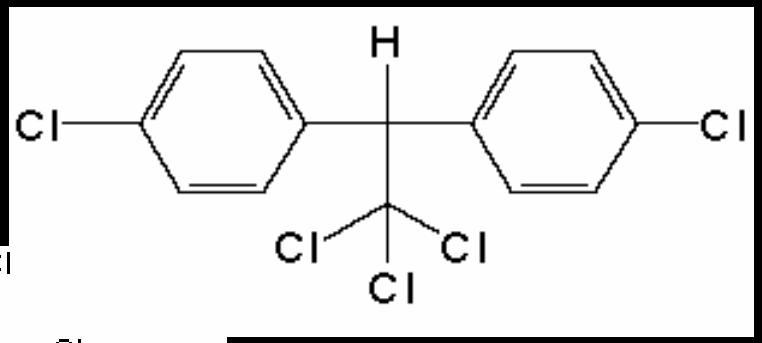
"Scaling up Experience in Improvement of Chemical Safety to Contribute to Poverty Reduction in Rural Armenia"
Yerevan – March, 29th – 2010

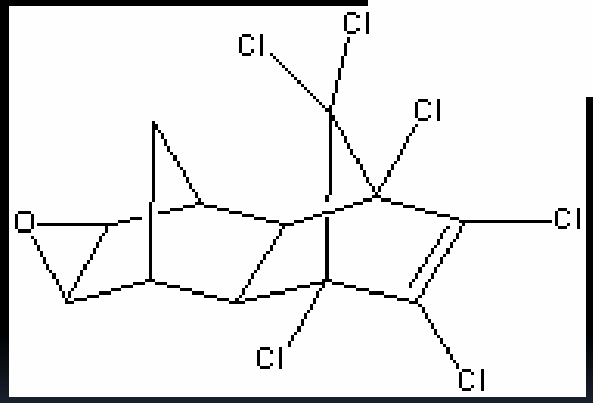
Technologies for Obsolete Pesticides Destruction and Clean-up Methods

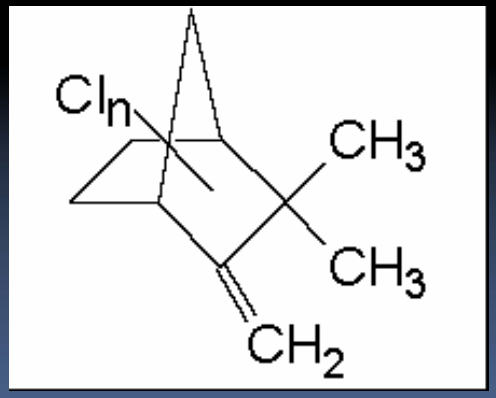
Jindrich Petrlik
Arnika – Toxics and Waste Programme

