Pesticides POPs waste from Inventory to Elimination: Part 3 Environmental Disposal of (pesticides) POPs waste

Stockholm Convention Regional training workshop on PCBs and POPs wastes

Kingston 2- 5 February 2009

John Vijgen

IHPA

International HCH and Pesticides Association

Updated Technical Guidelines on ESM of POPs

Welcome to Module c of Guideline I

Environmentally Sound disposal of POPs

This module will provide you with information on environmentally sound disposal of POPS waste. Information for this module was taken from the 'Updated general technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs)', p.27-46. You can find this guideline and others on POPs wastes at the following address:

http://www.basel.int/meetings/sbc/workdoc/techdocs.html

Please close this window to start this module.

close

SBC Training Manual:

http://www.basel.int/meetings/sbc/workdoc/techdocs.html

See under Training manuals

DESTRUCTION AND DECONTAMINATION TECHNOLOGIES FRO PCBs AND OTHER POPs WASTES UNDER THE BASEL CONVENTION

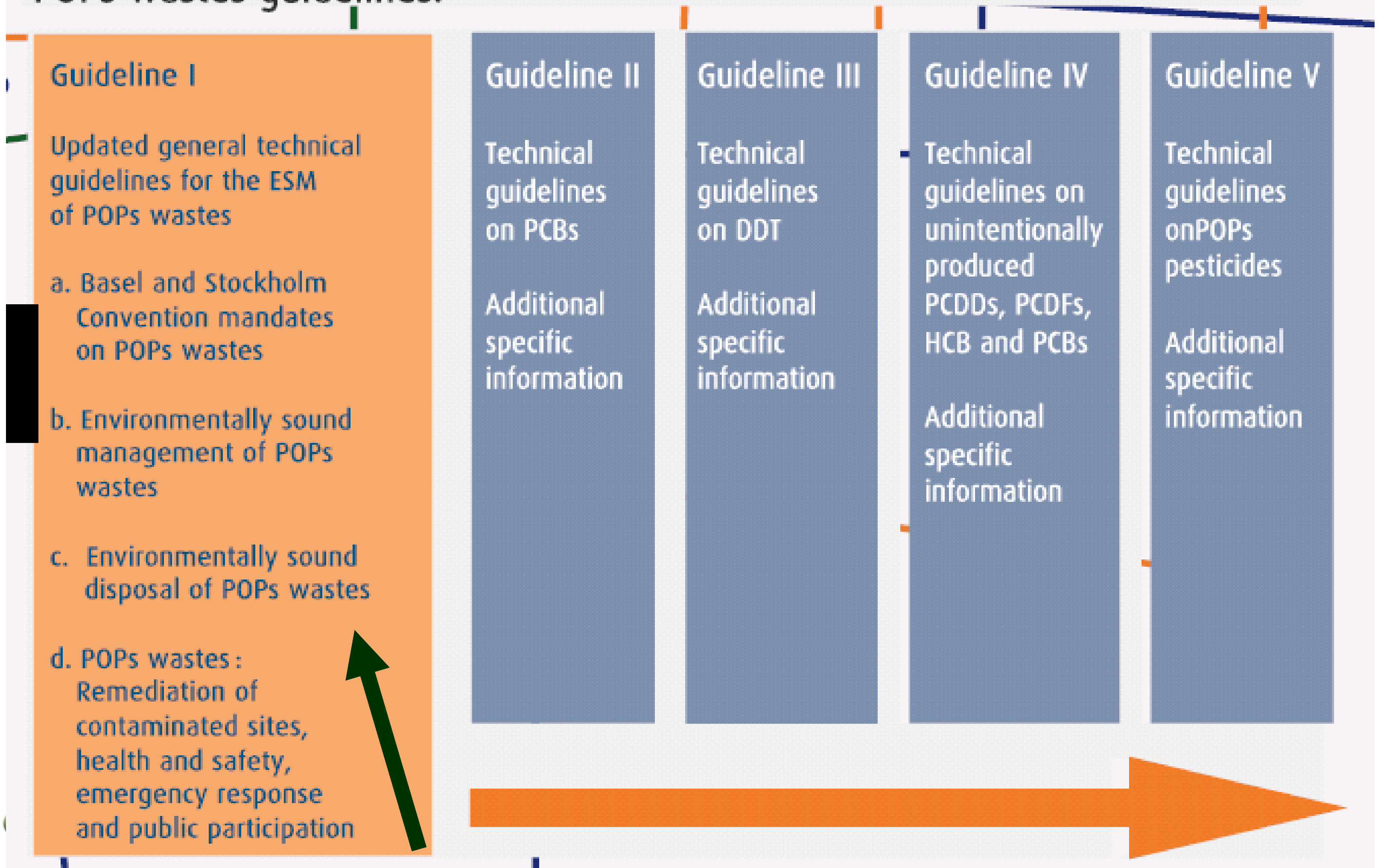
A Training Manual for Hazardous Waste Project Managers

