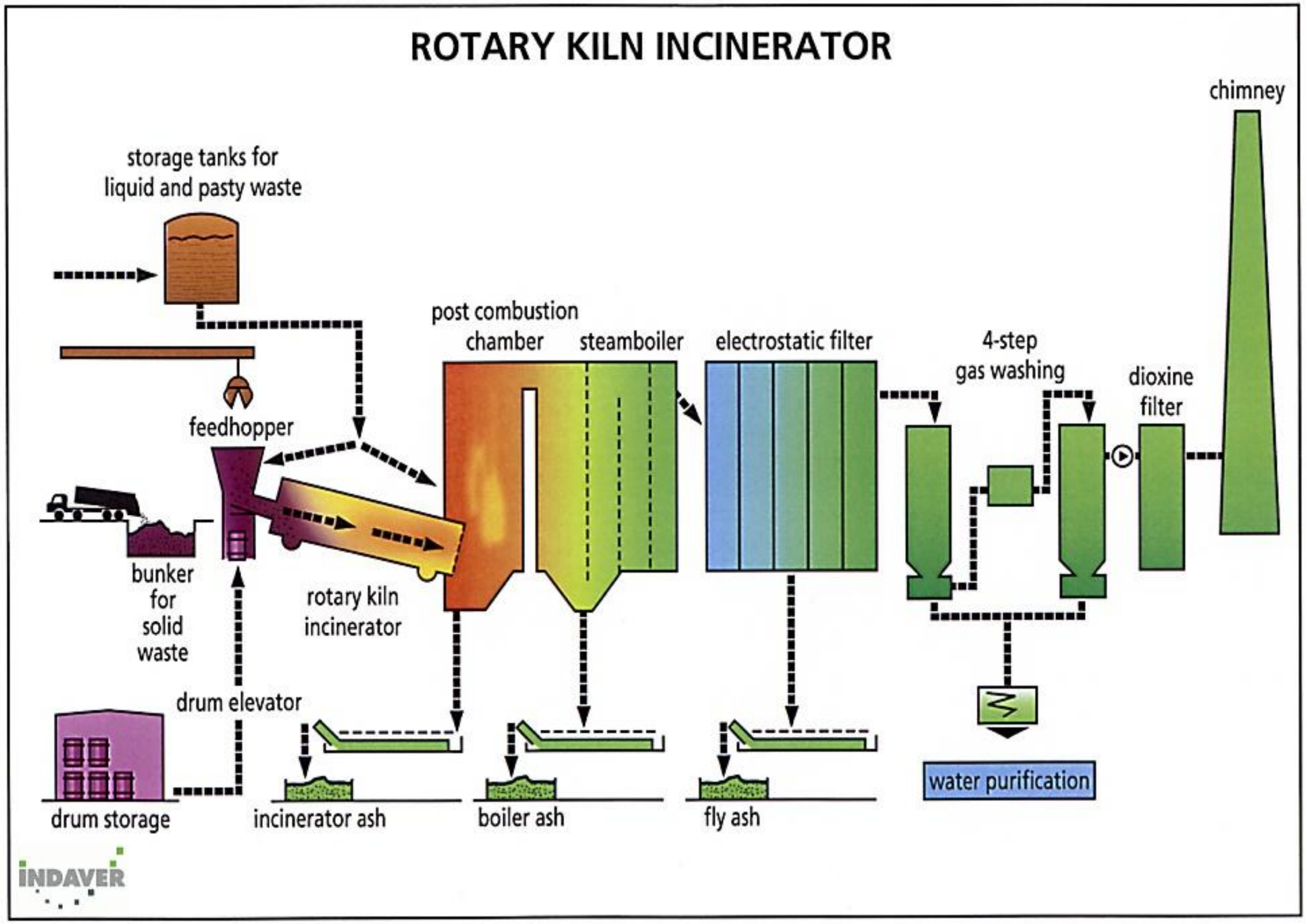
Rotary kiln: T ≥ 1 000 °C

Afterburner: T ≥ 1 200 °C

O_2 ≥ 6 % obj. (typical ~ 10 %vol.)

Multistage APCS including efficient POPs removal

Example of flue gas cleaning technology



Examples of APCD's relevant to the prevention or reduction of unintentional POPs releases

- Cyclones and multi-cyclones
- Electrostatic precipitators – wet, dry or condensation
- Fabric filters – including catalytic bag filters
- Static bed filters
- Scrubbing systems - wet, spray dry, or ionization
- Selective catalytic reduction (SCR)
- Rapid quenching systems
- Carbon adsorption

Dust removal

- **Mechanic separation**
  wet/dry (300 - 150 mg.m^{-3})
- **Electrostatic precipitation**
  dry/wet (5 - 25 mg.m^{-3})
- **Textile filters**
  mechanic/catalytic
  (less than 5 mg.m^{-3})

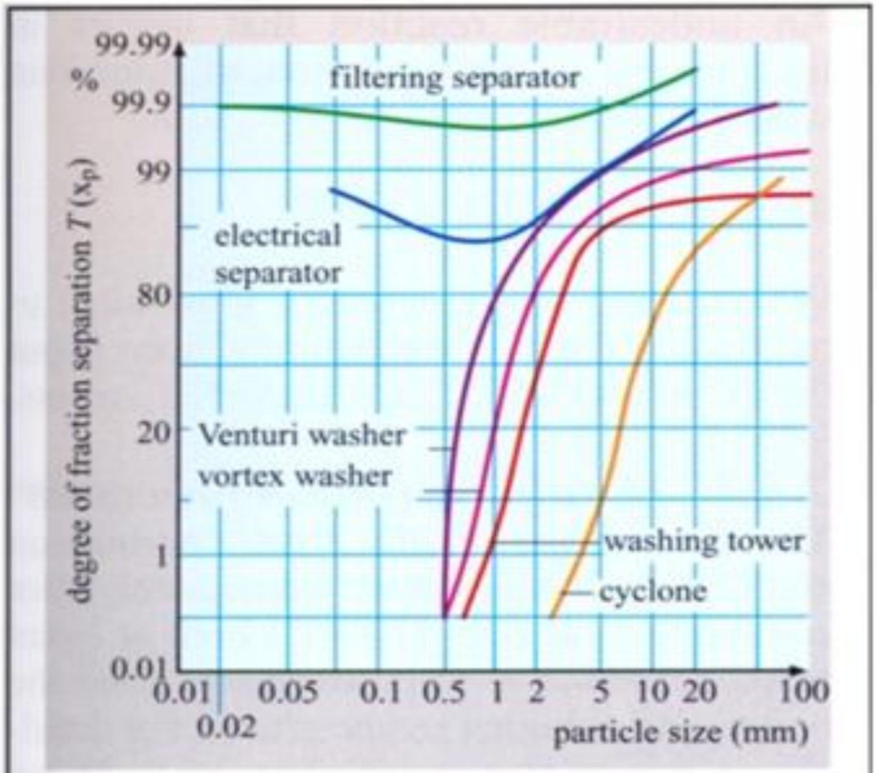


Figure 2.5.2 Comparison of different dust particle separation systems

Electrostatic precipitator principle

Unintentional POPs formation can occur within the ESP at temperatures in the range of 200 °C to about 450 °C.

Operating the ESP within this temperature range can lead to the formation of unintentional POPs in the combustion gases released from the stack.

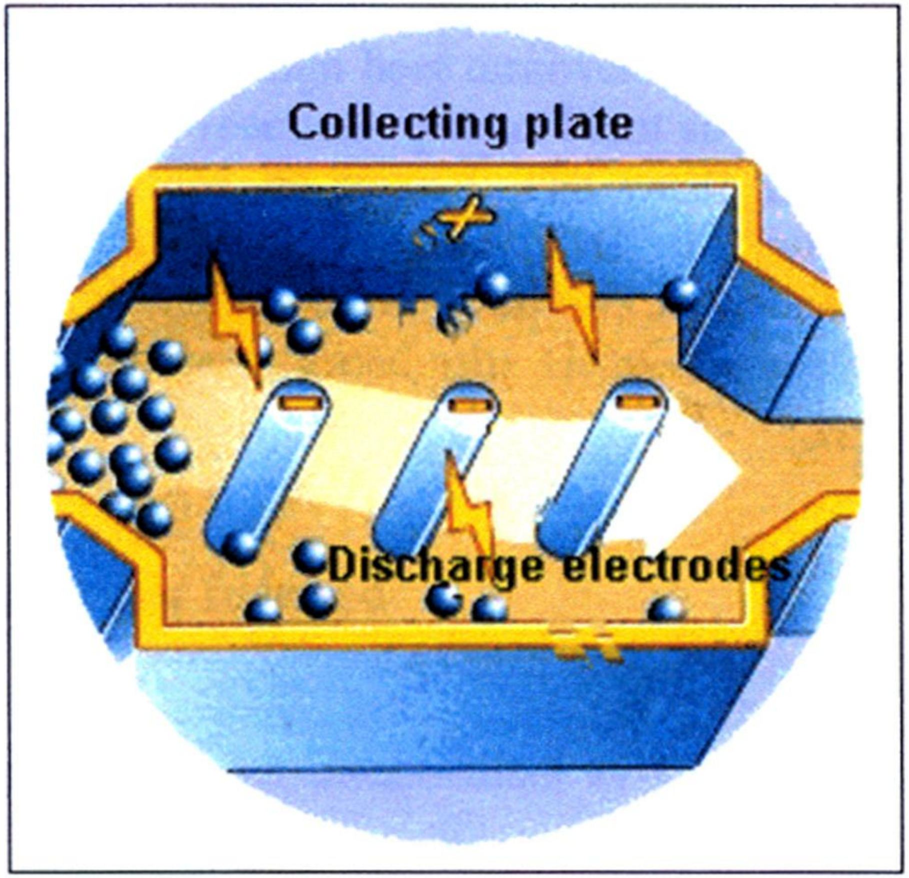


Figure 4.1 Electrostatic Precipitator Principle [source: EU BREF, 2004]

Best Environmental Practices for Waste Incineration

Well-maintained facilities, well-trained operators, a well-informed public, and constant attention to the process are all important factors in minimizing the formation and release of the unintentional POPs from the incineration of waste.

In addition, effective waste management strategies (*e.g.*, waste minimization, source separation, and recycling), by altering the volume and character of the incoming waste, can also significantly impact releases.

Waste Inspection and Characterization

Waste type	Techniques	Comments
Mixed municipal wastes	• visual inspection in bunker • spot checking of individual deliveries by separate off loading • weighing the waste as delivered • radioactive detection	Industrial and commercial loads may have elevated risks
Pre-treated municipal wastes and RDF	• visual inspection • periodic sampling and analysis for key properties/substances	
Hazardous wastes	• visual inspection • sampling/analysis of all bulk tankers • random checking of drummed loads • unpacking and checking of packaged loads • assessment of combustion parameters • blending tests on liquid wastes prior to storage • control of flash-point for wastes in the bunker • screening of waste input for elemental composition e.g. by EDXRF	Extensive and effective procedures are particularly important for this sector. Plants receiving mono-streams may be able to adopt more simplified procedures
Sewage sludges	• periodic sampling and analysis for key properties and substances • checking for stones/metal prior to drying stages • process control to adapt to sludge variation	

Proper Handling, Storage, and Pre-Treatment

Storage areas must be properly sealed with controlled drainage and weatherproofing.

Fire detection and control systems for these areas should be considered.

Storage and handling areas should be designed to prevent contamination of environmental media and to facilitate clean up in the event of spills or leakage.

Odors can be minimized by using bunker air for the combustion process.

Proper Handling, Storage, and Pre-Treatment

Waste type	Segregation techniques
Mixed municipal wastes	• segregation is not routinely applied unless various distinct waste streams are received when these can be mixed in the bunker • bulky items requiring pretreatment can be segregated • emergency segregation areas for rejected waste
Pre-treated municipal wastes and RDF	• segregation not routinely applied • emergency segregation areas for rejected waste
Hazardous wastes	• extensive procedures required to separate chemically incompatible materials (examples given as follows) • water from phosphides • water from isocyanates • water from alkaline metals • cyanide from acids • flammable materials from oxidising agents • maintain separation of pre-segregated packed delivered wastes
Sewage sludges	• wastes generally well mixed before delivery to plant • some industrial streams may be separately delivered and require segregation for blending

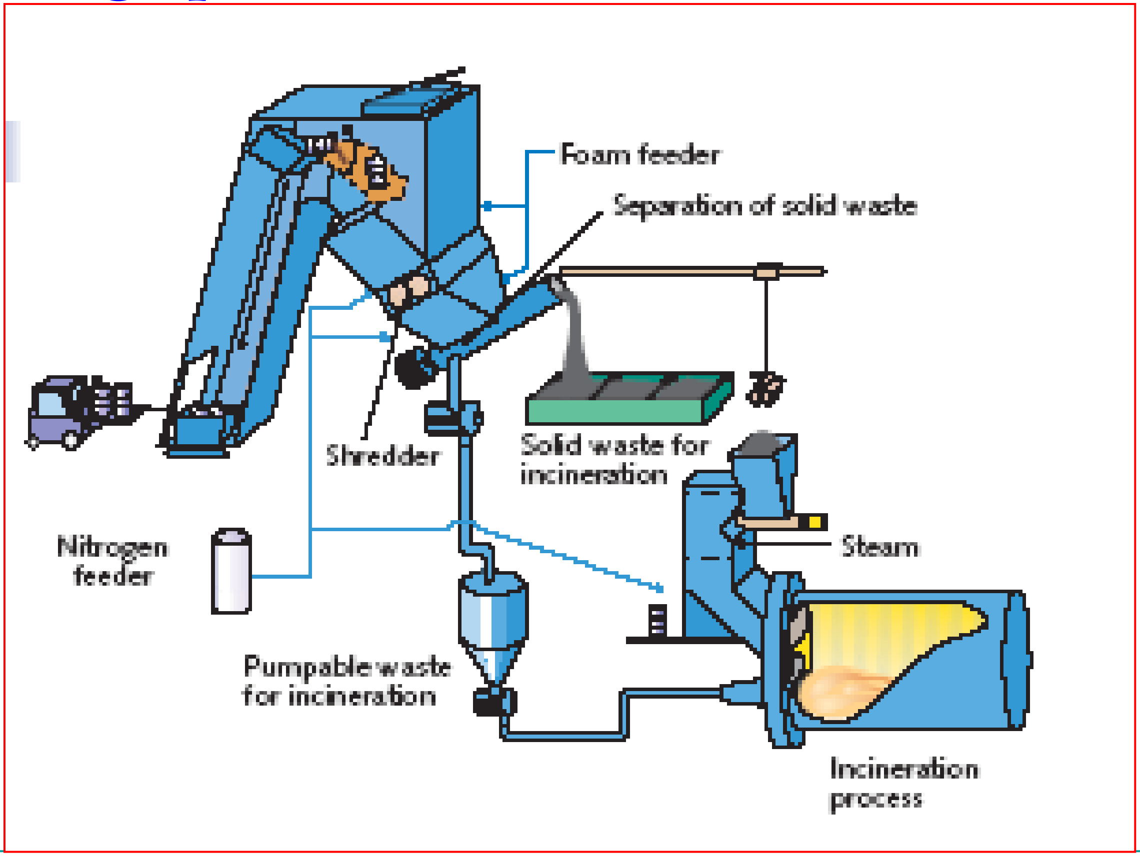
Minimizing Storage Times

Minimizing the storage period will help prevent putrefaction and unwanted reactions, as well as the deterioration of containers and labeling.