POPs pesticides

- DDT
- Lindane
- Aldrin
- Dieldrin
- HCHs
- Endosulfan
- and many others

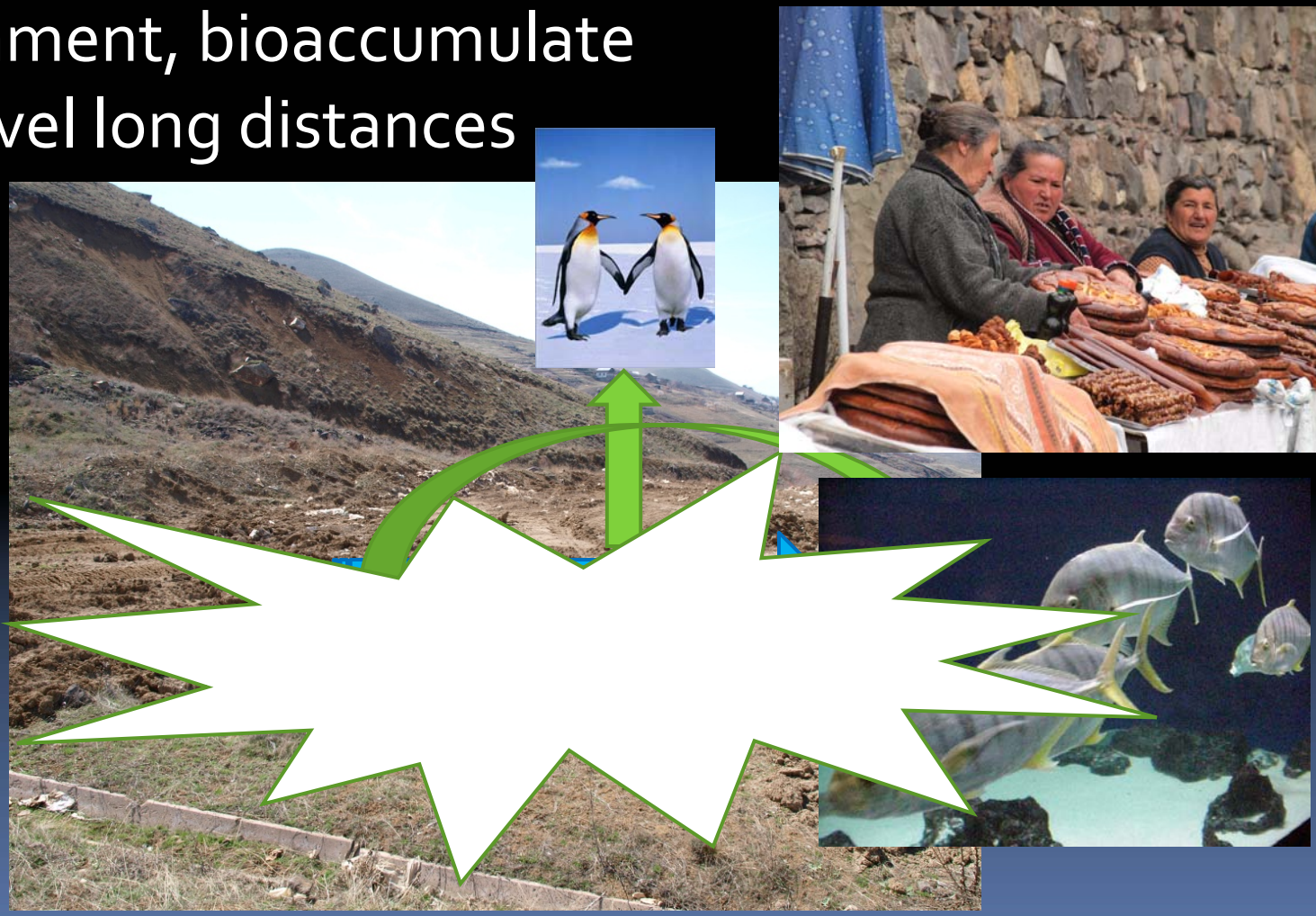






POPs – Why to destroy them?