Volume C - Annexes

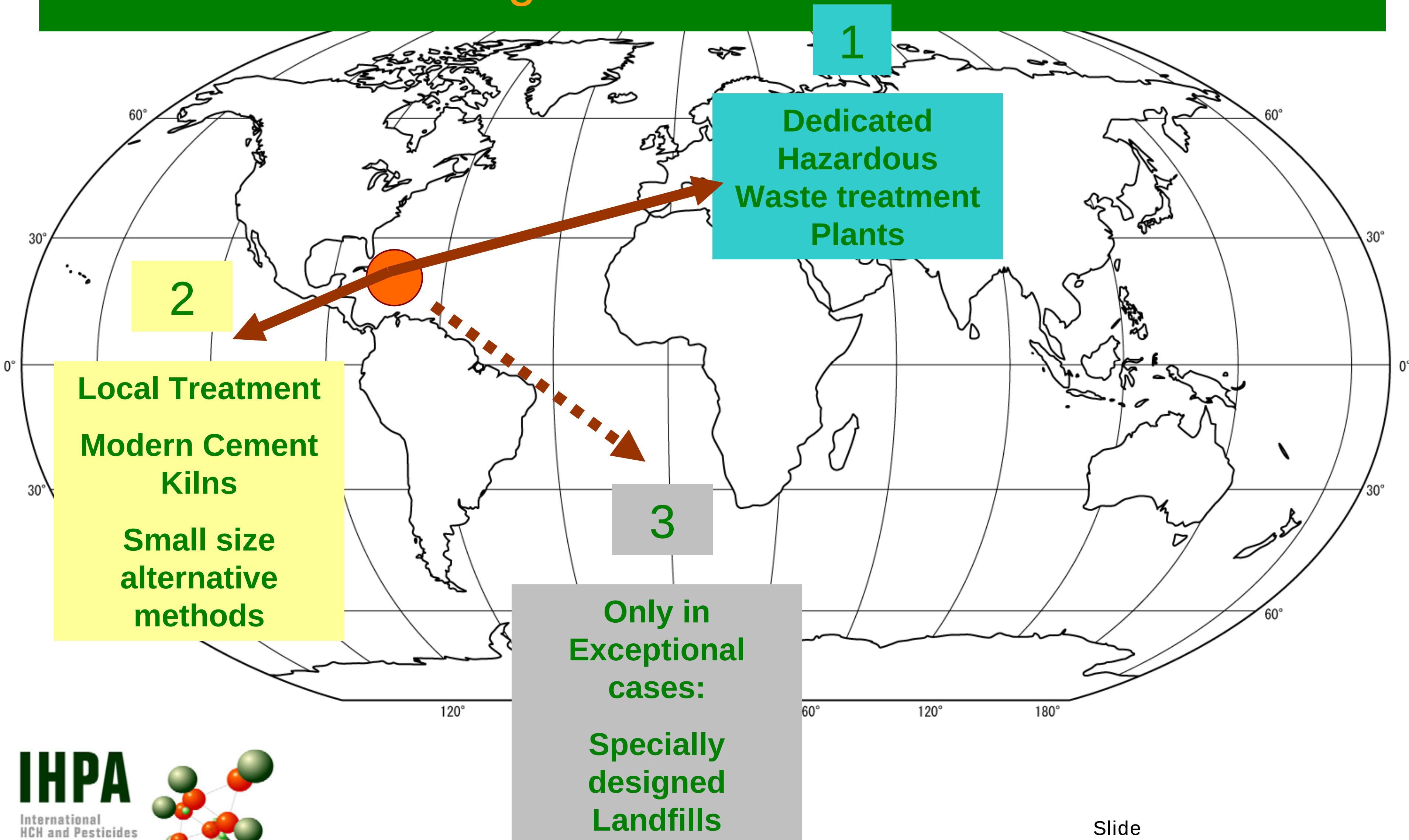
Secretariat of the Basel Convention

Stockholm Training Tool

The graphic below shows the link between the available guidelines. Guideline I contains information that is relevant to all the other individual POPs wastes guidelines.



Treatment strategies



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Combustion ------ Non- combustion

Destruction and irreversible transformation methods

There are many different destruction technologies, which can be grouped into two main categories - combustion and non-combustion methods.

The following operations are currently in commercial use :

Combustion methods

- Waste incineration
- Cement kiln co-incineration

Non-combustion methods

- Alkali metal reduction
- Base-catalysed decomposition (BCD)
- Gas-phase chemical reduction (GPCR)
- Plasma arc

SBC Training manual contains Fact Sheets of these technologies + Autoclave

Overview technologies mentioned in guidelines:

2. Destruction and irreversible transformation methods 28

(a) Alkali metal reduction 28

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(c) Catalytic hydrodechlorination (CHD) 32

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(g) Photochemical dechlorination (PCD) and catalytic dechlorination (CD) reaction 37

(h) Plasma arc 38

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3. Other disposal methods when neither destruction nor irreversible transformation is the environmentally preferable option 44

(a) Specially engineered landfill 45

(b) Permanent storage in underground mines and formations 45

Pre-treatment

Environmentally sound disposal of POPs wastes

There are two processes to complete ESM :

1. Pre-treatment
2. Destruction or irreversible transformation methods

Pre-treatment :

Normally, waste is treated before destruction can take place.

Treatment may include :

- Adsorption and absorption
- Dewatering
- Mechanical separation
- Mixing
- Oil-water separation
- pH adjustment
- Size reduction
- Solvent washing
- Thermal desorption

Lets go to Training Tool Guideline I: Module C Environmentally sound disposal of POPs waste

- Hazardous Waste incineration --→Alwin Booij
- Cement kiln co-incineration
- Alkali Metal Reduction → Michael Müller

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Cement kiln co-incineration

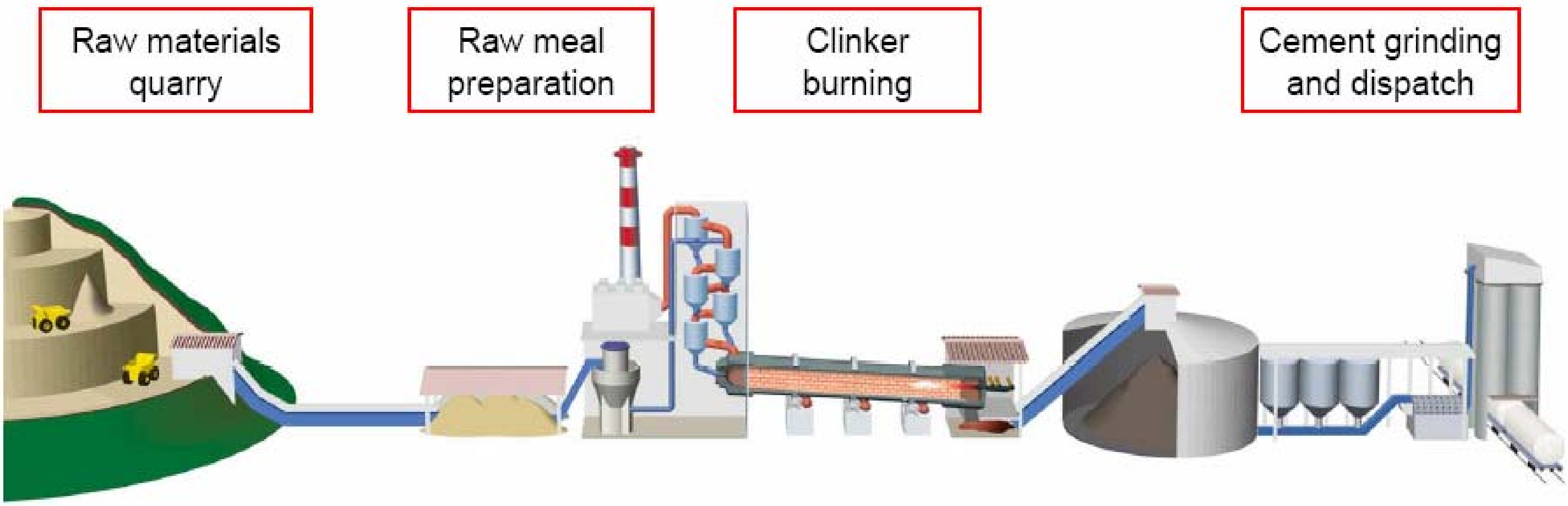
Cement kilns are designed to produce cement. However, due to the high temperature, which reaches 1,400°C- 1,500°C, these kilns are able to destroy POPs waste.

Cement kilns are particularly used for the destruction of PCBs as the destruction and removal efficiency is higher than in hazardous waste incinerators. These kilns can [redacted]lso be used for other POPs in liquid and solid form. The use of POPs as a fuel will [redacted]lso reduce fuel costs for the production of the cement.

Pre-treatment may include thermal desorption of solid waste and homogenization of solid and liquid wastes. The treatment of POPs waste has to be properly designed and operated in order to be relatively safe.

Cement kilns are large plants that require a lot of space compared to non-combustion techniques. Cement kilns are fixed installations.