Managing deliveries and communicating with suppliers will help ensure that reasonable storage times are not exceeded.

Establishing Quality Requirements for Waste Fed

Facilities must be able to accurately predict the heating value and other attributes of the waste being combusted in order to ensure that the design parameters of the incinerator are being met.

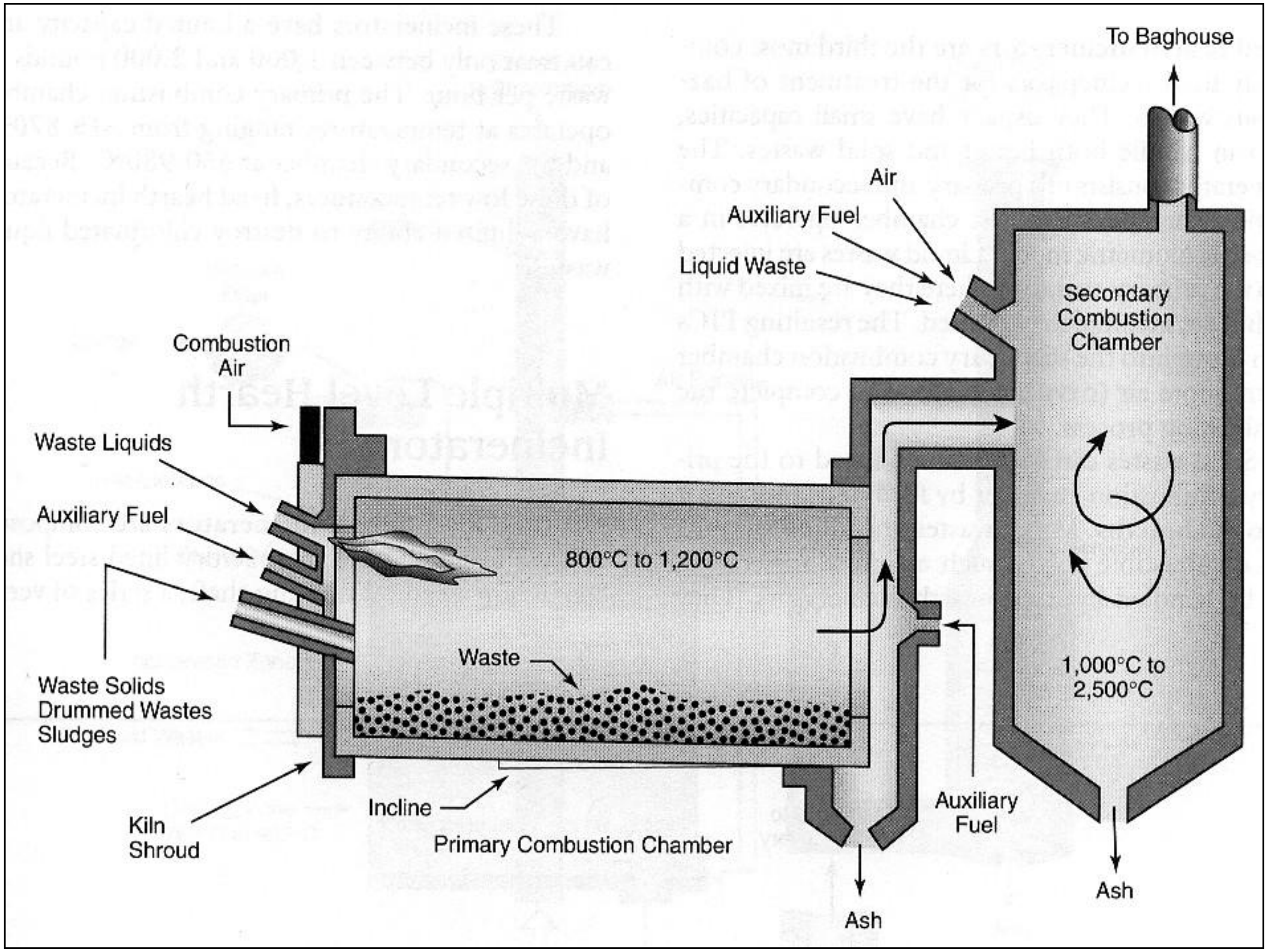


Monitoring

In addition to carbon monoxide, oxygen and NO_x in the flue gas, air flows and temperatures, pressure drops, and pH in the flue gas can be routinely monitored at reasonable cost.

While these measurements in some instances can represent reasonably good surrogates for the potential for unintentional POPs formation and release, periodic measurement of PCDDs/Fs in the flue gas will aid in ensuring that releases are minimized and the incinerator is operating properly.

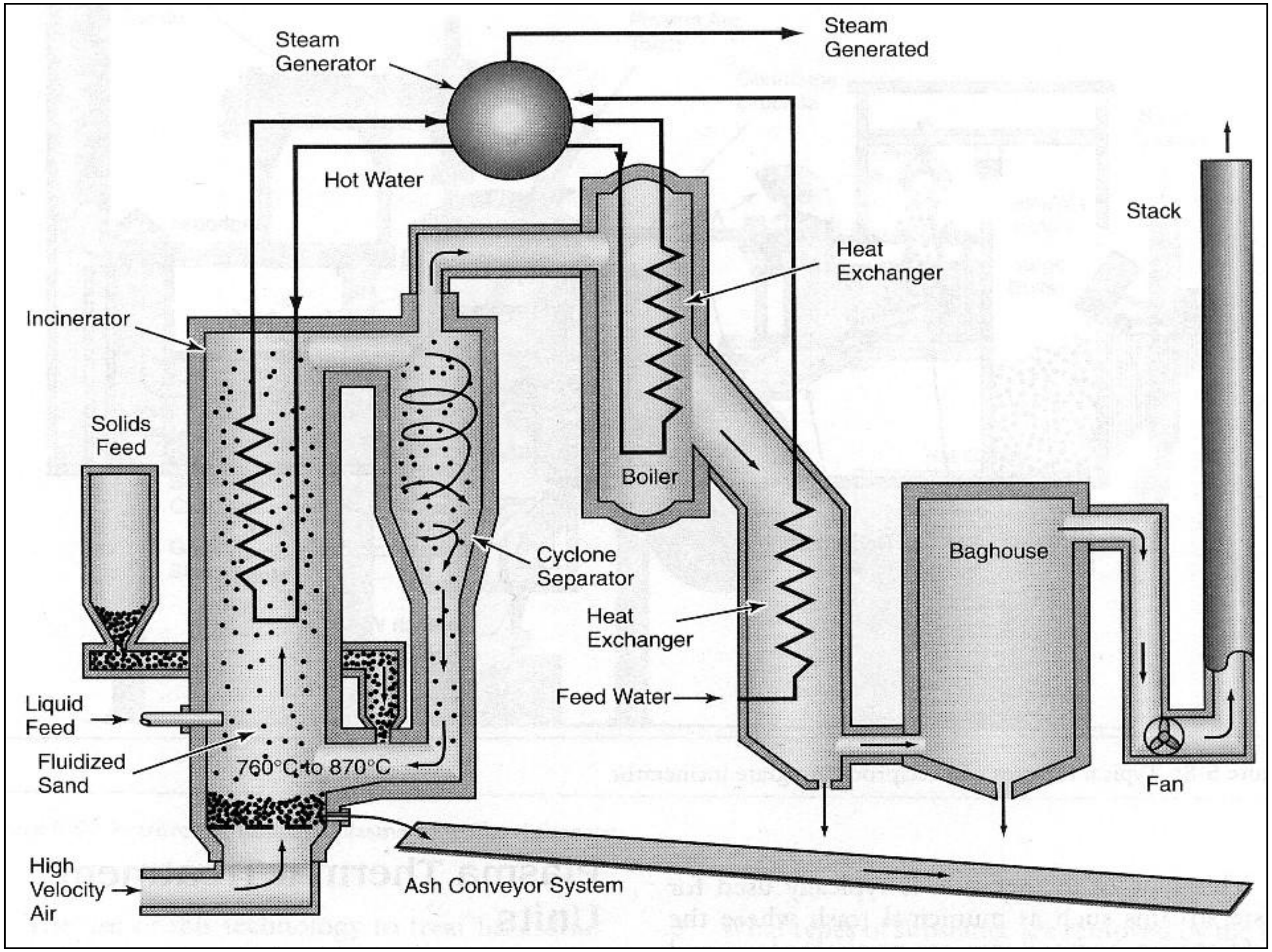
Rotary kiln incinerator



Operator training

Regular training of personnel is essential for proper operation of waste incinerators

Circulating fluidised bed

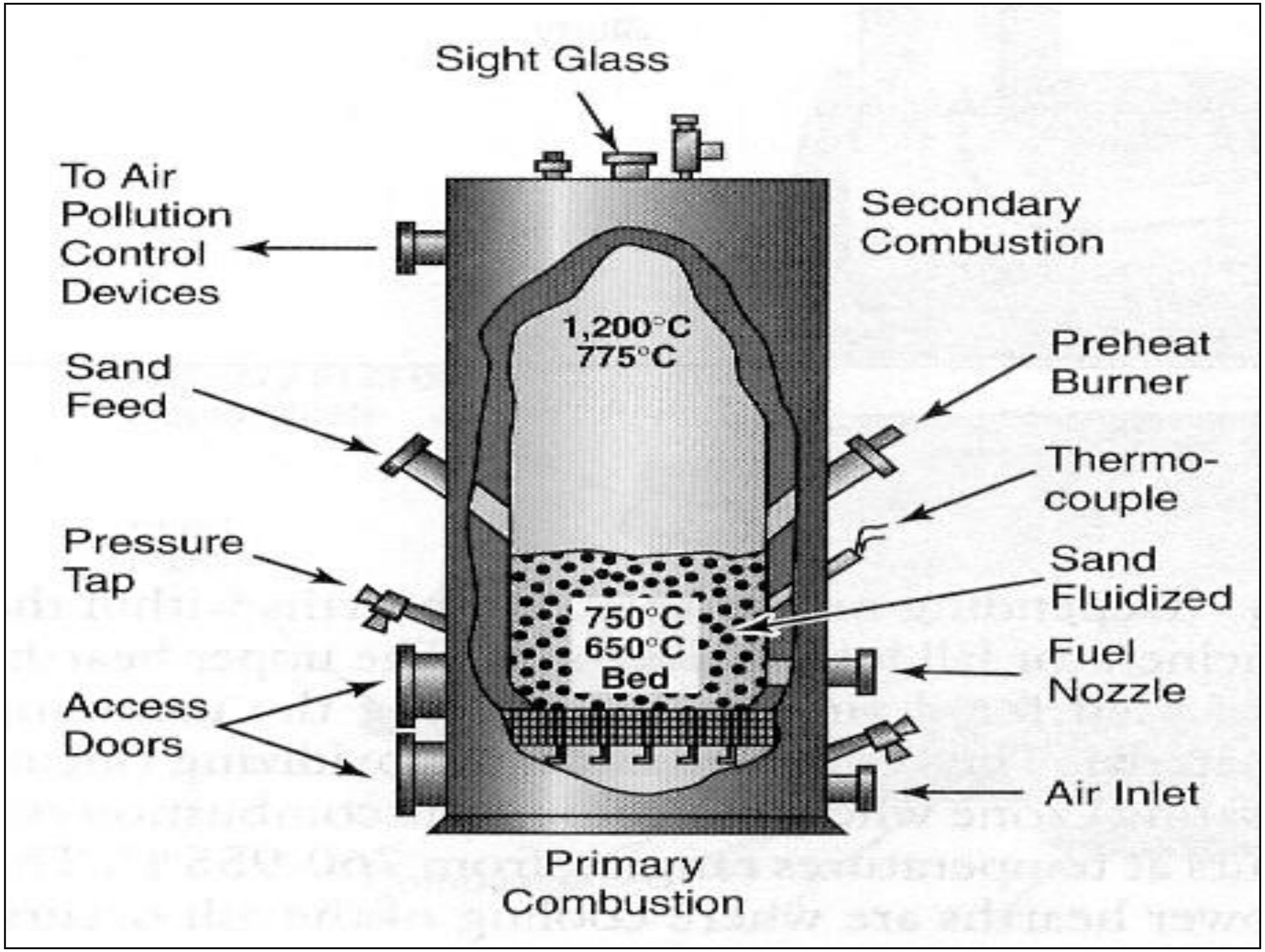


Maintaining Public Awareness and Communication

Successful incineration projects have been characterized by:

- **holding regular meetings with concerned citizens;**
- **providing days for public visitation;**
- **posting release and operational data to the Internet; and**
- **displaying real time data on operations and releases at the facility site.**

Bubbling fluidised bed



BAT - General Combustion Techniques

- Ensure design of furnace is appropriately matched to characteristics of the waste to be processed.
- Maintain temperatures in the gas phase combustion zones in the optimal range for completing oxidation of the waste.
- Provide for sufficient residence time (e.g. 2 seconds) and turbulent mixing in the combustion chamber(s) to complete incineration.
- Pre-heat primary and secondary air to assist combustion.
- Use continuous rather than batch processing wherever possible to minimize start-up and shut-down releases.