- POPs persist in the environment, bioaccumulate and travel long distances



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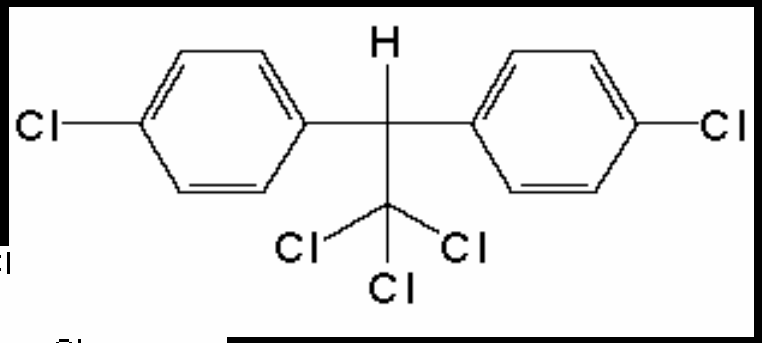
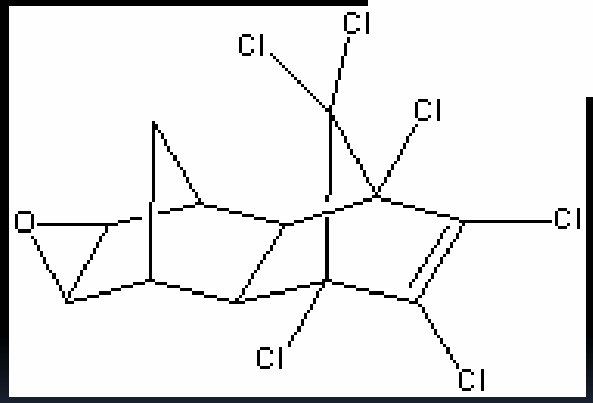
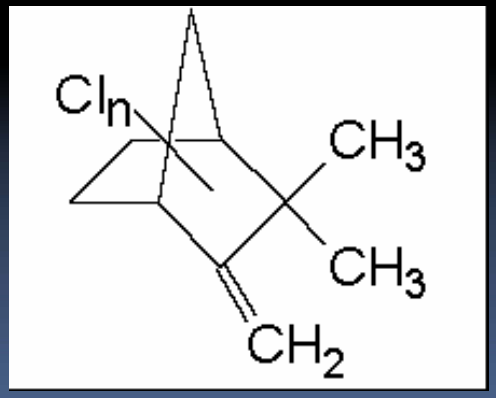






Cleaning up the mess

- Stockpiles of PCBs, pesticides, wastes
- Lands, sediments, groundwater, materials contaminated with DDT, PCBs, dioxins and other POPs
- Essential that this is done in a way that doesn't result in formation or release of POPs
- Use of non-combustion destruction technologies

Waste incinerator back end

Waste Incineration – dioxin releases

- Liberec Incinerator data (Czech Republic)

Total 3 – 7 g TEQ/year

- 3% of total dioxin releases were to air
- 3% of total dioxin releases were to bottom ash
- 94% of total dioxin releases were to fly ash