The cement manufacturing process in a nutshell

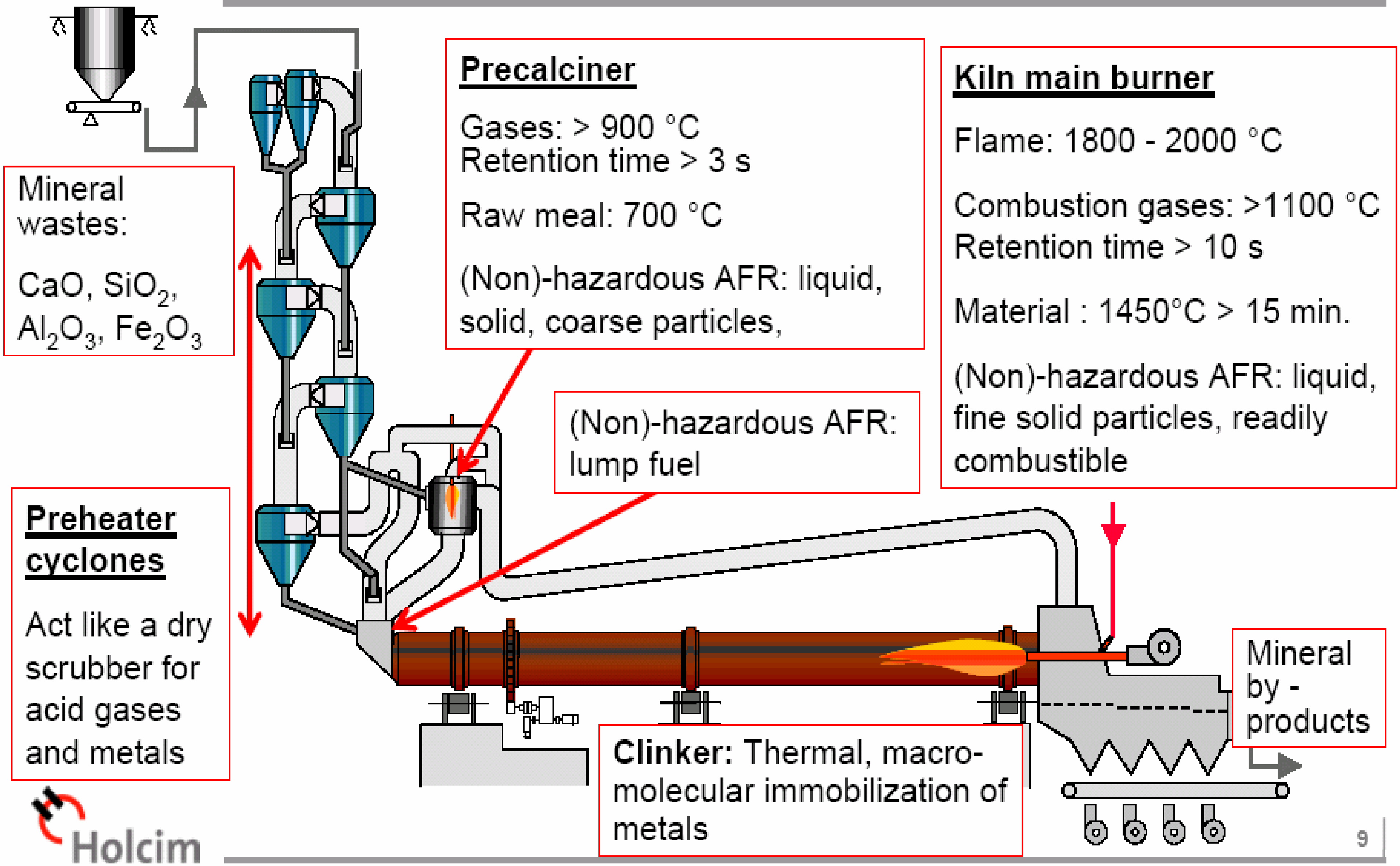


Raw meal
- Ca: limestone
- Si: e.g. sand
- Fe: e.g. pyrite
- Al: e.g. clay

Clinker
- Calcination & burning at 1,450 °C
- Formation of clinker minerals
  → C2S, C3S,
  → C3A, C4AF

Cement
- Grinding with gypsum (OPC)
- Blended cement with
  → slag, fly ash
  → filler...

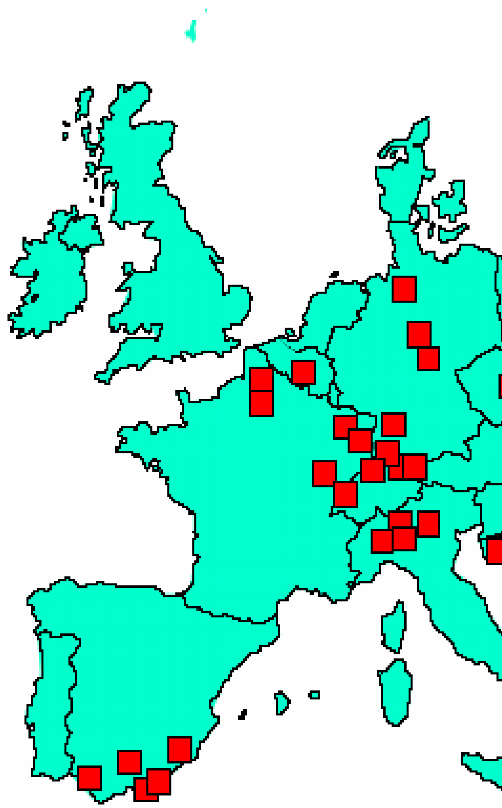
Technical characteristics of the cement kiln



…but it is also an opportunity as the example from the European Union clearly shows

Alternative fuels by source classes and respective quantities 2002

■ 35 Holcim Cement plants



Waste co-processed (2002)

Benelux	350.000 t
France	400.000 t
Switzerland	180.000 t
Germany	200.000 t
Italy	150.000 t
Spain	150.000 t
Others	120.000 t
TOTAL	1.500.000 t

Source class	%	Quantity [t/a]
Waste management	36.0	534‘600
Agricultural	13.1	194‘500
Thermal processes	19.5	289‘600
Chemical	10.3	153‘000
Petroleum	5.0	81‘700
Metal	6.5	96‘500
Wood	5.0	74‘200
Tires	1.3	19‘300
Pharmaceutical	1.3	19‘300
Automotive	1.0	5‘300
Electronics/photographic	0.2	3‘000
Glass	0.1	1‘500
Mechanical	0.1	1‘500
Plastics, paints, miscellaneous	0.1	1‘500
TOTAL Europe	100.0	1‘475‘500

A large variety of wastes, hazardous or not, can be co-processed

Strengths and weaknesses of cement kiln co-incineration for POPs waste treatment

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- Can treat hazardous wastes as fuel to a maximum of 40 % of heat requirement
- Cement kilns with high throughput may treat significant quantities of waste
- PCBs demonstrated, should be applicable to other POPs
- Can treat liquid and solid wastes
- Pre-treatment by thermal desorption or blending of waste
- Fixed plants – no mobility costs
- Much experience and success with reliable expertise and logistics
- DREs greater 99.99998%
- Comparable cost-effectiveness