BAT - General Combustion Techniques

- **Establish systems to monitor critical combustion parameters including grate speed and temperature, pressure drop, and levels of CO, CO_2, O_2.**

- **Provide for control interventions to adjust waste feed, grate speed, and temperature, volume, and distribution of primary and secondary air.**

- **Install automatic auxiliary burners to maintain optimal temperatures in the combustion chamber(s).**

BAT – Hazardous Waste Combustion Techniques

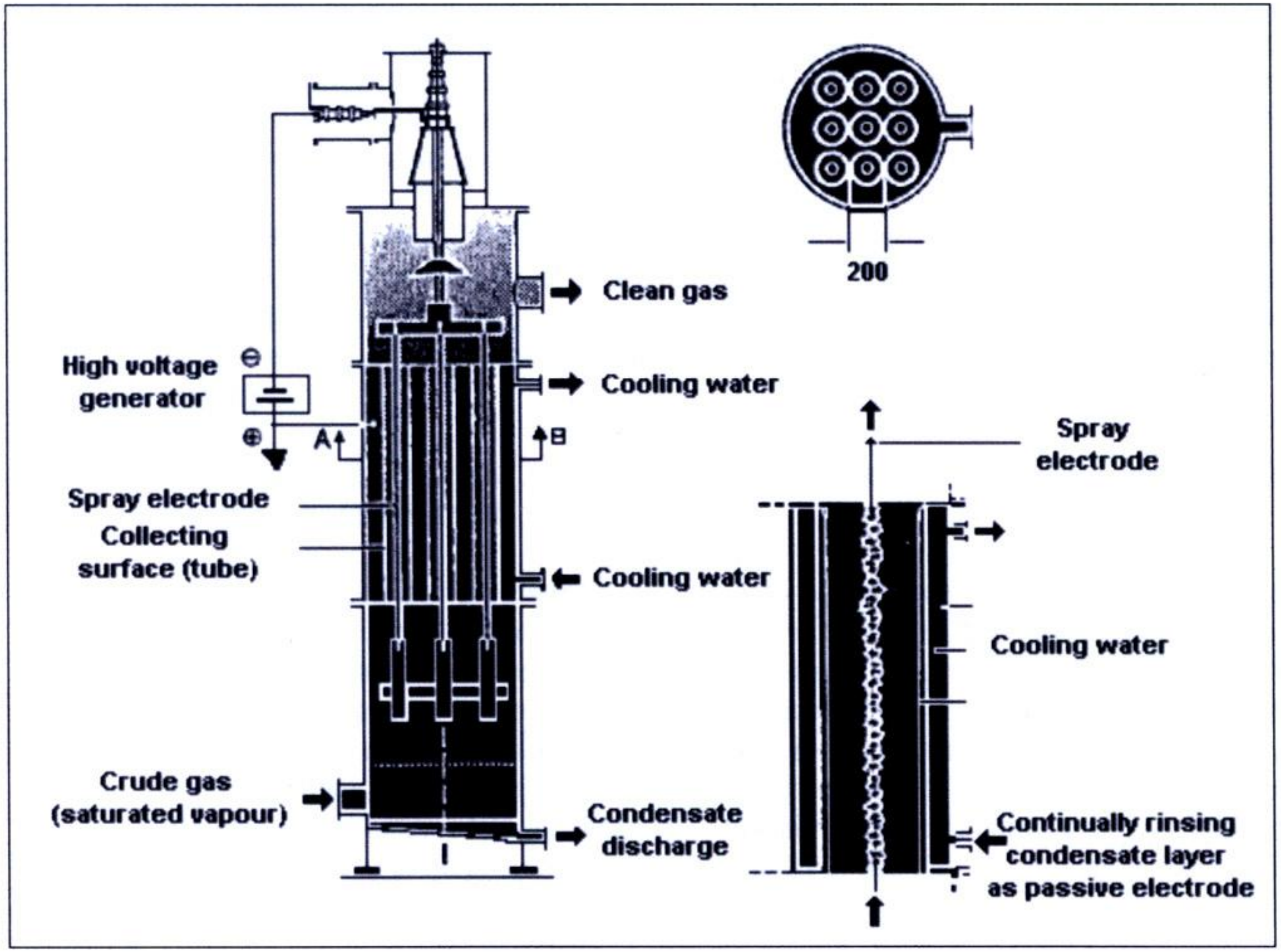
- **Rotary kilns are well demonstrated for the incineration of hazardous waste and can accept liquids and pastes as well as solids.**

- **Water-cooled kilns can be operated at higher temperatures and allow acceptance of wastes with higher energy values.**

- **Waste consistency (and combustion) can be improved by shredding drums and other packaged hazardous wastes.**

- **A feed equalization system e.g., screw conveyors that can crush and provide a constant amount of solid hazardous waste to the furnace, will ensure smooth feeding.**

Condensation electrostatic precipitator



BAT – Flue Gas Treatment

The type and order of treatment processes applied to the flue gases once they leave the incineration chamber is important, both for optimal operation of the devices as well as for the overall cost effectiveness of the installation.

Waste incineration parameters that affect the selection of techniques include:

- waste type - composition and variability;
- type of combustion process;
- flue gas flow and temperature;
- and the need for, and availability of, wastewater treatment.

Fabric filters

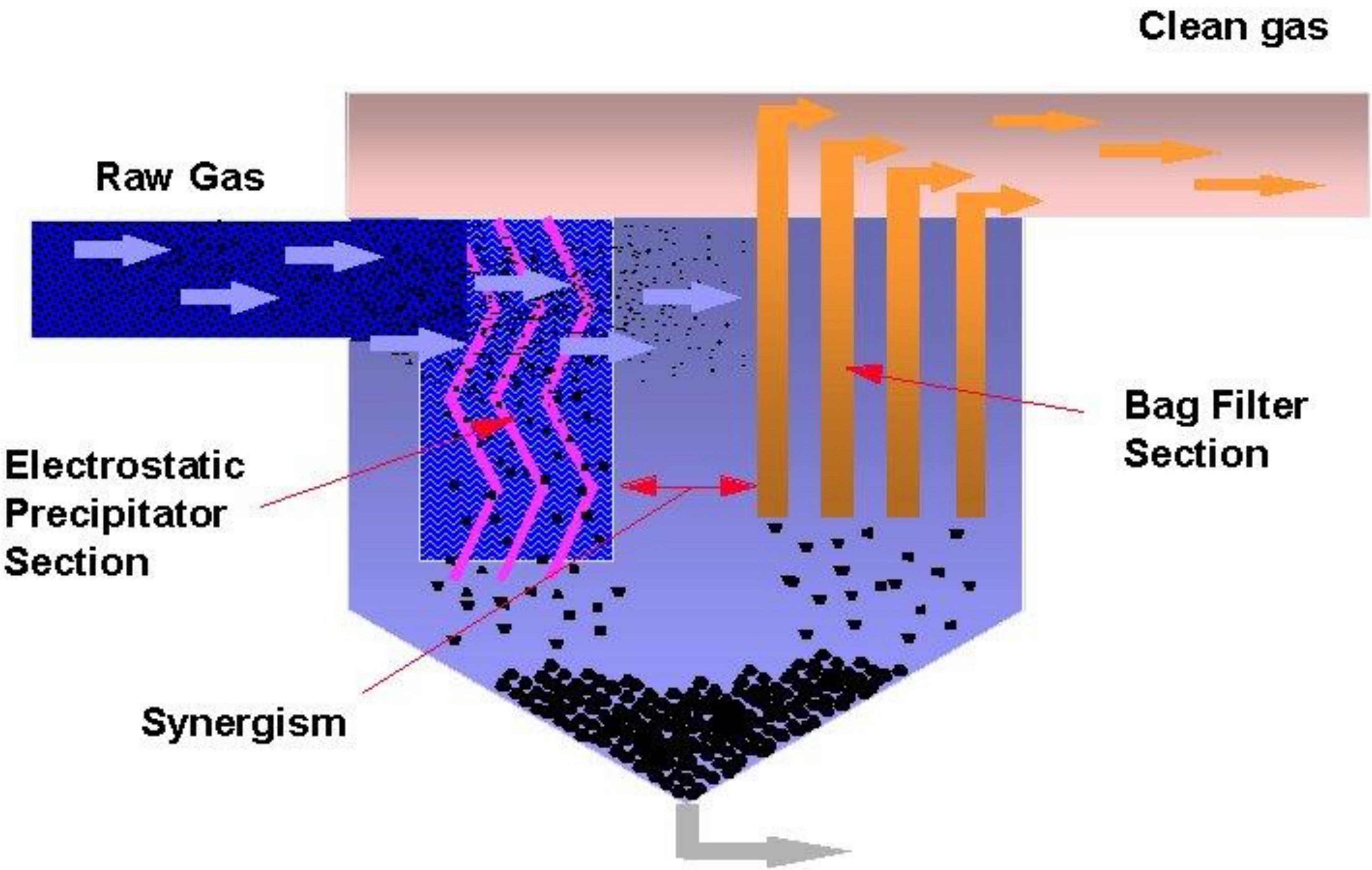
Fabric filters are also referred to as baghouses or dust filters.

These particulate matter control devices can effectively remove unintentional POPs that may be associated with particles and any vapors that adsorb to the particles in the exhaust gas stream.

Filters are usually 16 to 20 cm diameter bags, 10 m long, made from woven fiberglass material, and arranged in series.

Fabric filters are sensitive to acids; therefore, they are usually operated in combination with spray dryer adsorption systems for upstream removal of acid gases.