Waste incinerator and its fly ash (94% of dioxins) „storage“

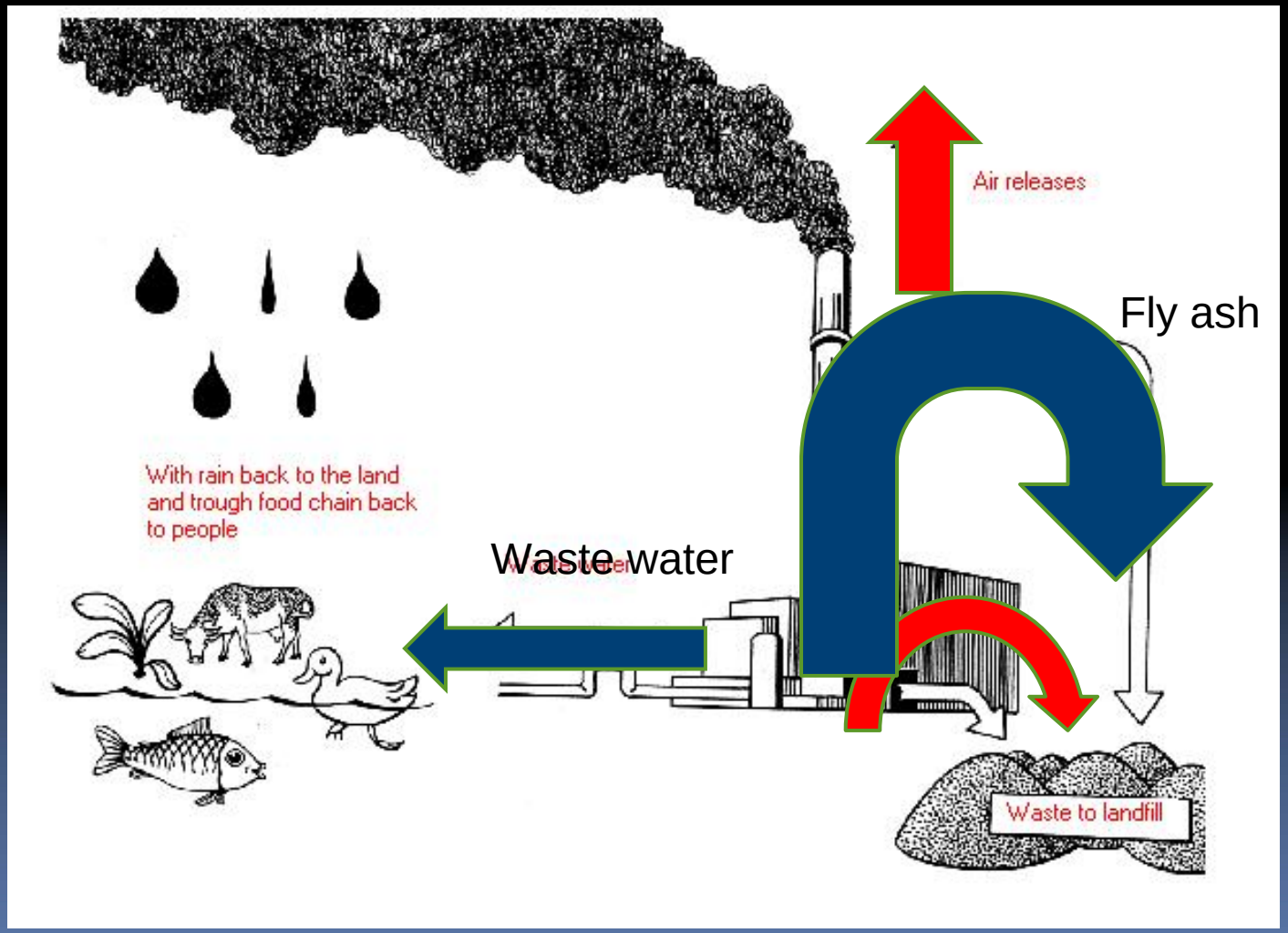
… a bicycle path

Dioxin realeases within EU

Community Implementation Plan for the Stockholm Convention:

- "… 20 kg/y in Europe with 20% emitted to air and around 80% discharged in the form of solid process residues entering the waste regime. "
- Burning of POPs waste creates new POPs

Destruction Efficiency X Destruction and Removal



Technologies - Criteria derived from Stockholm Convention

A suitable destruction process/technology should:

- Prevent the formation of dioxins, furans and other by-product POPs.
- Prevent the release of dioxins/furans and other by-product POPs.
- Not generate any wastes with POPs characteristics.
- Not utilise any POPs disposal methods which are non-destructive, such as landfilling or recycling in any form.

IPEN Criteria for the Destruction of POPs Wastes

Destruction … must be accomplished in a manner that does not further degrade the environment.

1. An effective destruction efficiency of 100% - taking into account all inputs and releases;
2. Complete containment of all process streams to enable testing and reprocessing if necessary to ensure;
3. No uncontrolled releases from the process.