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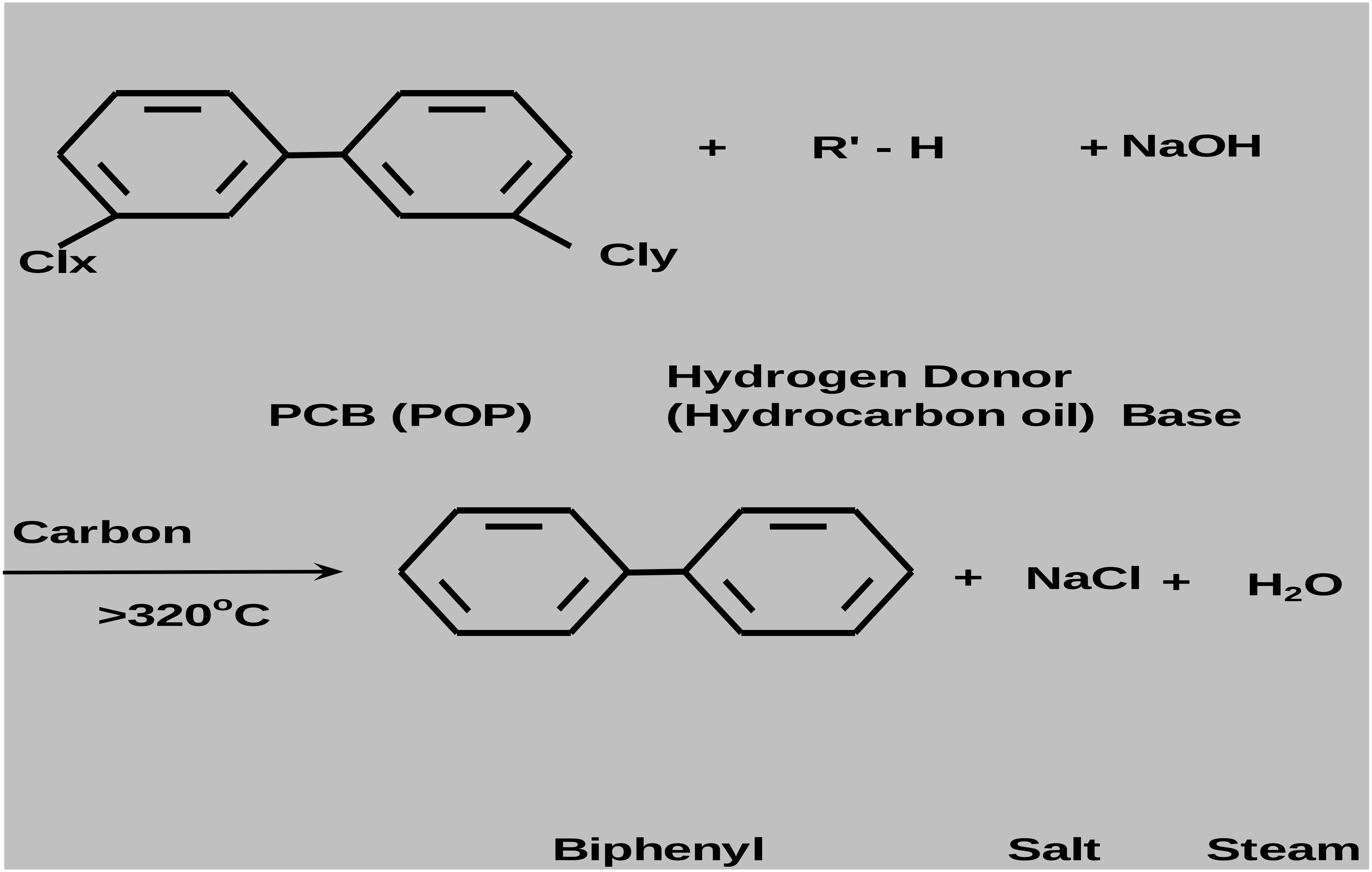
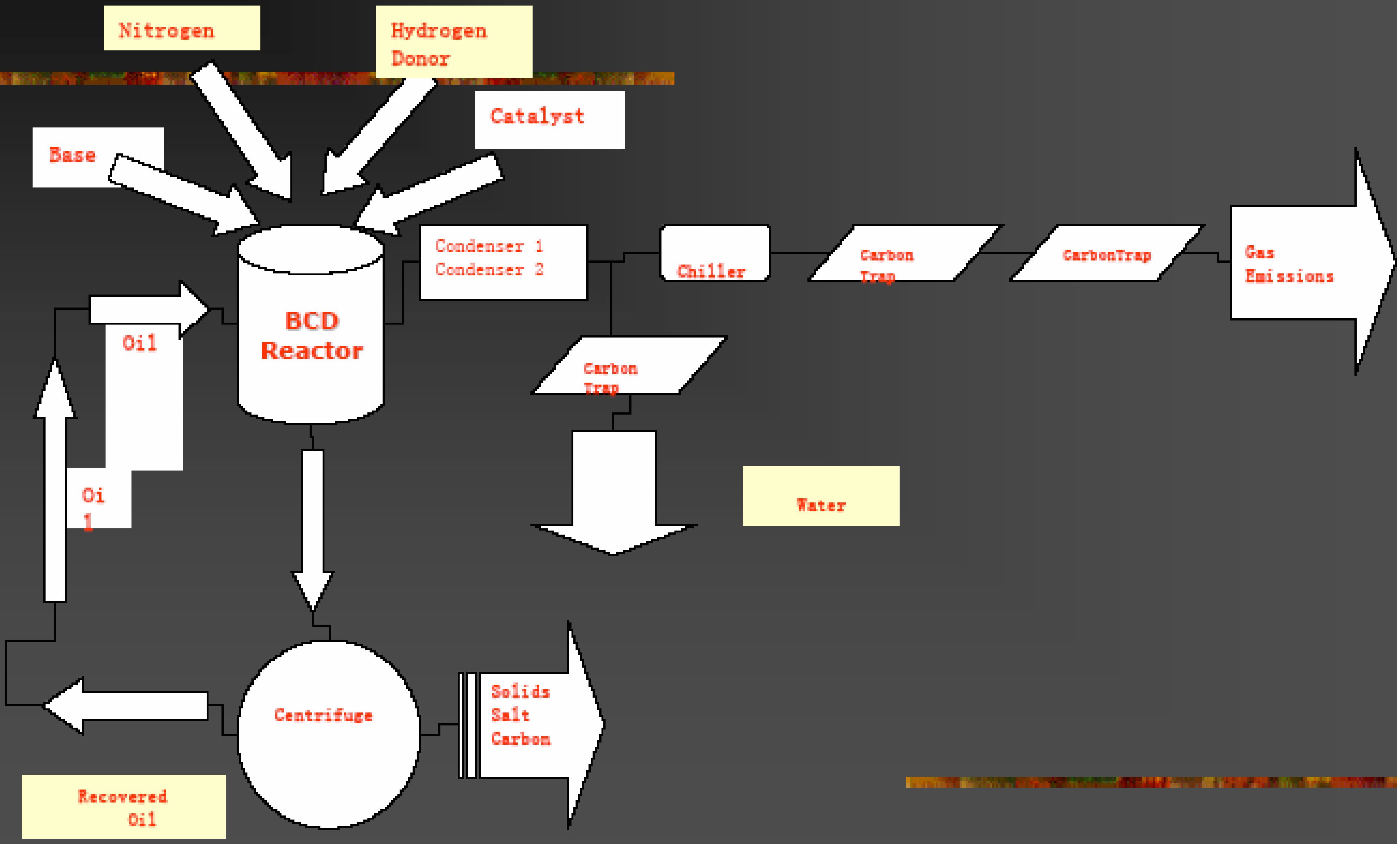
- Remainder may require disposal at specially engineered landfill
- Modifications to rotary kiln may be required for waste treatment
- Chlorine levels in waste can be critical; if blended down sufficiently, highly chlorinated hazardous waste can be treated
- Huge space requirements