Combined dust removal



Desulphurization process

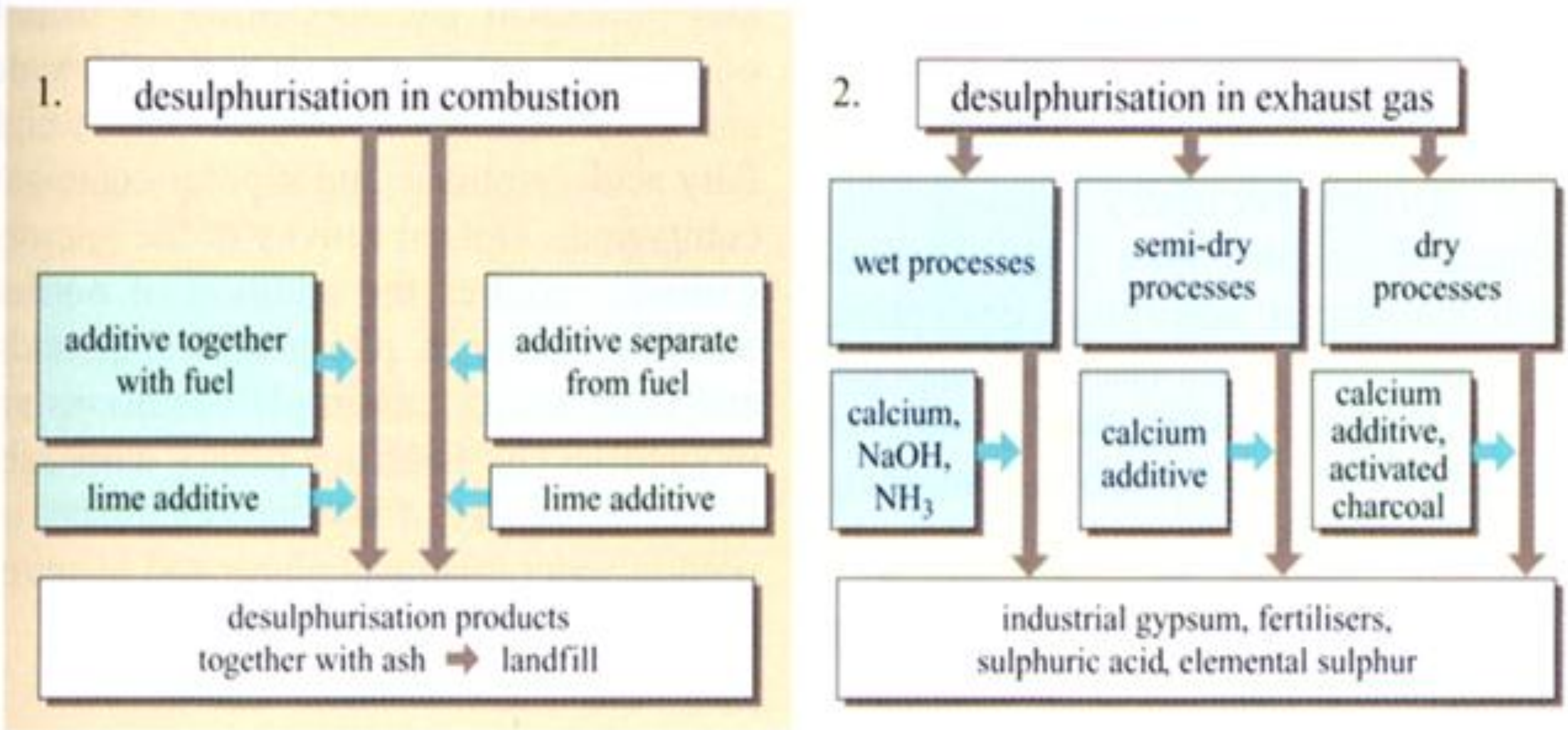


Figure 2.5.7 Desulphurisation processes

De-NOx

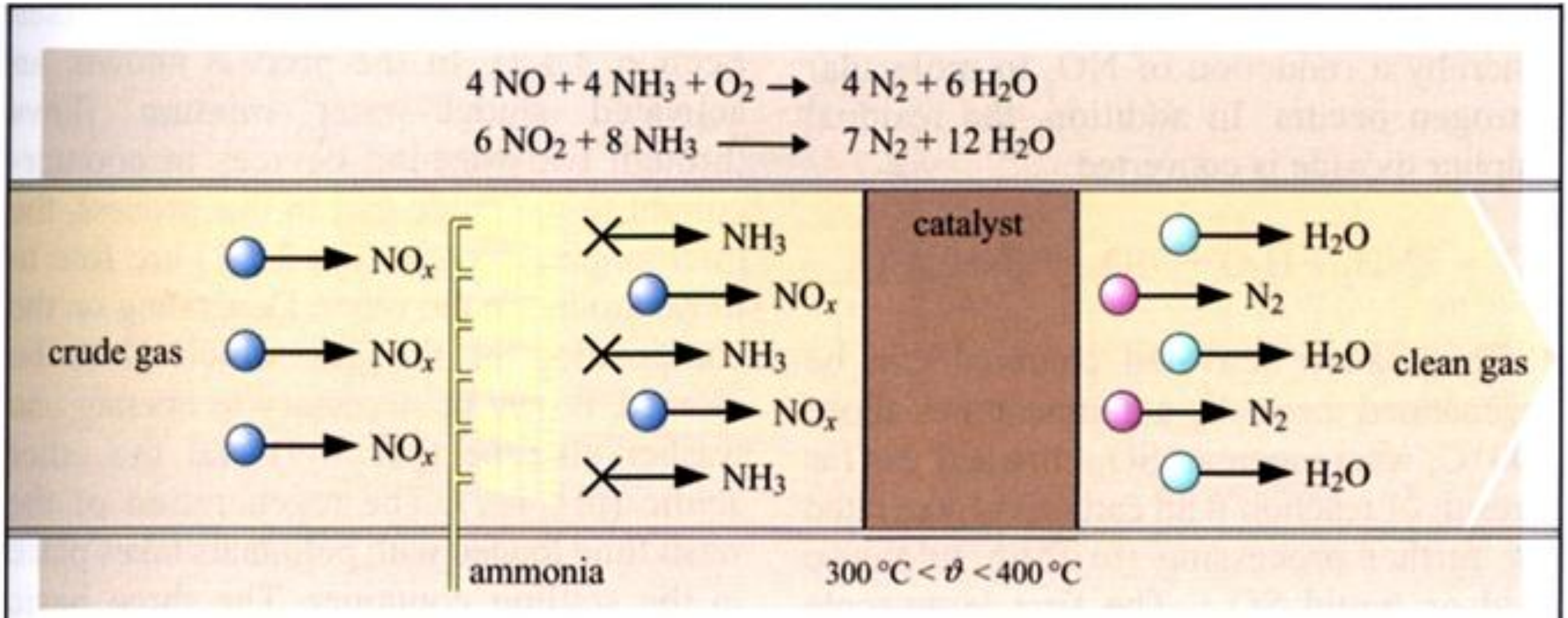


Figure 2.5.6 Catalytic NO_x reduction

De-SOx & De-NOx

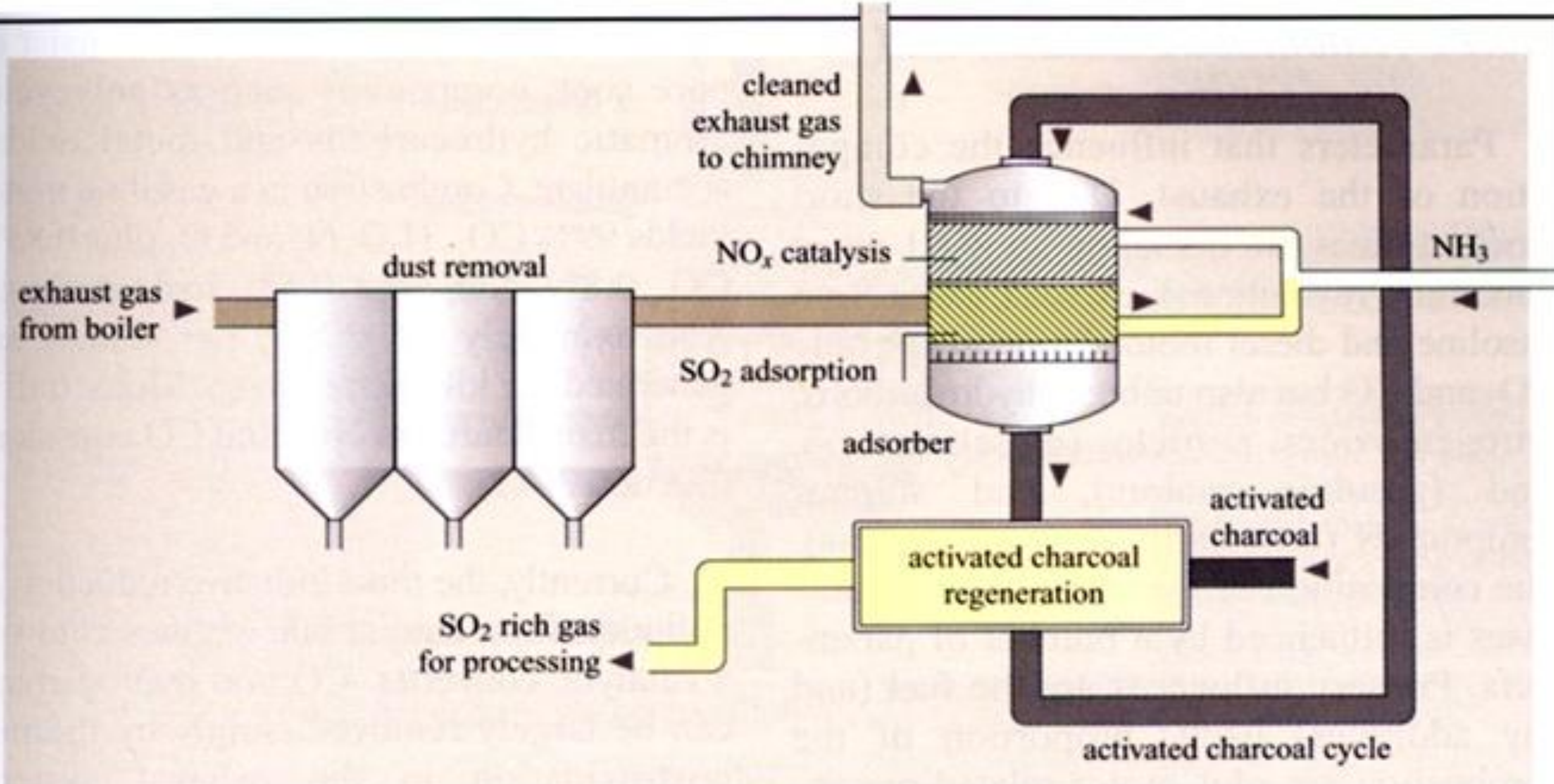
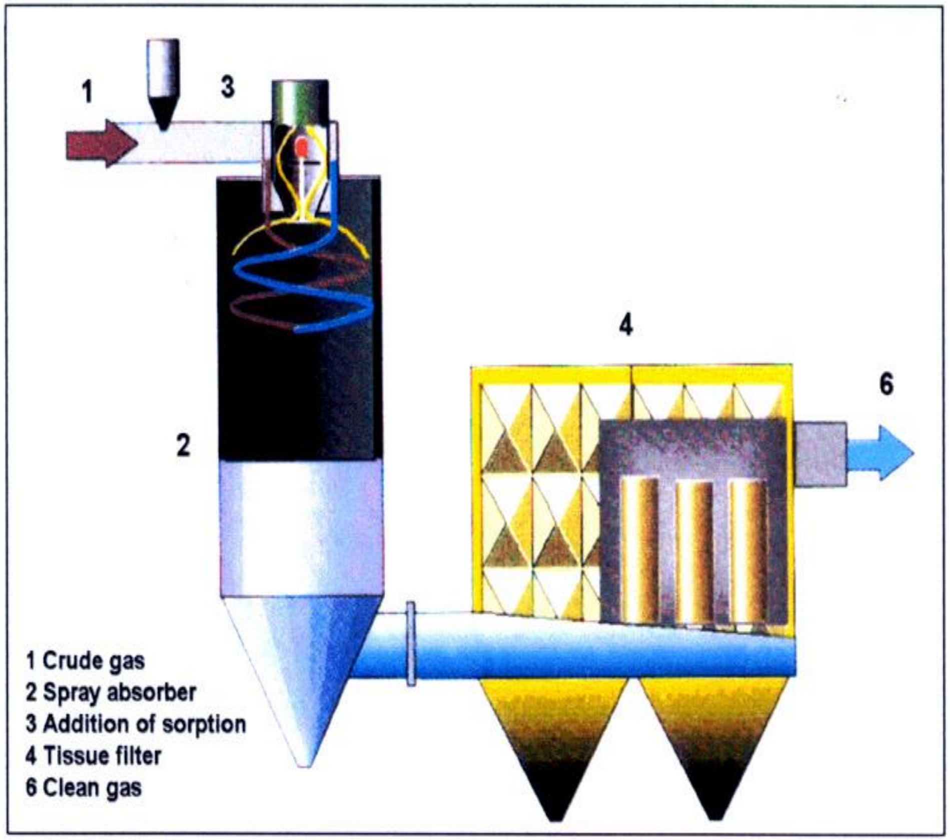


Figure 2.5.8 Simultaneous processes for desulphurisation and denitration of exhaust gas

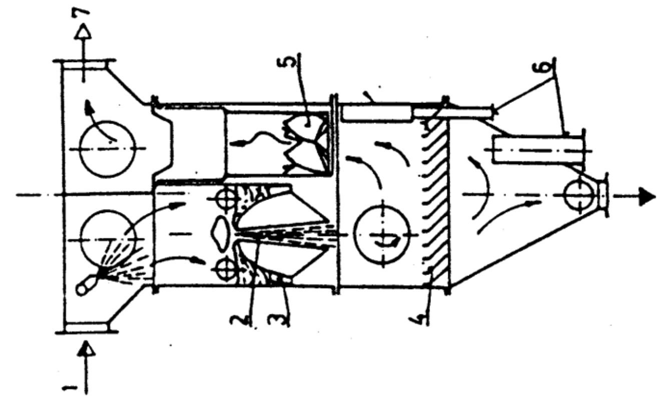
Spray dry slurry

- Semi-wet scrubbing with injection of atomized hydrated lime slurry
- Removal of acid gases, dust and prevention of de-novo synthesis of dioxins and furans by rapid quenching
- No waste water

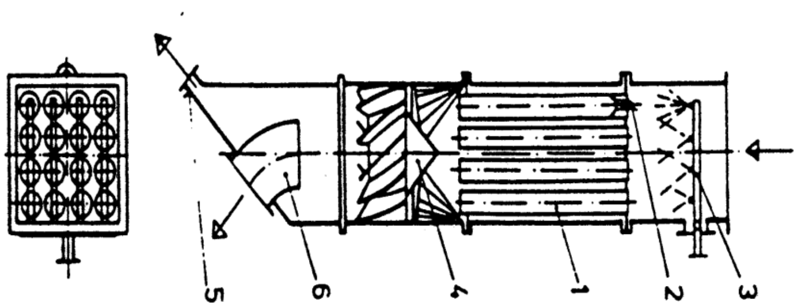


Wet scrubbers

- Acid gas and dust removal
- Rapid quenching
- Two stage (water + lime)
- Catalytic oxidation in packed tower scrubbers (polypropylene embedded with carbon)
- Fine dust absorbers for specific dioxin separation