Further Considerations when Evaluating Technologies

- Eliminate inappropriate technologies (based on guidance/criteria)
  E.g. formation of POPs/releases of POPs/POPs wastes/landfill etc
- Destruction Efficiency (based on inputs vs. all outputs)
- Ability to contain all process streams
- Ability to reprocess materials, residues, gases, liquids if required
- Availability of complete process information (analytical data)
- Track record/commercial availability
- Safety/OH&S
- Hazardous materials use
- Community acceptability

Non-combustion technologies

- GPCR – Gas Phase Chemical Reduction
- BCD - Base Catalysed Dechlorination
- Sodium Reduction
- Ball Milling

Some other emerging technologies:

- e. g. CMD - Copper Mediated Destruction

Technology	Commercial scale	Countries where licensed and/or used for commercial treatment
Gas Phase Chemical Reduction	full	Australia, Canada, USA, Japan
Sodium reduction	full	France, Germany, UK, Netherlands, South Africa, Australia, USA, Saudi Arabia, Japan, New Zealand
Base Catalysed Dechlorination	full	Australia, USA, Mexico, Spain, New Zealand, Japan, Czech Republic
Solvated electron	full	USA
Electrochemical	limited	USA, UK
Copper Mediated Destruction	pilot/limited	Poland, Czech Republic
Super-critical water oxidation	limited	USA, Japan
Ball milling	full	Japan

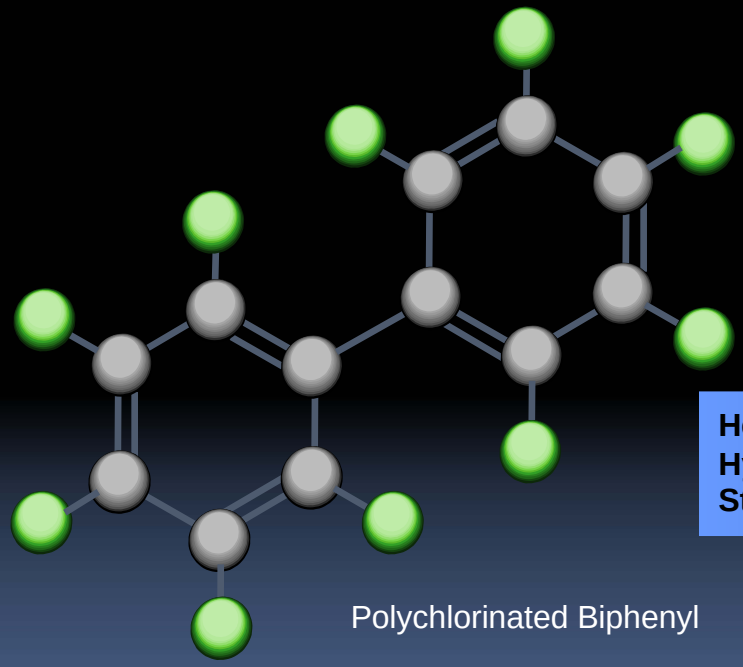
GPCR Gas Phase Chemical Reduction

This process has been reported to demonstrate high destruction efficiencies (DE) for HCB, PCBs, dioxins/furans contaminated wastes and mixed chlorinatedpesticides. In commercial scale performance tests in Canada, DEs of 99.999% have been reported for PCBs and HCB.

Gas Phase Chemical Reduction of PCBs

Technology Overview

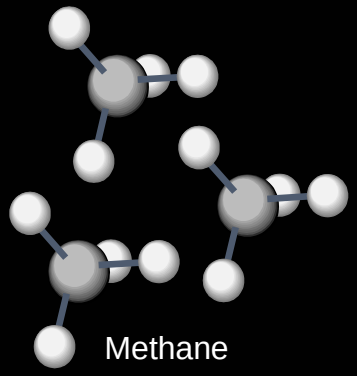
Gas-Phase Chemical Reduction of PCBs



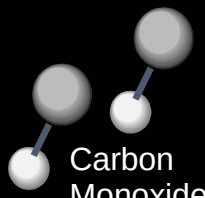
Polychlorinated Biphenyl

Heat (> 850° C)
Hydrogen (> 65%)
Steam (20-30%)

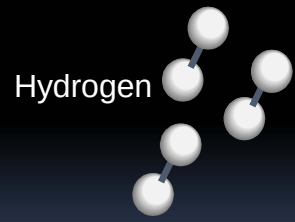
Principal Products from Gas-Phase Chemical Reduction of PCBs