BCD Technology description



BCD Flow Schedule



Mexico PCB plant

Major Breakthrough
Spolana Neratovice, Czech Republic

- Big project, large amounts
- Excellent period for technical optimization
- Extremely difficult
- Ideal project to eliminate all ”problematic” issues
- Sufficient budget
- Ideal to combine with thermal desorption
- This is often lacking for alternative technologies

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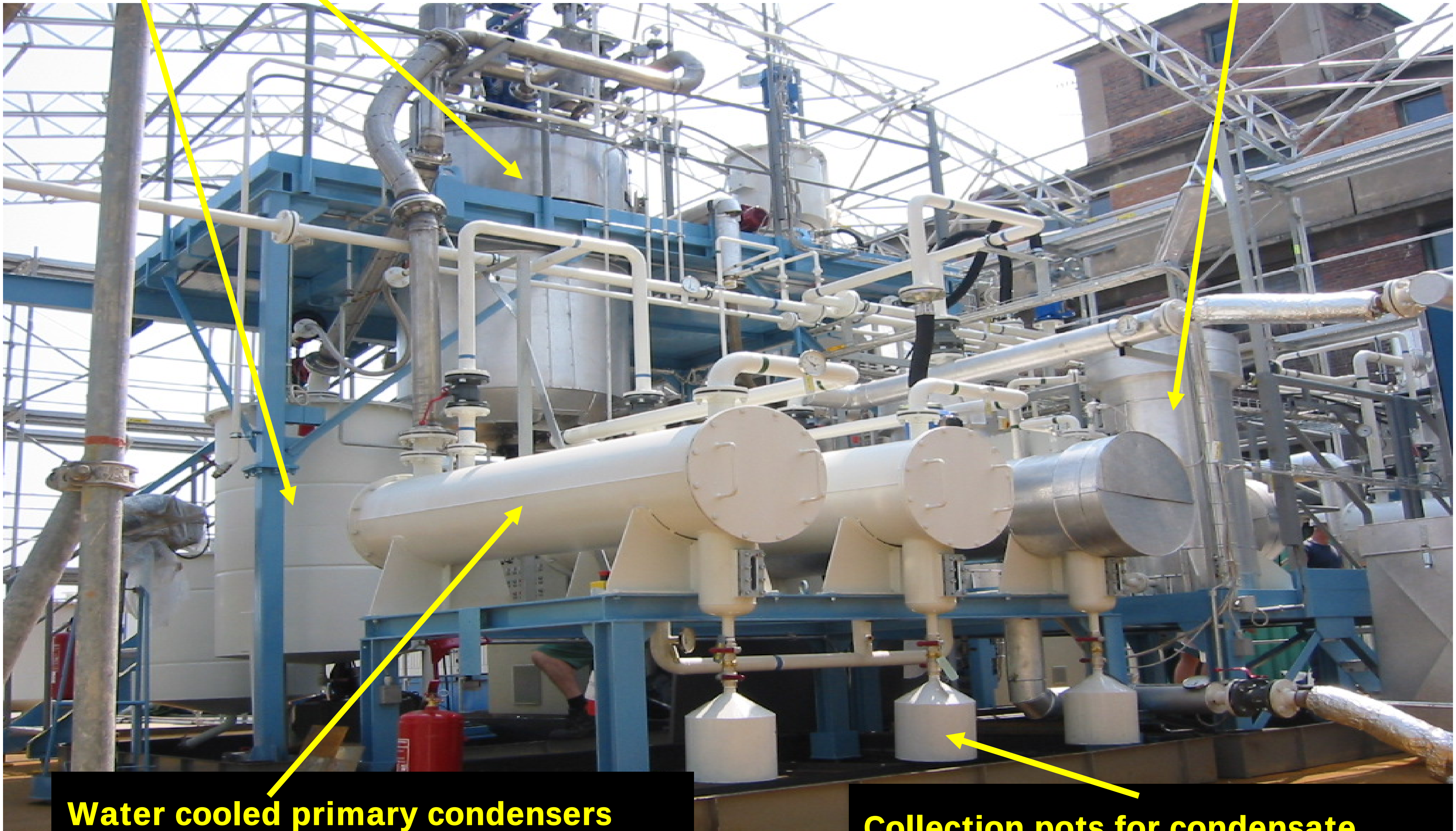
BCD Pilot Plant - Spolana



Strenghts and Weaknesses → Training Tool

Strengths and weaknesses of BCD for POPs waste treatment

- Simple process
- Proven technology
- Re-use 90-95% of donor oil
- Treatment of POPs with high concentrations possible
- DEs greater than 99.99% achievable
- Capacity of 1000 t/y
- Modular, transportable and fixed plants
- Relatively low energy consumption
- Air emissions expected to be relativelyminor
- Potential for PCDDs/PCDFs formation relatively low

- Pre-treatment needed with solvent extraction for transformers and capacitors
- PCDDs eventually formed from chlorophenols under alkaline conditions at 150°C
- If remaining sludges cannot be treated for use as a neutralizing agent, then disposal in a landfill is necessary