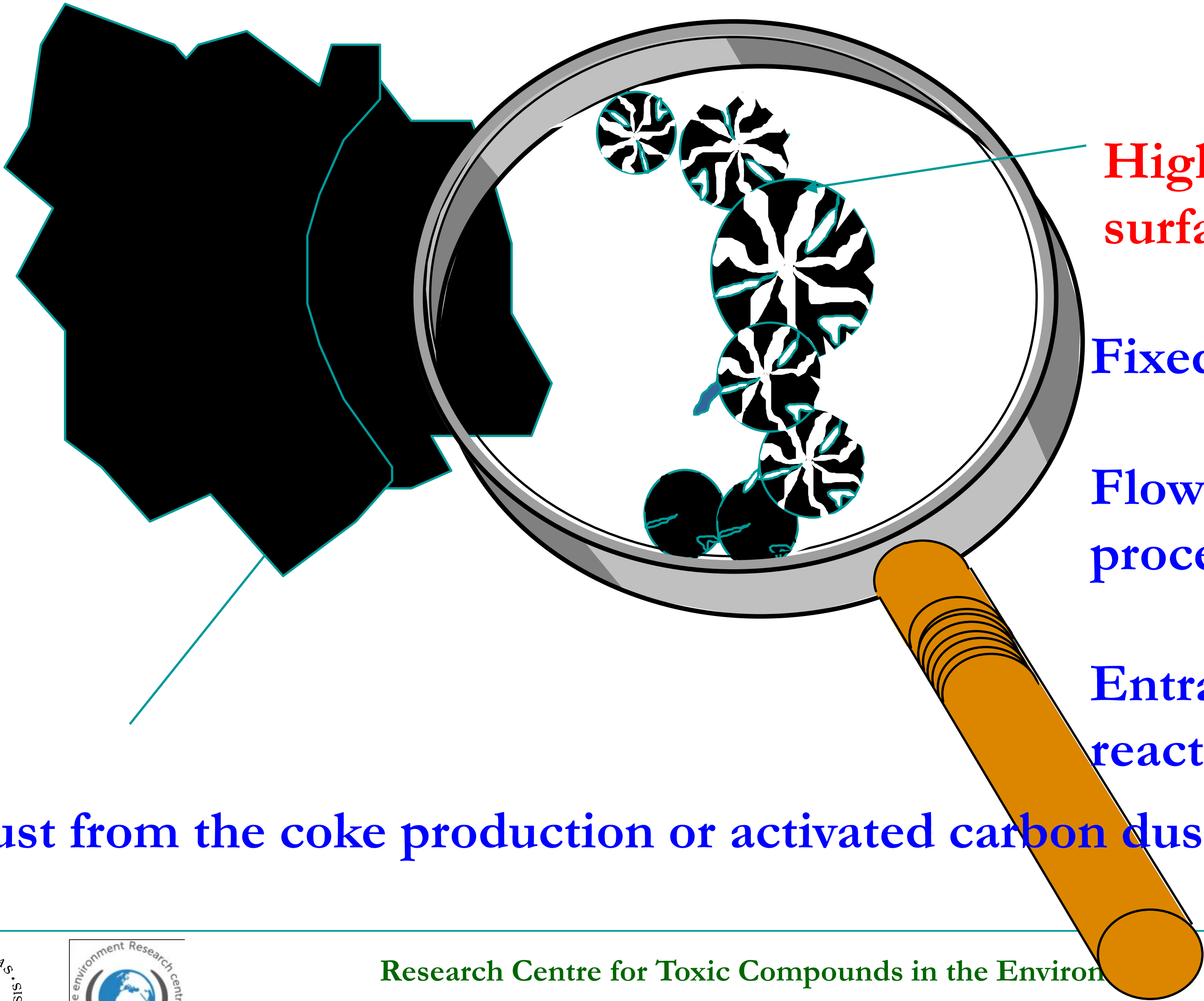


Obr.52. Odlučovač s Venturiho trubicí obdélníkového průřezu



Obr.51. Mokrý vírníkový odlučovač

Sorption processes



High specific surface

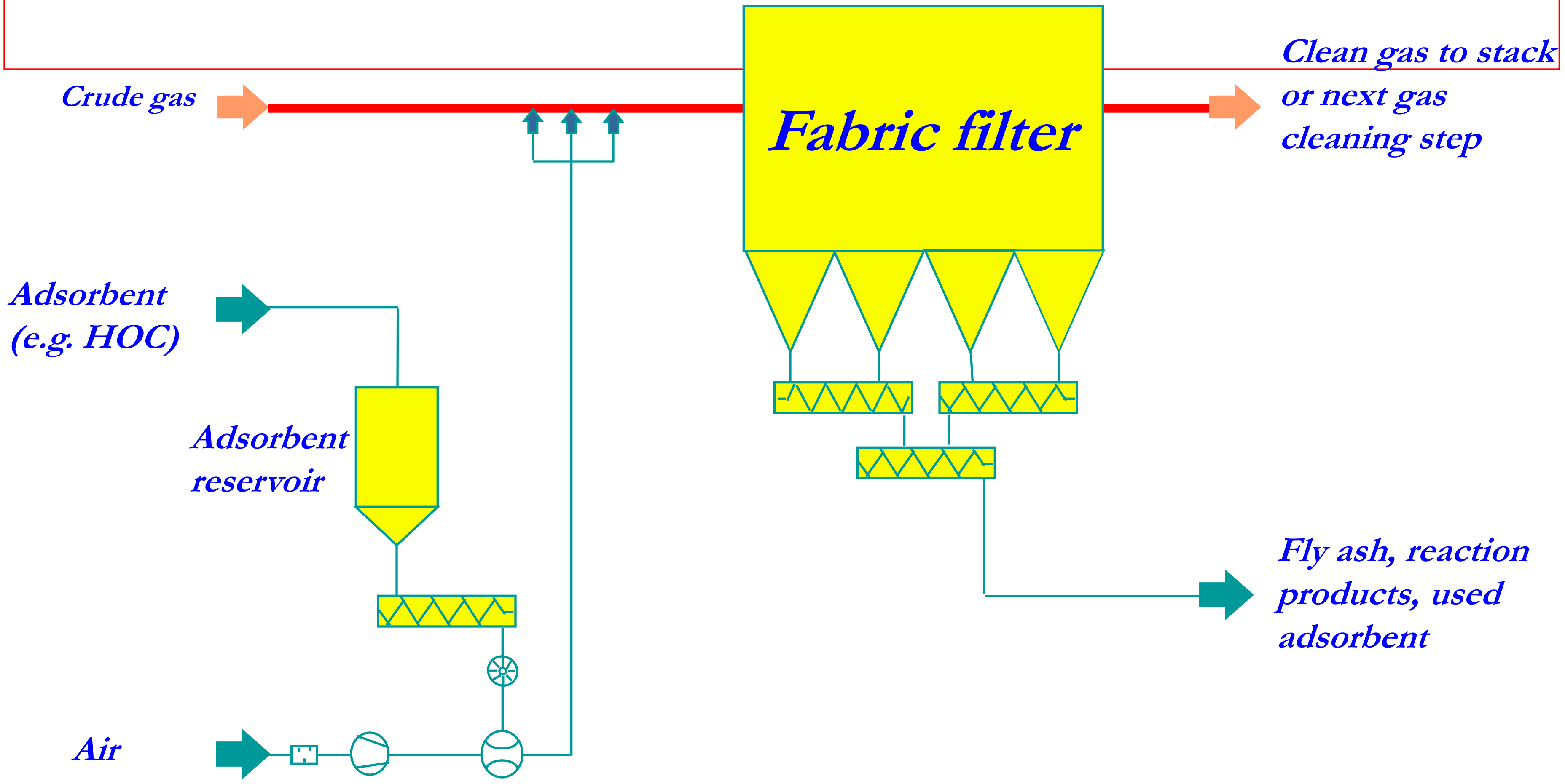
Fixed bed filters

Flow injection processes

Entrained flow reactor

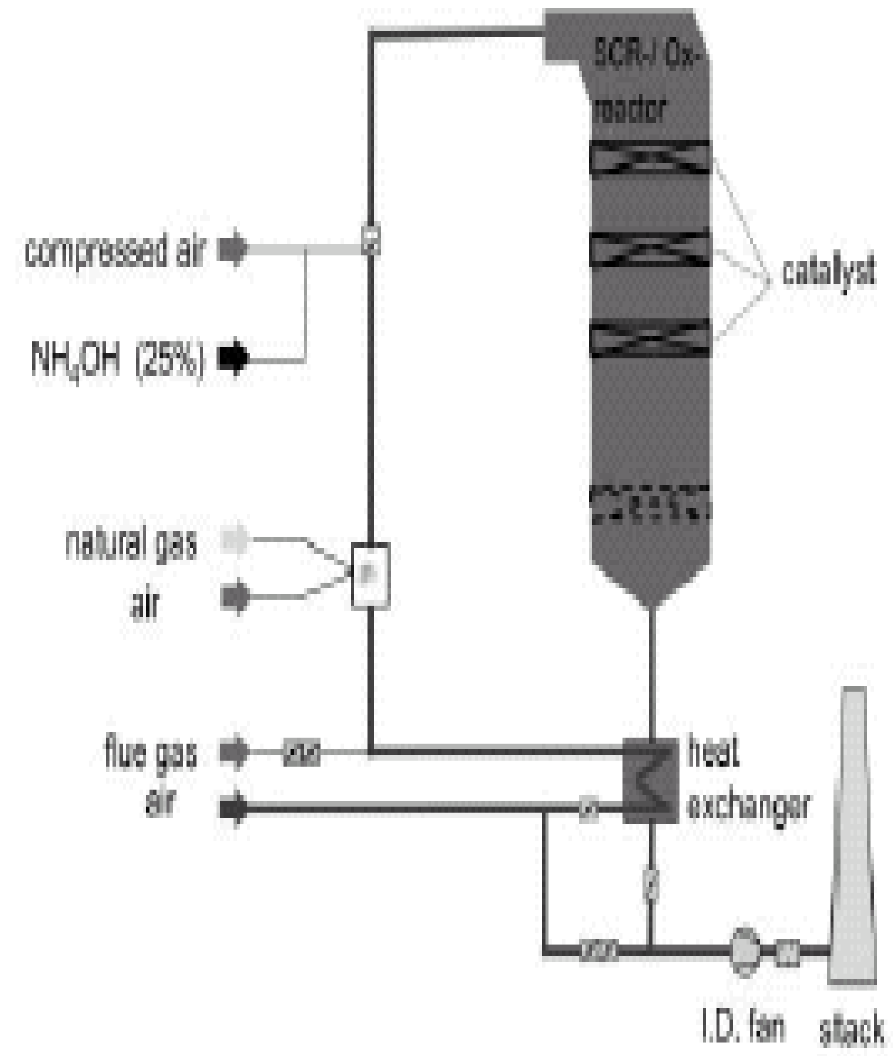
Dust from the coke production or activated carbon dust

POPs adsorption – injection of dry adsorbent



Catalytic oxidation

- Pre-cleaned gas
- May be combined with DeNox
- Catalytic bag filters
- Easy operation and no residues



$$C_{12}H_4Cl_4O_2 \rightarrow 12\ CO_2 + 4\ HCl$$

Flue gas residue treatment

- Recycling
- Disposal to landfill
    - Direct land filling
    - Solidification (cement stabilization)
    - Vitrification, melting and sintering
    - Extraction and separation
    - Chemical stabilization
- Incorporation into road making materials
- Valorization in salt or coal mines

BAT - Residue Management Techniques

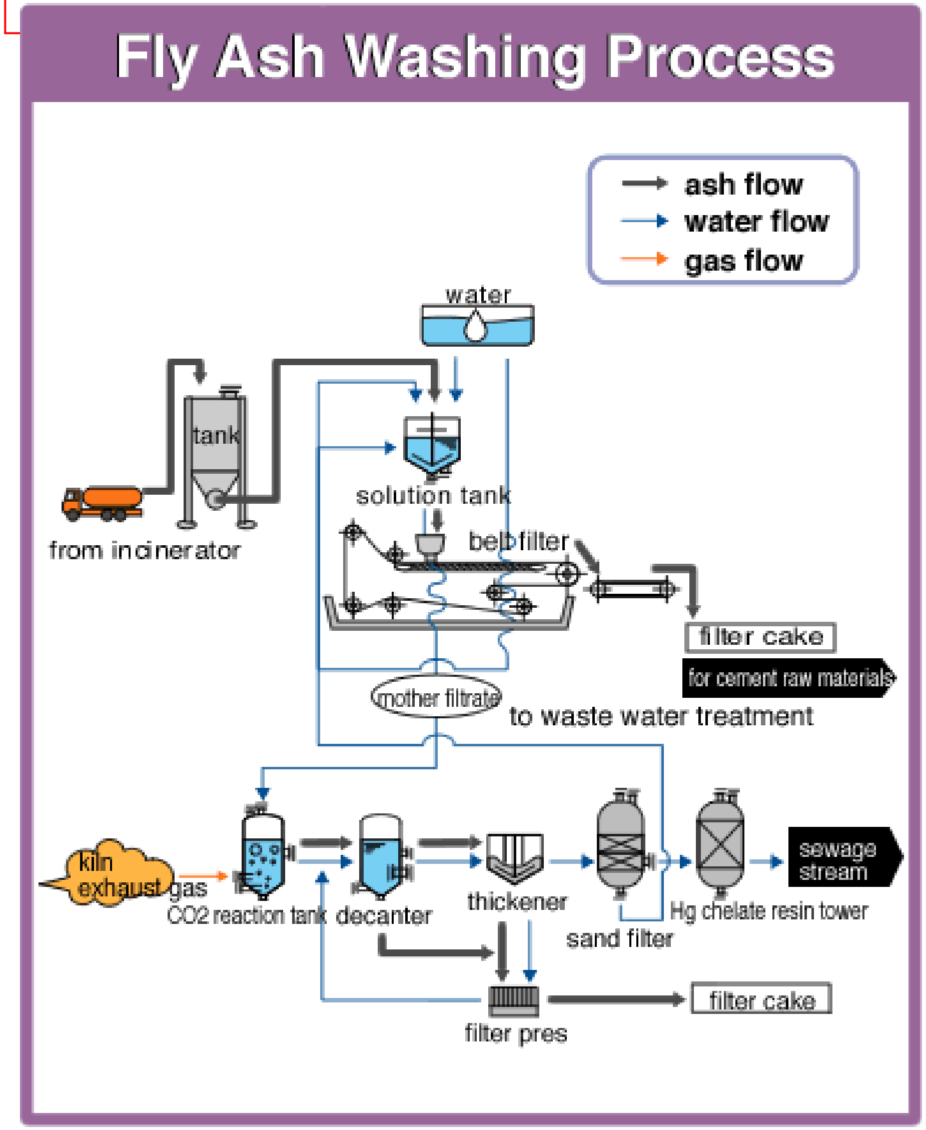
- Unlike bottom ash, APCD residuals including fly ash and scrubber sludges may contain relatively high concentrations of heavy metals, organic pollutants (including PCDDs/Fs), chlorides and sulfides.

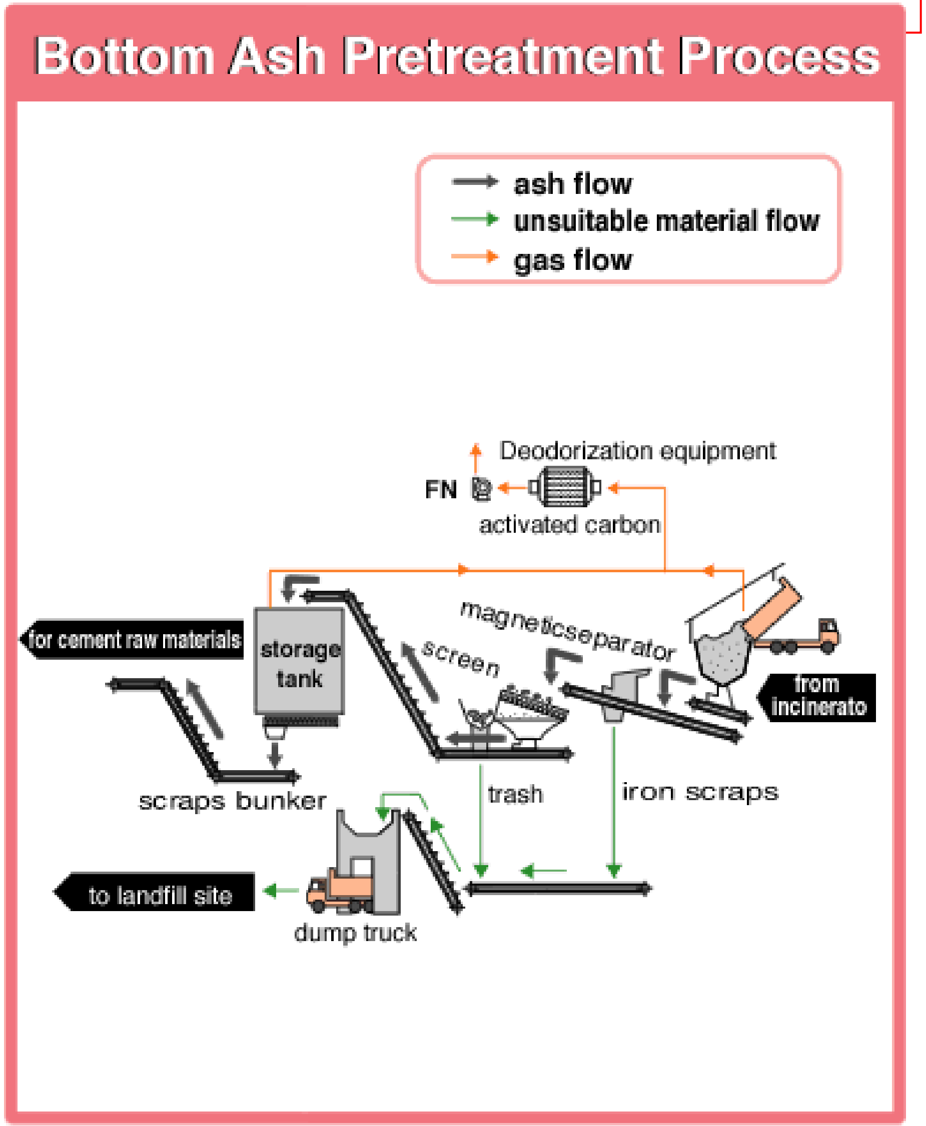
- Mixing fly ash and FGT residues with bottom ash should be avoided since this will limit the subsequent use and disposal options for the bottom ash.