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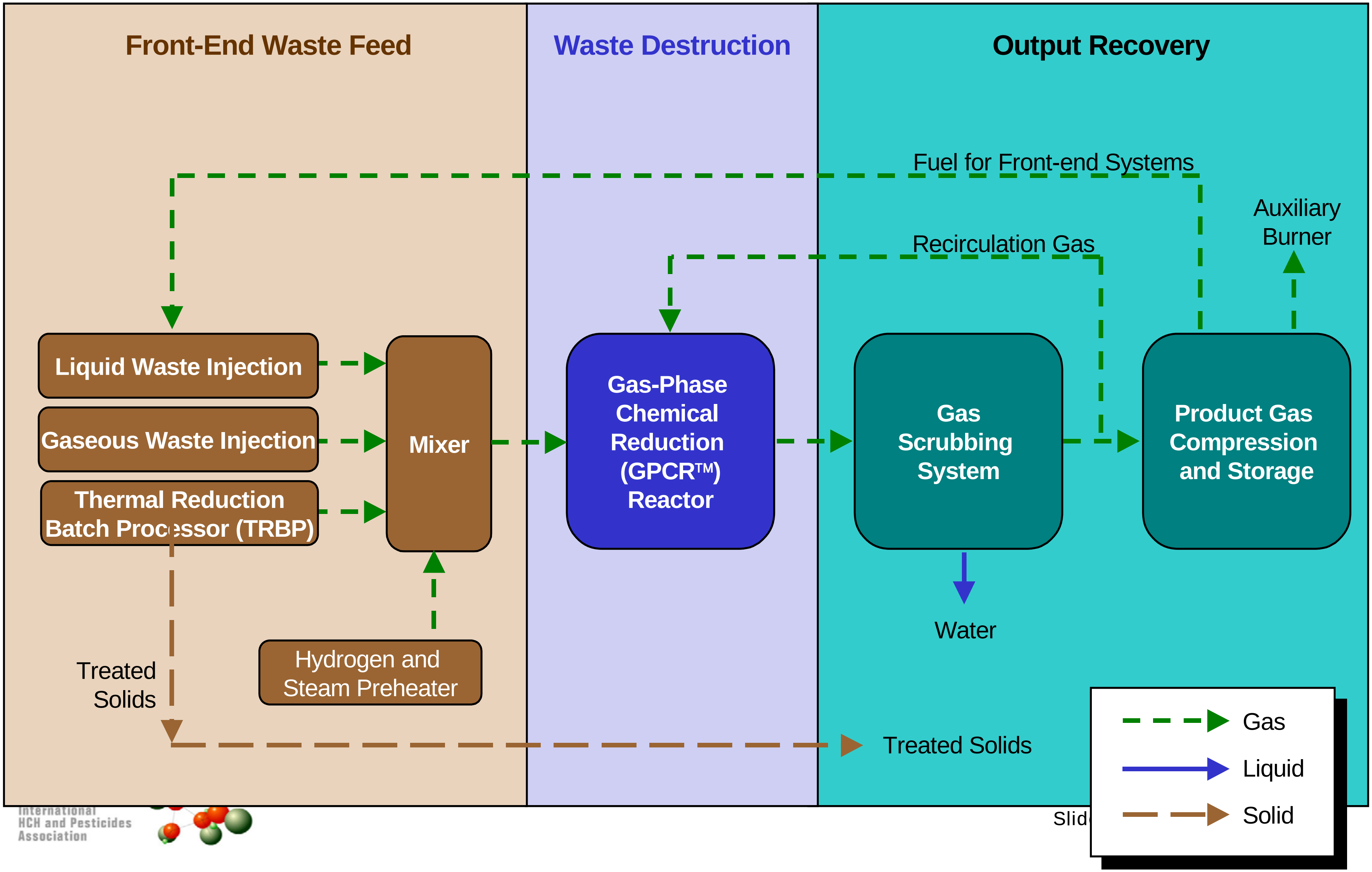
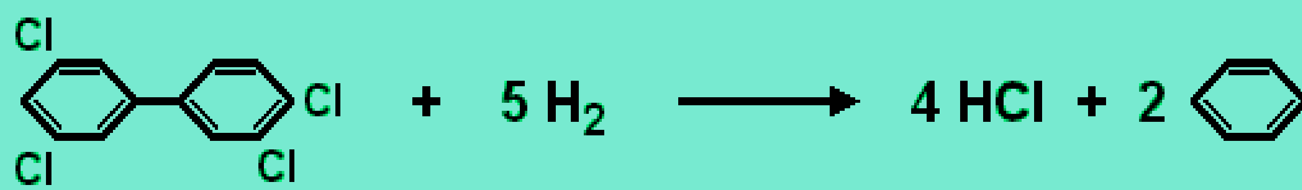
GCPR: Gase Phase Chemical Reduction

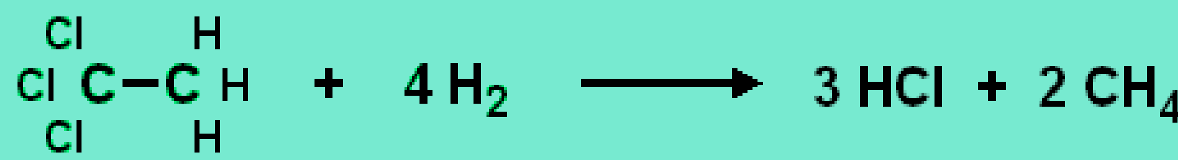


Principal chemistry

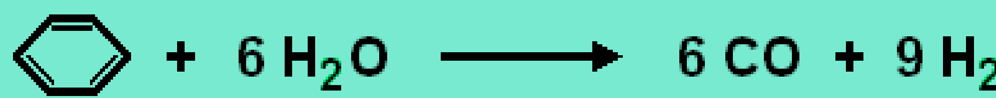
Reduction of a PCB Molecule



Reduction of a Chloro-Alkane



Steam Reforming of Benzene



Steam Reforming of Methane

$$CH_4 + H_2O \longrightarrow CO + 3\,H_2$$

Steam Reforming of Carbon Monoxide

$$CO + H_2O \longrightarrow CO_2 + H_2$$

Drummed HCB waste placed inside of the SBV in Kwinana, Australia

SBV used in Kwinana, Western Australia

Kwinana plant Australia

Strenghts and Weaknesses → Training Tool

Strengths and weaknesses of GPCR for POPs waste treatment

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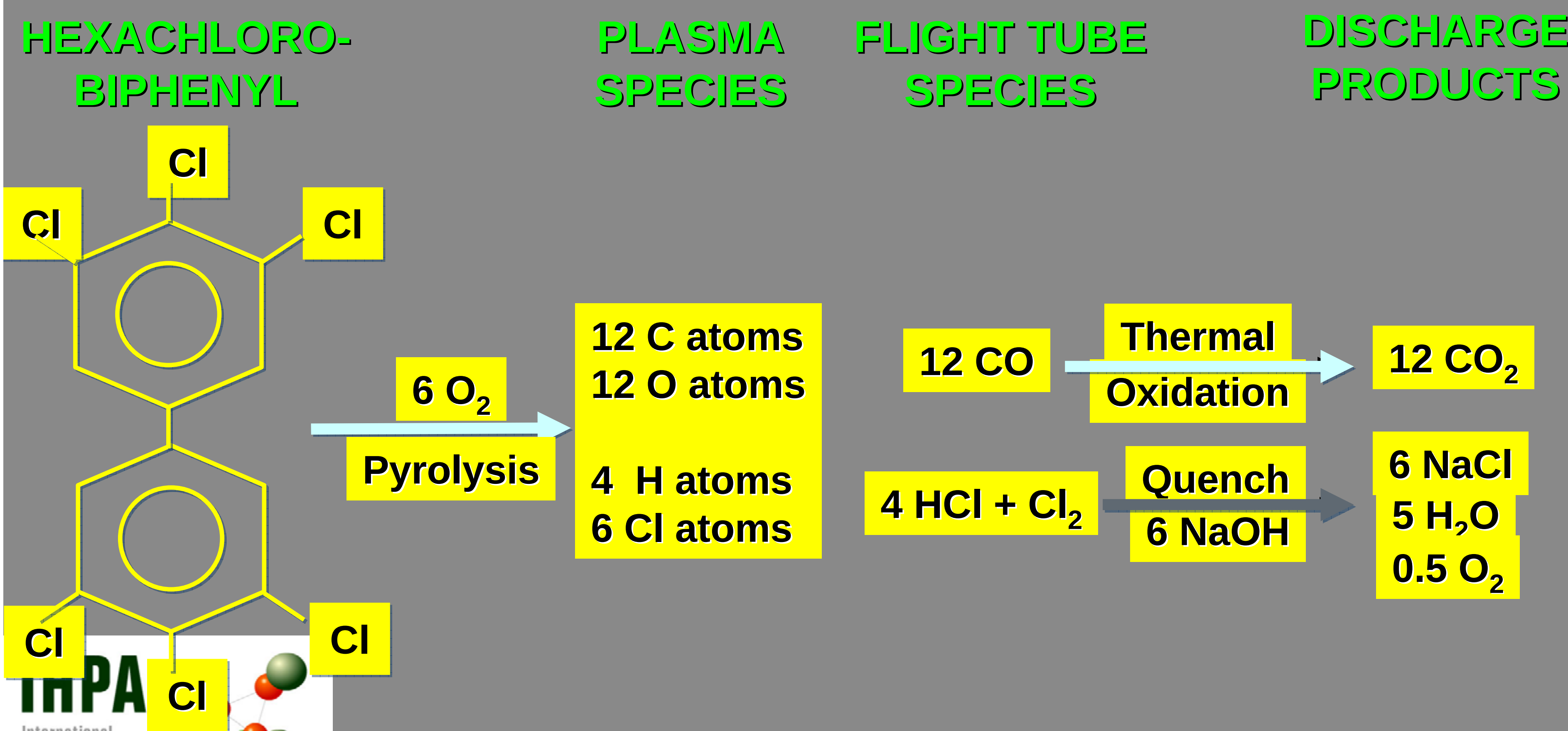
- Handles all kind of wastes
- Proven technology
- High destruction rates (99.9999%)
- Minimum operator exposure
- Mobile and fixed units
- Possibility of PCDD/PCDF formation is considered limited

−

- Not cost- effective for wastes with low POP concentrations
- Costly to operate
- Pre-treatment required
- High power use
- Complex and labour intensive
- Need for hydrogen which requires a need for high quality risk management
- Residuals require off-site disposal

Plasma Arc (Plascon)

DESTRUCTION OF TYPICAL PCB WASTE



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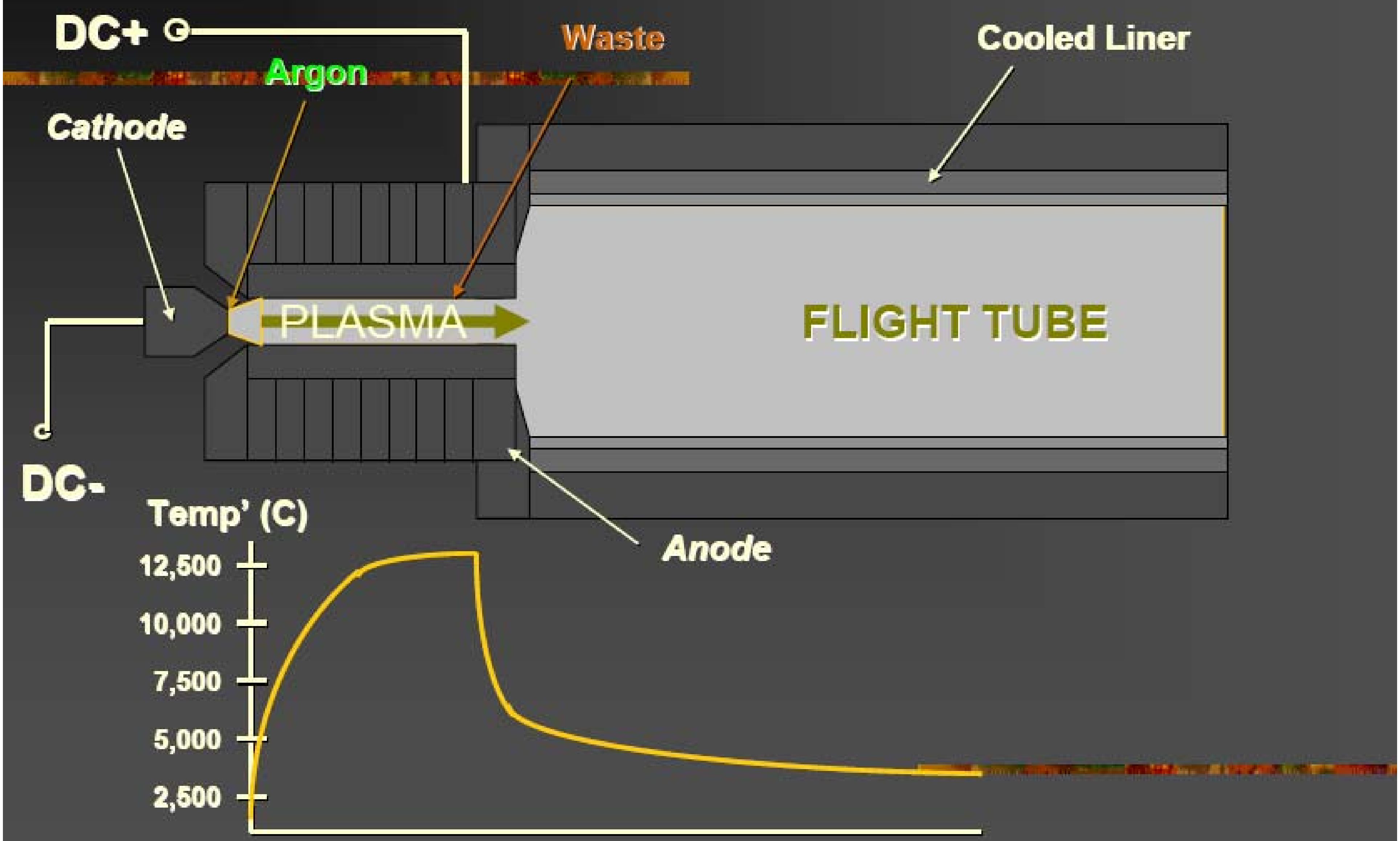
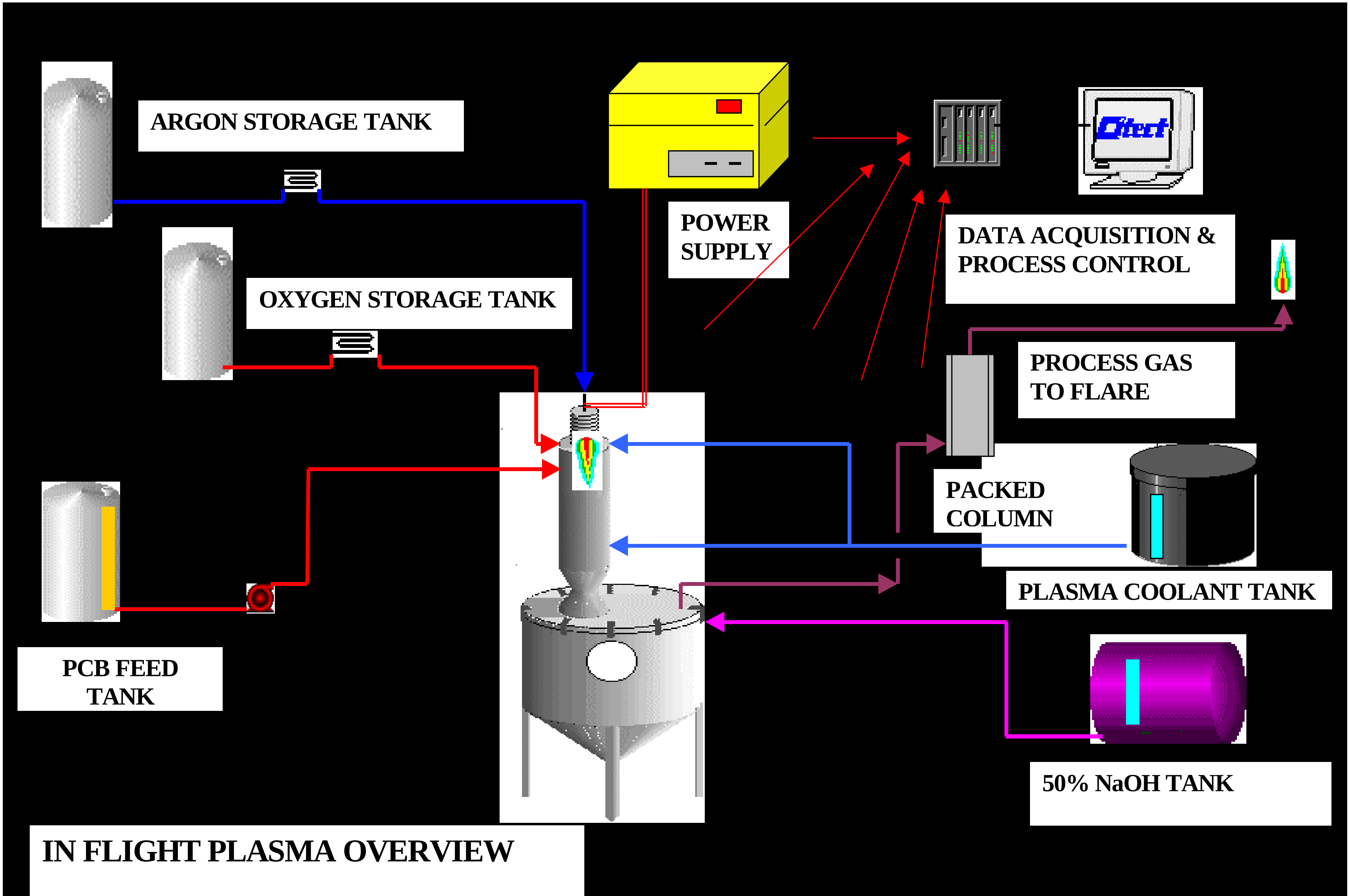
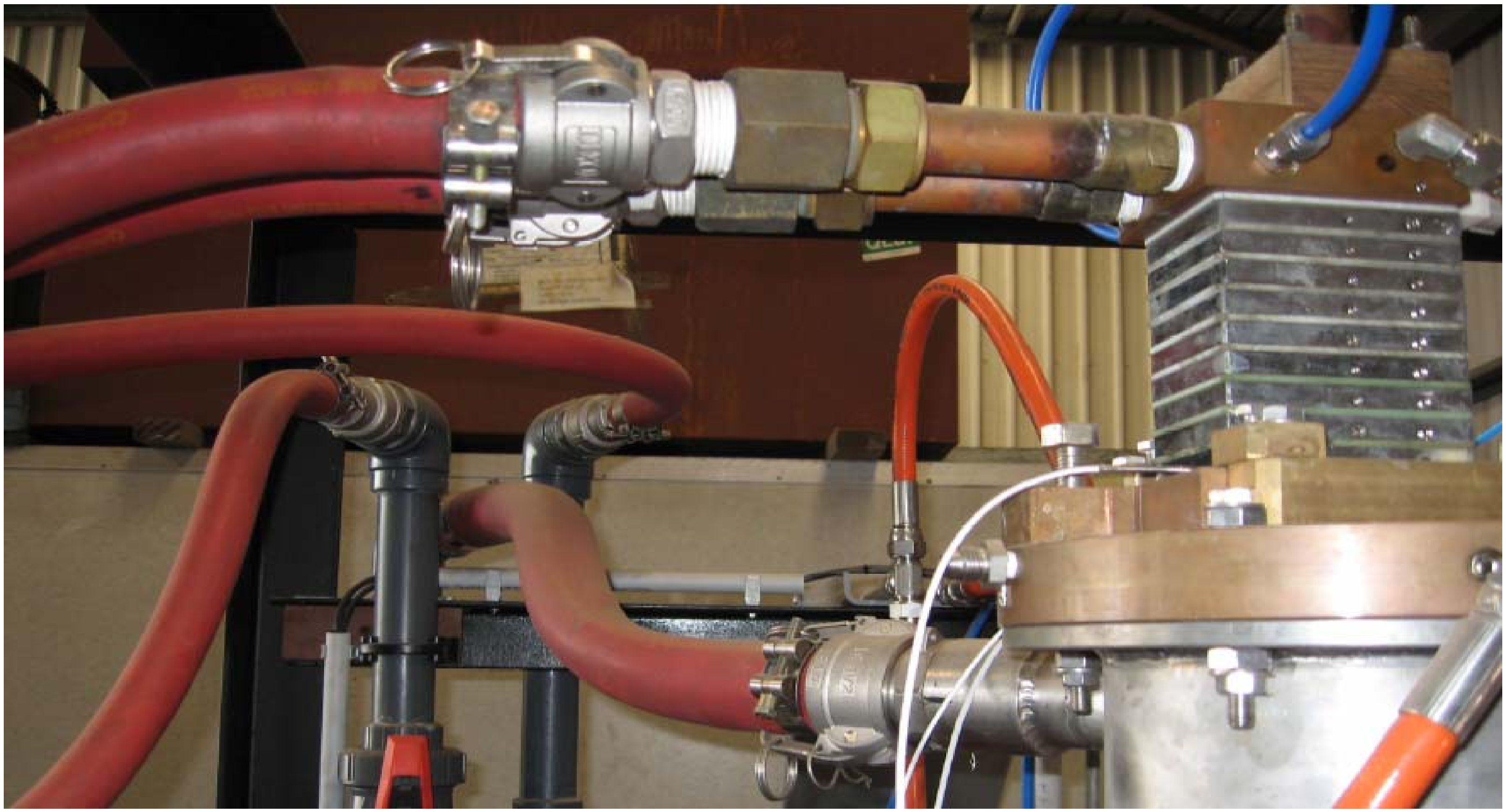
PLASCON TORCH & FLIGHT TUBE