- Treatment techniques for these residues include:
  - Cement solidification. Residues are mixed with mineral and hydraulic binders and additives to reduce leaching potential. Product is landfilled.
  - Vitrification. Residues are heated in electrical melting or blast furnaces to immobilize pollutants of concern. Organics, including PCDD/F are typically destroyed in the process.
  - Catalytic treatment of fabric filter dusts under conditions of low temperatures and lack of oxygen;
  - The application of plasma or similar high temperature technologies.

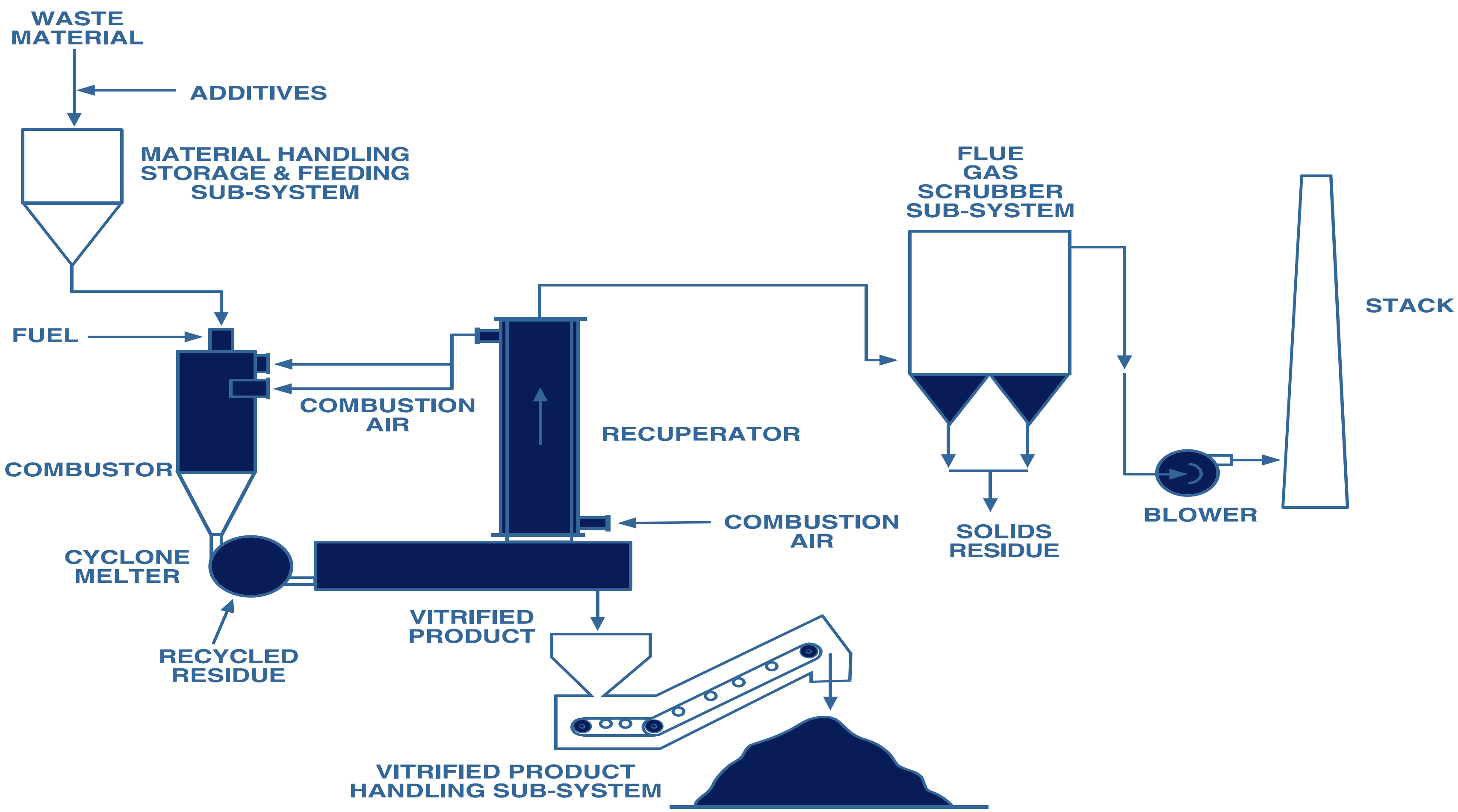
- Fly ash and scrubber sludges are normally disposed of in landfills set aside for this purpose. Some countries include ash content limits for PCDD/F in their incinerator standards. If the content exceeds the limit, the ash must be re-incinerated.

Residue treatment





Flue gas residue treatment



Combination flue gas treatment

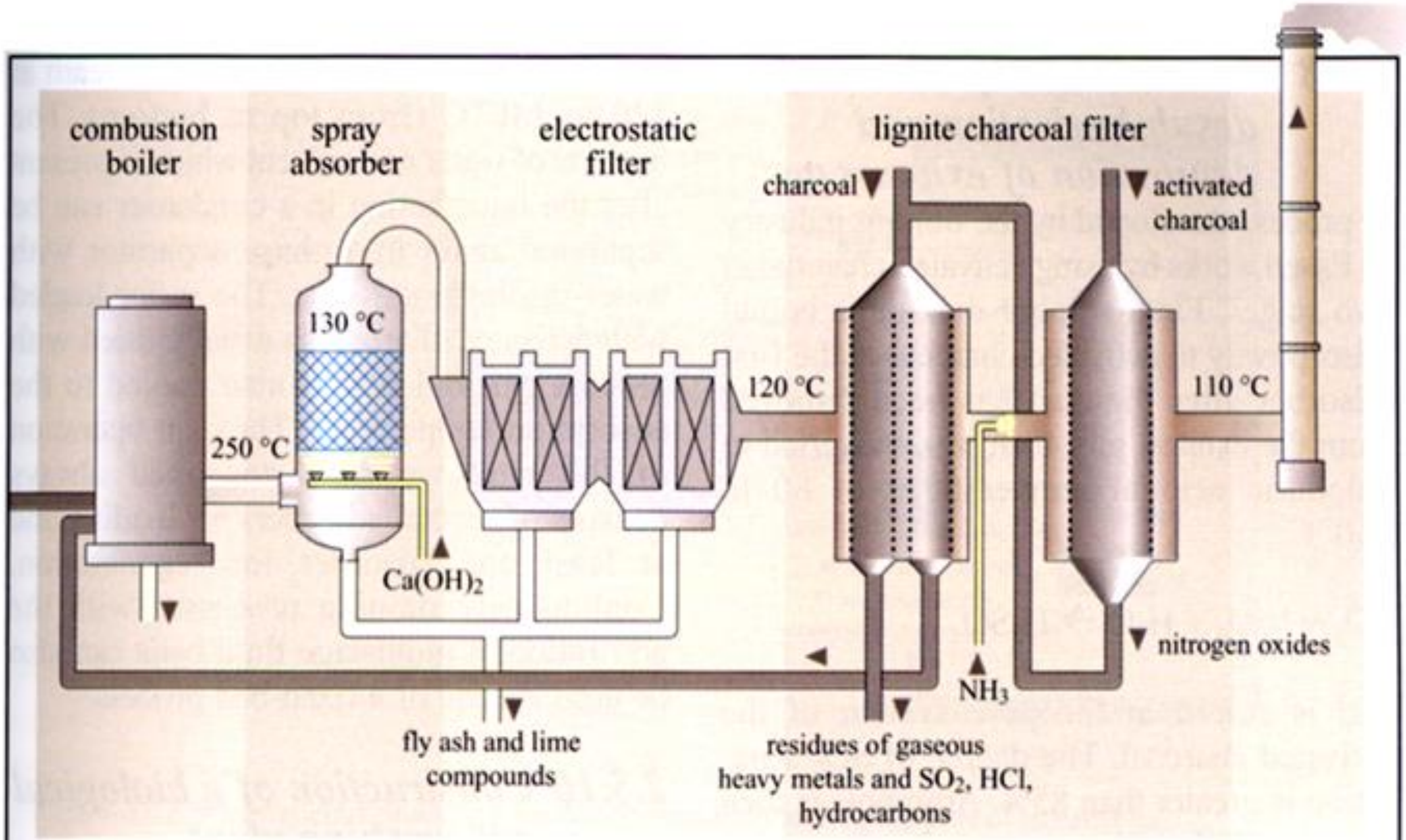


Figure 2.5.5 Combination process for cleaning exhaust gas

Sound practices

MODERN WASTE MANAGEMENT SYSTEMS

- Resource use reduction
- Reuse
- Recovery/recycling
- Composting
- Environmentally sound landfiling
- Incineration using BAT

Barriers to use alternatives

- Lack of education
- Lack of government will to reduce dependence upon open burning to accomplish goals
- Open burning is an integral part of local agriculture
- Lack of alternative machinery or process or necessary infrastructure
- Cost of alternatives

- Economic instruments
- Demonstration projects

Residential combustion sources

- **Purpose:** Small scale energy conversion for household heating and cooking
- **BAT / BEP:** High quality efficient combustion (combustion chamber temperature, turbulence of the burning gases, residence time, excess oxygen and fuel type); use of more efficient improved stoves (improving also indoor air quality); no use of household waste as fuel
- **Performance:** < 0.1 ng $TEQ.Nm^{-3}$

Residential combustion

- **PCDD/PCDF formation: wood< coke< coal < biomass << co-combustion of wastes**
- **Incomplete combustion**
- **Central heating or individual stoves**
- **No possibility for emission control**
- **Developing countries:**
- **Very simple stoves**
- **No chimney/ventilation, resulting in indoor pollution**
- **Significant health effects on women and children**

- **Global Partnership for Clean Indoor Air (2003)**

  http://www.pciaonline.org/ and http://www.rwedp.org/

BAT/BEP

BAT:

- Good mixing of gas and air (high turbulence)
- Sufficient residence time in the hot zone
- Minimal disturbance of the glow bed and homogenous distribution of the primary air
- Minimal residence time in the temperature range between 180 – 500 °C and minimal dust deposition ability
- Stack kept clean and free of soot by ensuring complete combustion and regular cleaning

BAT/BEP

Great attention should be paid to regular maintenance of the appliances in order to prevent/discover and repair potential problems, such as:

- Cracked heat exchanger
- Not enough air to burn fuel properly
- Defective/blocked flue
- Maladjusted burner
- Defective grate
- Green or treated wood
- Inappropriate fuel (other than required by the constructor; residential waste

BAT/BEP

- Ventilation to reduce indoor pollution and ensure propper combustion
- Hood fan over the stove
- Ensure sufficient air flow into the house
- The vent is connected and unblocked without cracks or holes
- Ad more air (opening the stoker door)
- Smoke and soot indoors are signs of that the stove is releasing pollutants into the indoor air
- Inspection and maintenance at regular intervals

BAT/BEP

Correct use of appliances and fuel

- Understand and follow the operating instructions and to use the recommended kind of fuel
- Burn hardwood rather than softwood (hotter/less creosote)
- Avoid green wood and wet wood
- Never burn any kind of waste, treated wood

Education awareness and training programmes

- Programmes for sellers and buyers of the stoves
- Proper information on potential hazards to human health
- Education and awareness on the appropriate use of fuels and general BEP issues

Biomass/wood stoves

- Replacing poorly designed stoves with improved stoves that burn fuel more efficiently can be an effective strategy for reducing hazardous POPs releases and improving indoor air quality. In addition 50-80% of fuel may be saved
- Options for effective use of improved stoves:
  - Stow design should match the specific available fuel
  - Raising of public awareness about improved stoves
  - Training on appropriate use of stoves
  - Implement training programs for stove maintenance and repair
  - Cost-effectiveness of the new stoves
  - Raising of awareness about indoor air pollution and adverse health effects