ARGON STORAGE TANK
OXYGEN STORAGE TANK
POWER SUPPLY
DATA ACQUISITION & PROCESS CONTROL
PROCESS GAS TO FLARE
PACKED COLUMN
PLASMA COOLANT TANK
PCB FEED TANK
50% NaOH TANK
IN FLIGHT PLASMA OVERVIEW

Close up of torch



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PLASCON- ODS Unit

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Strenghts and Weaknesses → Training Tool

Strengths and weaknesses of PLASCON for POPs waste treatment

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- Proven technology
- Handles all wastes
- No pre-treatment for gas and liquid wastes
- Easy set-up and handling
- Few operators required
- Limited space required
- POPs with high concentrations can be destroyed
- High destruction rates (99.9999 - 99.999999%)
- Fixed and mobile units available
- Low amount of residues
- Simple gas treatment

– –

- Small capacity
- Argon use required
- High electrical power usage
- Generally costly to operate
- Metal-like compounds may cause problems for residue disposal

Specially engineered landfill → Training Tool

- Only when both irreversible transformation and destruction are not the environmentally preferable option

How much obsolete Pesticides have been destroyed? Not yet updated

- Obsolete pesticides: last 7-10 years
- *Incinerators in Europe 25-30 000 t*
- *Alternative technologies 5 000 t*
- PCB’s:
- *Incinerators in Europe 100 -115 000 t*
- *Alternative technologies 15 000 t*
- *Chlorphenols Alt tech* ***7000 t***

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Status on destruction

- More than 75-90% of all pesticides are destroyed by the dedicated incinerators mainly in Europe
- Major interest by international Cement industry to cut energy costs by co-incineration of waste and also POPs and pesticides in the future.
- Cement industry will start competition with hazardous waste incinerators, as they can save money on production costs for cement by co-incineration of high energy waste
- Alternative technologies: smaller part of market and work in specialised niches

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