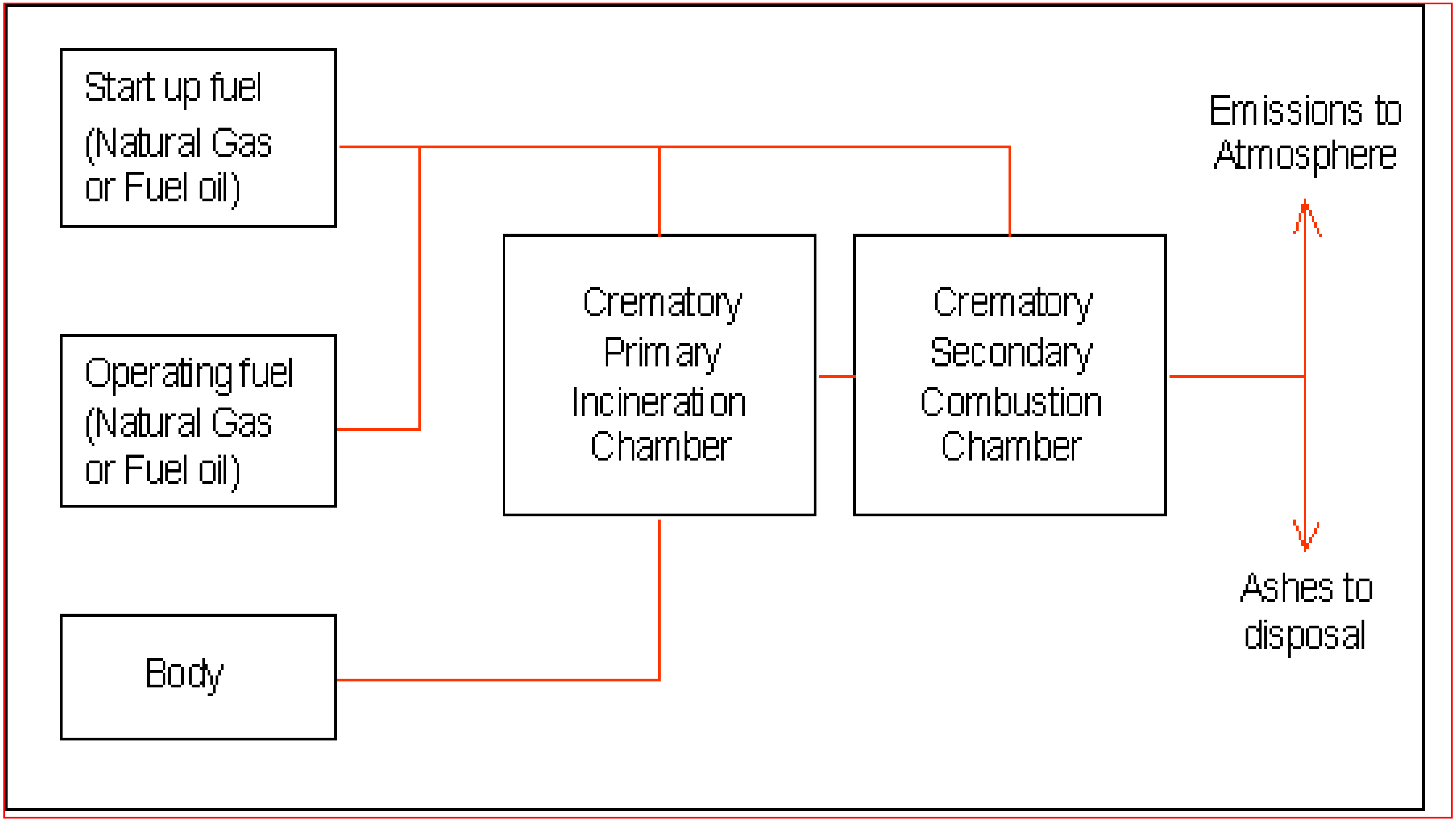
Crematoria

- **Purpose:** religiously and culturally accepted practice of dealing with the dead of human being; alternative to burial

- **BAT / BEP/ BECT:** Avoidance of chlorinated materials, maintenance of efficient combustion conditions (T over 850 °C), residence time 2 seconds, sufficient air (> 6% O_2), APC for sulphur dioxide, hydrogen chloride, CO, VOCs, dust and POPs (lime and activated carbon injection followed by a bag filter)

- **Performance:** dioxin/furan concentration < 0.1 ng TEQ.Nm^{-3}

Typical cremation process



Motor vehicles burning leaded gasoline

- **Purpose:** Transportation by using gasoline and diesel as fuel; particularly leaded gasoline, where chlorinated and brominated scavengers are used

- **Alternatives:** use of other fuels, such as unleaded gasoline, diesel, LPG, CNG, propane-butane, bio-fuels and alcohol/oil mixtures

- **BAT/BACT:** banning of halogenated scavengers, fitting the vehicle with and oxidation catalyst or particulate filter

Smoldering of copper cables

- **Purpose:** Recovering of scrap copper
- **BAT/BACT:** mechanical cable chopping, stripping or high temperature incineration (> 850 °C), residence time, excess oxygen, with APC
- "Open burning is not an environmentally acceptable solution for any kind of waste" (UNEP 2001)
  - Oxygen starved conditions
  - Low temperatures 250-700 °C
  - Cu is catalyzing PCDD/PCDF formation

Alternatives

- **Cable chopping**
  - Requires pre-sorting
  - Granulation (filtering is necessary)
  - Density/electrostatic separation (metal looses may occur)
- **Cable stripping**
  - Cheaper than chopping/lower throughput/lower cost
  - Presorting of the cables
  - Complete recovery
  - Rates: 60 m/min; 1.1 kg.min^{-1}; cable diameter 1.6 mm-150 mm
- **High temperature incineration**
  - To treat cables unsuitable for stripping or chopping

PCDDs/Fs – requirement for continuing minimization and, where feasible, ultimate elimination, by

- Establishing an action plan (within 2 years);
- Establishing and maintaining release inventories;
- Promote/require use of substitute or modified materials, products and processes to prevent the formation and release of unintentional POPs;
- Application of best available techniques (BAT) and best environmental practices (BEP);
- For new priority sources: as soon as possible but not later than 4 years after entry-into-force.

The worst case of POPs wastes management – disposal on dumping sites

Hazardous waste site - emission pathways

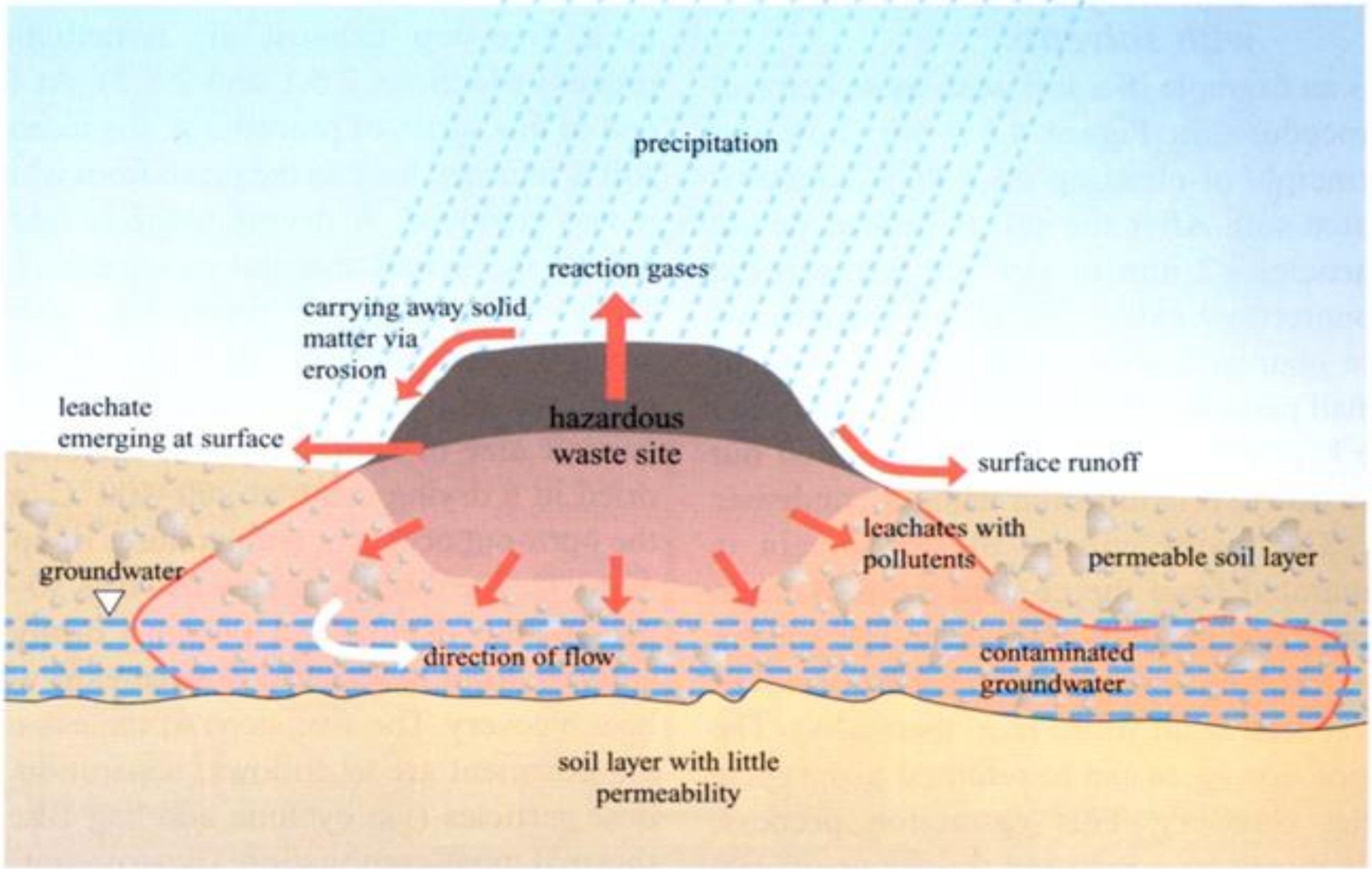
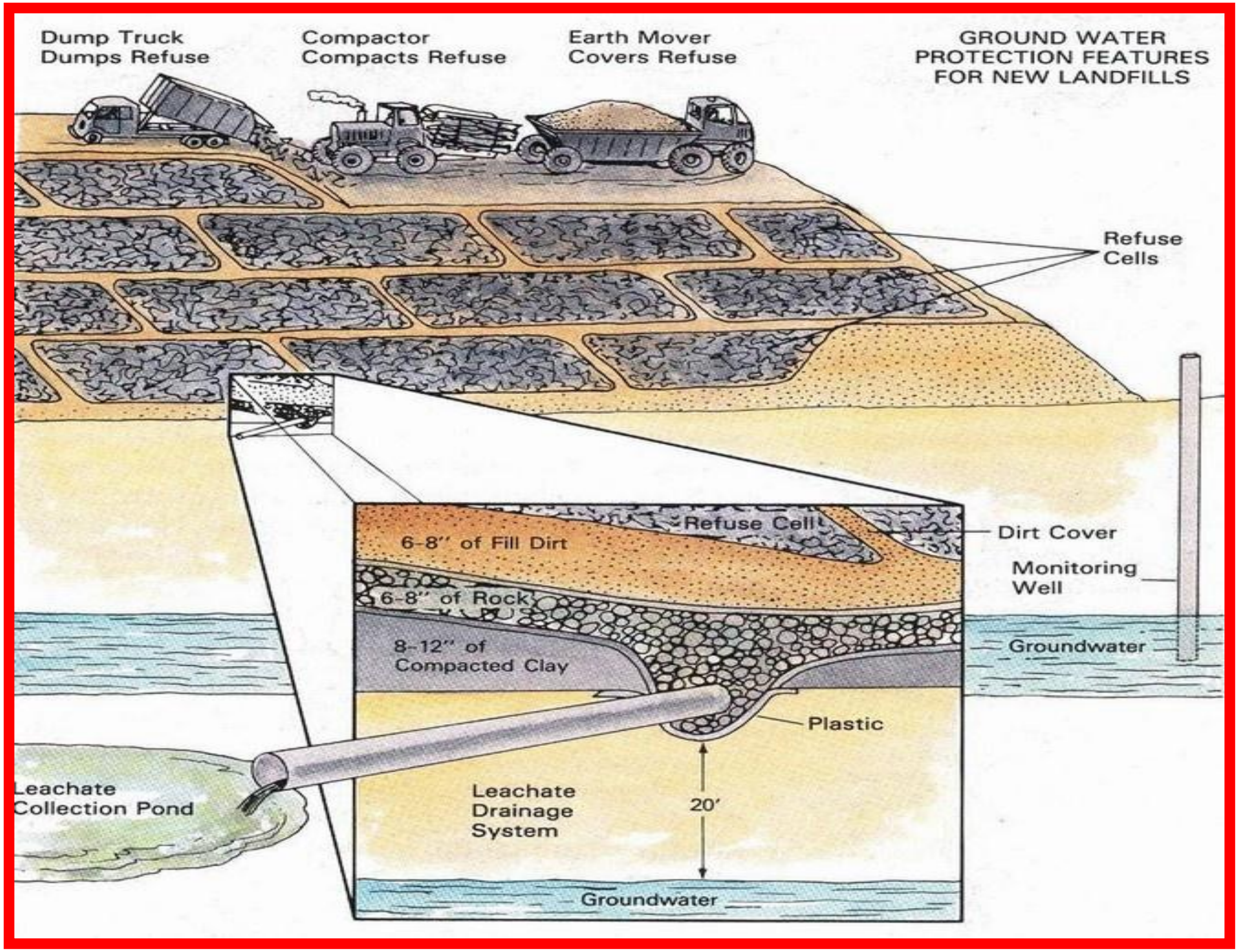
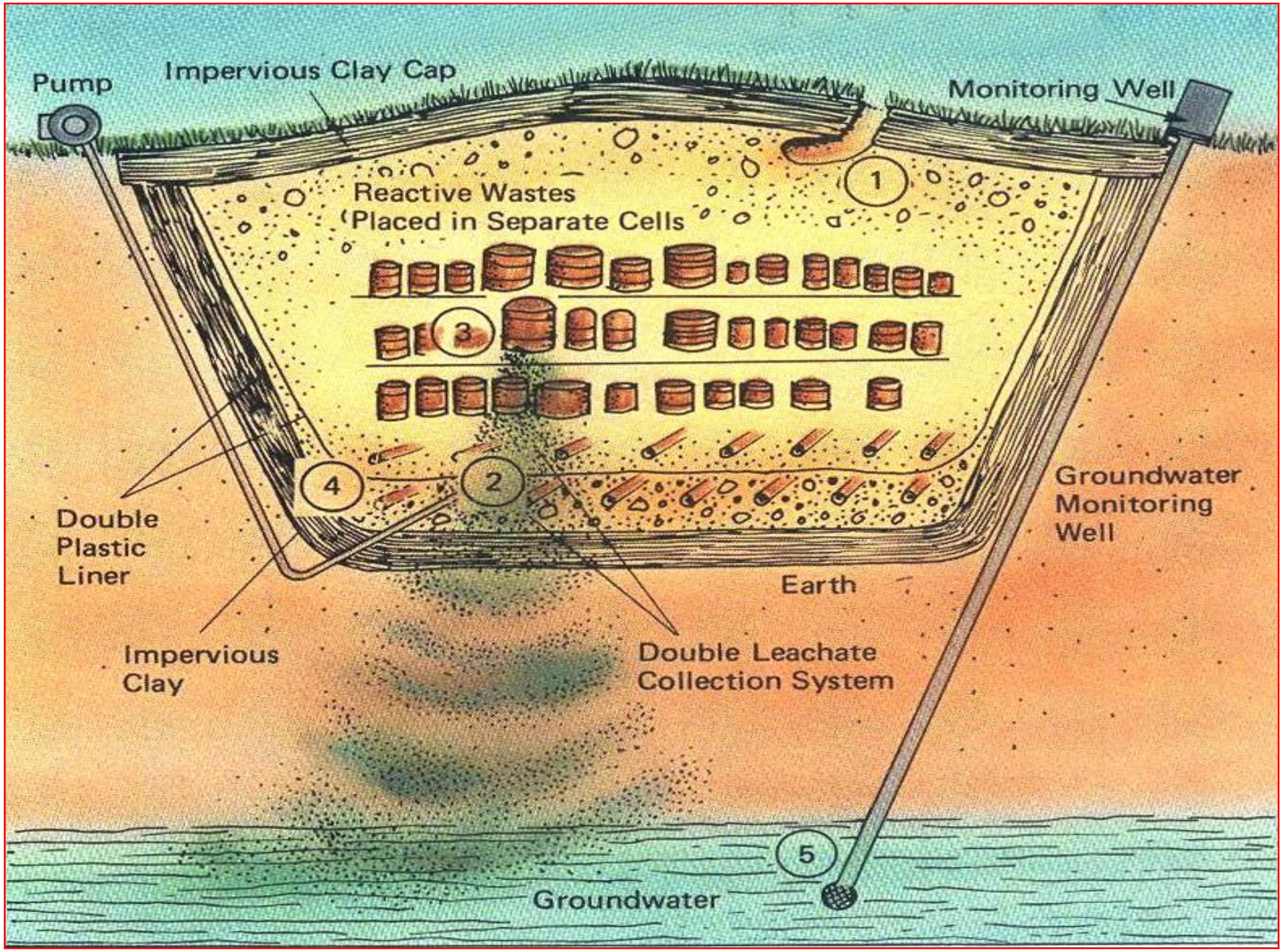


Figure 4.5.1 Emission pathways from a hazardous waste site (from *Altlastlexikon*)

Groundwater protection - hazardous waste site



Hazardous waste site



Best environmental practise – best storage practise

Best environmental practise – best storage practise

- Solution of POPs waste problems to the moment when we will have generally acceptable technics for destruction
- Economically more acceptable in present time than any development and construction of new facility (combustion/non-combustion)

Underground landfills

- Underground landfills in for example in Germany are former salt mines or separated parts of still existing mines.
- They are situated several 100 m under the earth's surface and isolated from ground water and the biosphere by natural sealants, e.g. clay layers.
- They are organized like warehouses with separated areas for, e.g., mercury containing wastes, arsenic containing wastes and PCB-containing wastes.
- Within a limited period of time the wastes deposited in an underground landfill may be moved back if necessary.
- After a longer time (several hundred years) the salt flows around the wastes, wrapping them – for eternity.

Underground landfills

- Underground landfilling/underground waste stowing as a non-destructive method of treating wastes containing POPs is now a highly recognized form of treatment, especially for wastes which are not thermally treated due to economical and ecological reasons, for example filter dust from waste incineration plants.
- This method of disposal as lain out in the Stockholm Convention should therefore be allowed use in the future.
- The amounts disposed of in Germany are from domestic as well as foreign origin.
- Dioxin contaminated filter dust, especially from waste incineration but also from metallurgic processing, make up the greater part of the wastes.
- Whilst the PCDD/F concentrations in filter dust from waste incineration amount to less than 10 000 $ng.kg^{-1}$, filter dust from metallurgic processing in some cases significantly exceed this amount (rising up to 100 000 $ng.kg^{-1}$).

Biological treatment

- The biological treatment, however, is a slow process and not well suited for the detoxification of wastes containing PCBs.

- Biological methods are under development and applied in the remediation of contaminated areas, especially in cases when an off-site treatment is not possible.

UNEP Resources

UNEP

PCB Inventory Form

First issue
August 2002

Inventory of PCB-Containing Equipment

Record number:	
Date:	
Inspector:	

A	Information about the company and the site		
1	Name:		
2	Address:		
3	Address of site: (if different from A2)		
4	Phone:		
	Fax:		
	E-mail:		
5	Name/position of contact:		
6	Type of company / Industry type / production at specific site:		
7	Public or private company?		
8	Location:	Industrial zone	
		Other urban area	
		Rural area	
9	Number of staff at visited site:	>50	
		10-50	
		<10	
10	Total number of pieces of equipment at site	Transformers	
		Capacitors	
		Others	
11	Total electricity consumption at site	in 1985	kWh / year
		now	kWh / year
12	PCB elimination action plan in place? - action plan intended but not started? - previous disposal activities? - time frame for program?		(Use a separate sheet if necessary)

United Nations
Environment Programme

UNEP

PCB Transformers and Capacitors

From Management to Reclassification and Disposal

First Issue
May 2002

PREPARED BY UNEP CHEMICALS

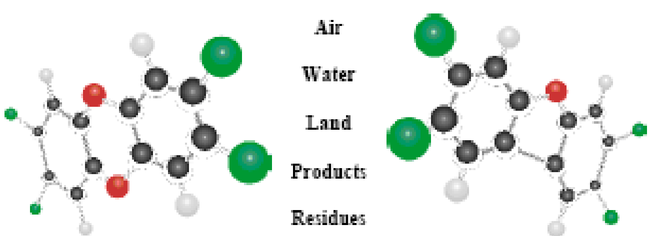
IOMC — INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS
A cooperative agreement among UNEP, ILO, FAO, WHO, UNIDO, UNITAR and OECD

UNEP Resources

UNITED NATIONS
ENVIRONMENT PROGRAMME

UNEP

Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases



1st edition
May 2003

Prepared by UNEP Chemicals
Geneva, Switzerland

IOMC INTER-ORGANIZATION PROGRAMME FOR THE SOUND MANAGEMENT OF CHEMICALS
A cooperative agreement among UNEP, ILO, FAO, WHO, UNIDO, UNITAR and OECD

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Asia Toolkit Project on Inventories of Dioxin and Furan Releases National PCDD/PCDF Inventories

Prepared by
UNEP Chemicals, Geneva

July 2003

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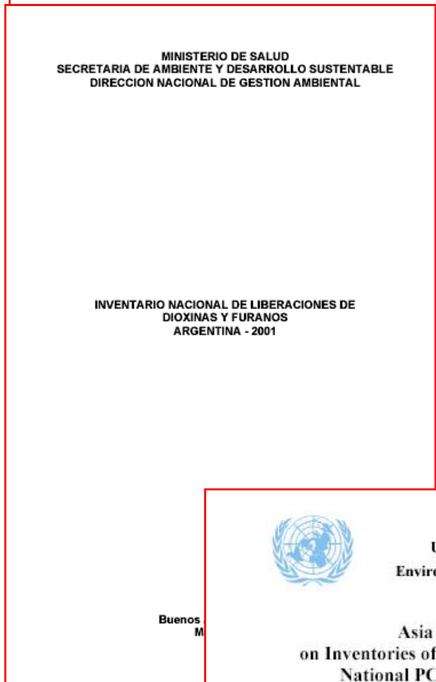
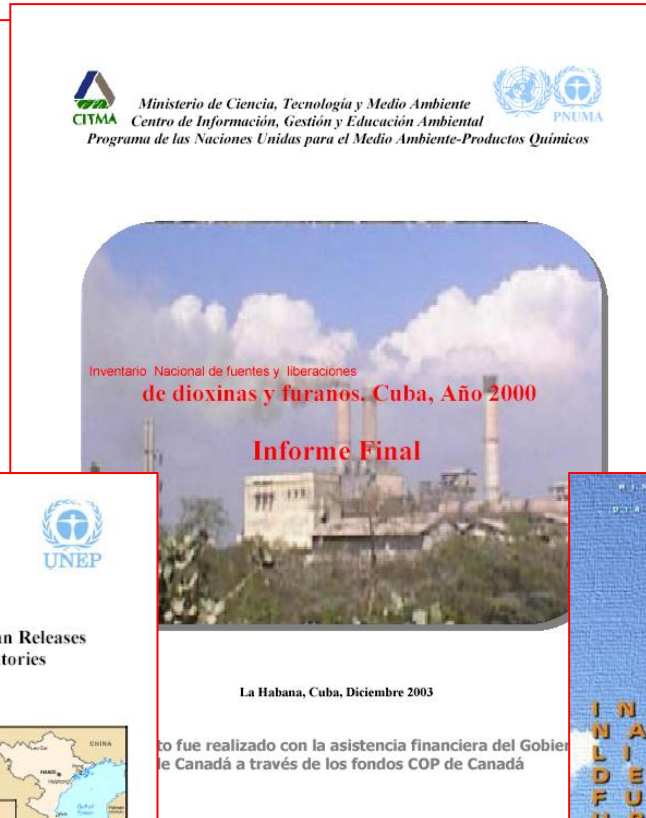
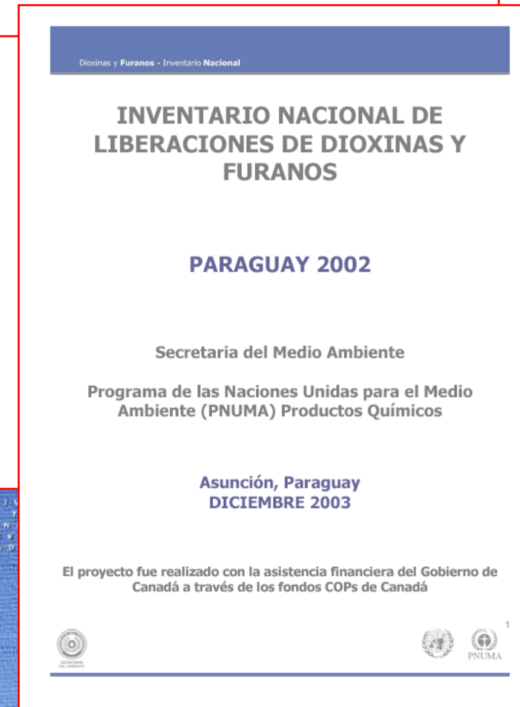
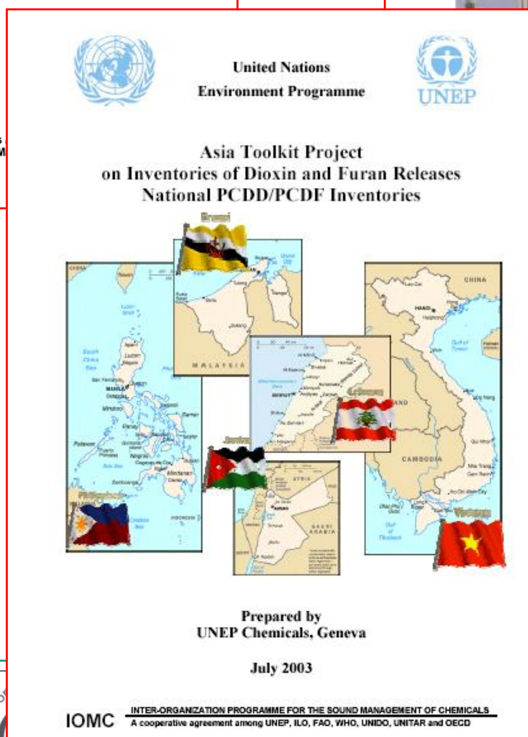




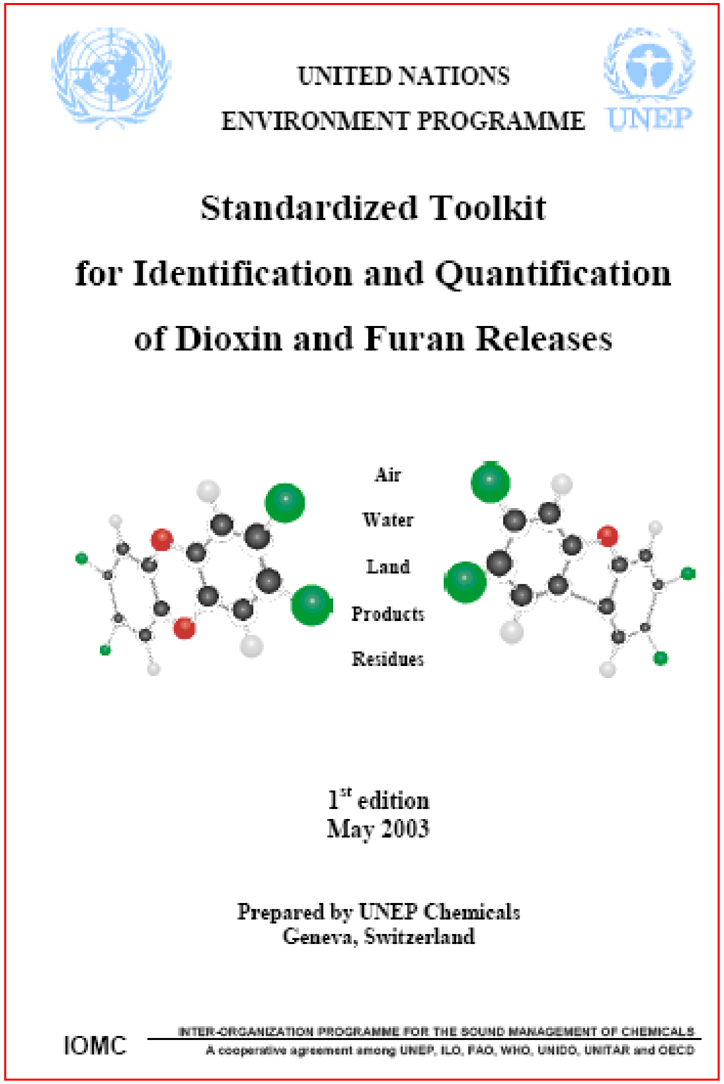




Dioxin Toolkit

The United Nations Environment Programme UNEP Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases is designed to cover all source categories and processes that are listed in Annex C, Parts II and III of the Stockholm Convention.

The Toolkit can be used where there are no measured data available and provides default emission factors for all source categories.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Standardized Toolkit
for Identification and Quantification
of Dioxin and Furan Releases

Air
Water
Land
Products
Residues

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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Inovace tohoto předmětu je spolufinancována Evropským sociálním fondem a státním rozpočtem České republiky