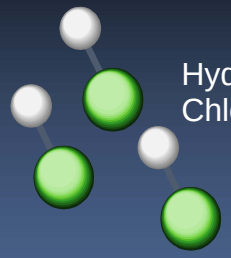
Methane



Carbon Monoxide



Hydrogen



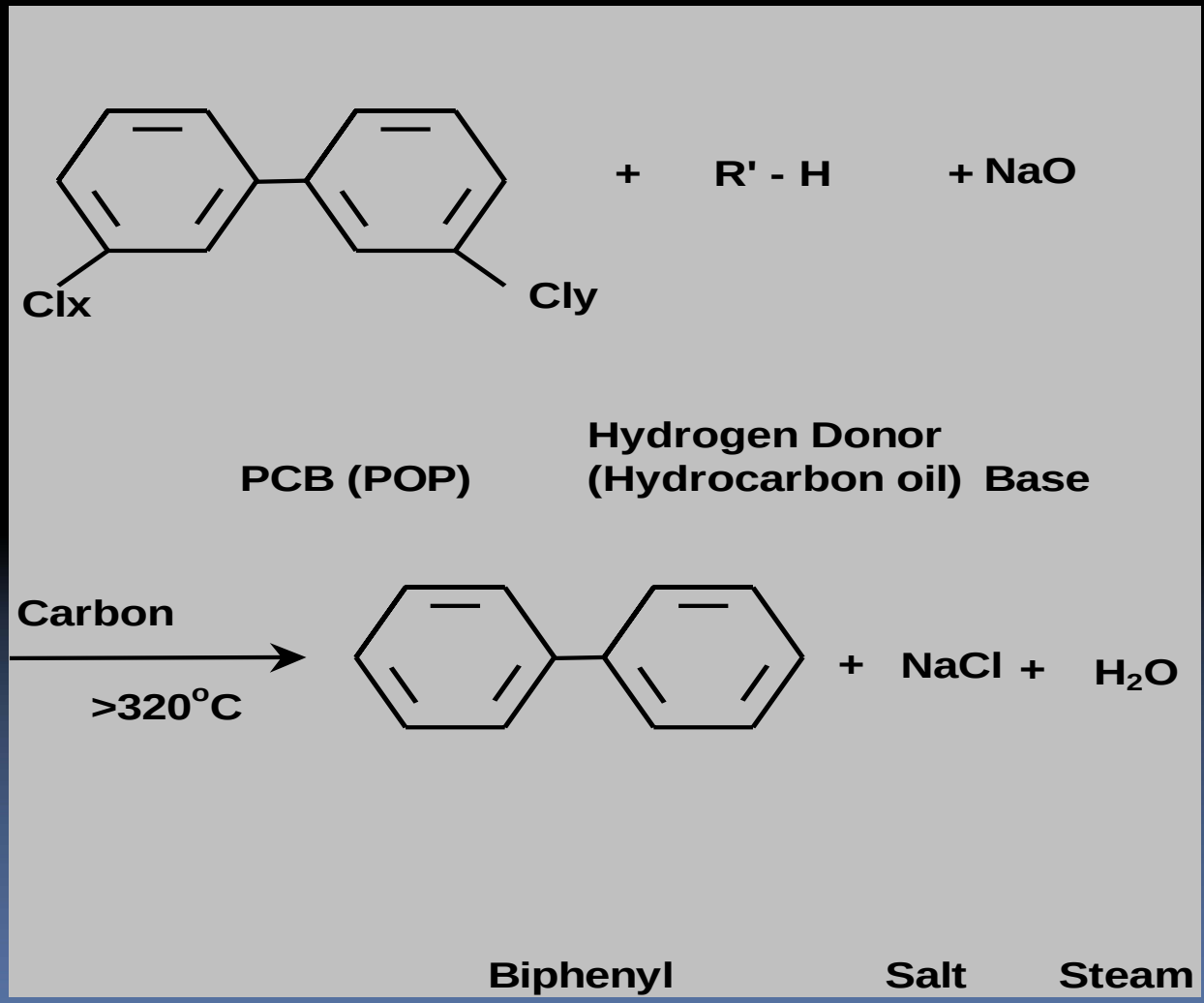
Hydrogen Chloride

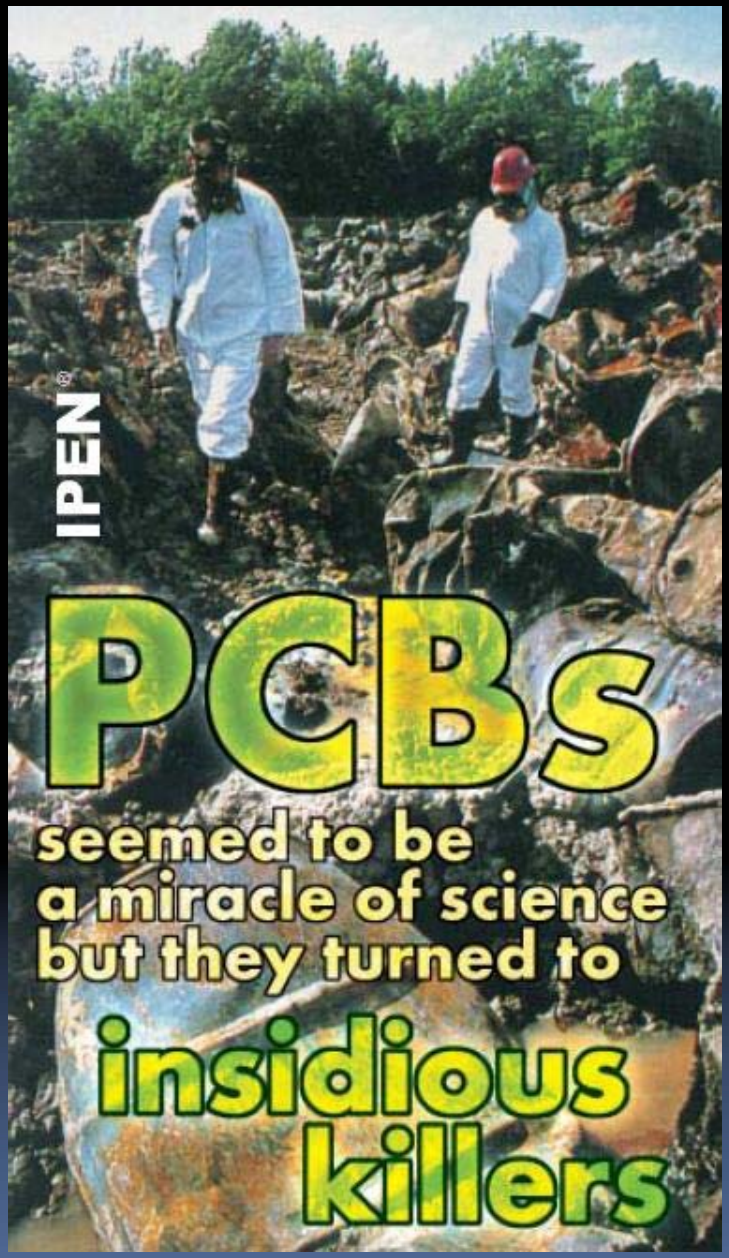
plus trace light hydrocarbons

BCD – Base Catalyzed Dechlorination

This technology has been employed to treat high strength POPs wastes contaminated with DDT, PCBs, dioxins and furans. DREs >99.99999% for 30% DDT input and >99.999999 for 90% PCB input have been reported. In trail operations, high Des have been reported for HCB, DDT, PCBs, dioxins & furans

The BCD Reaction

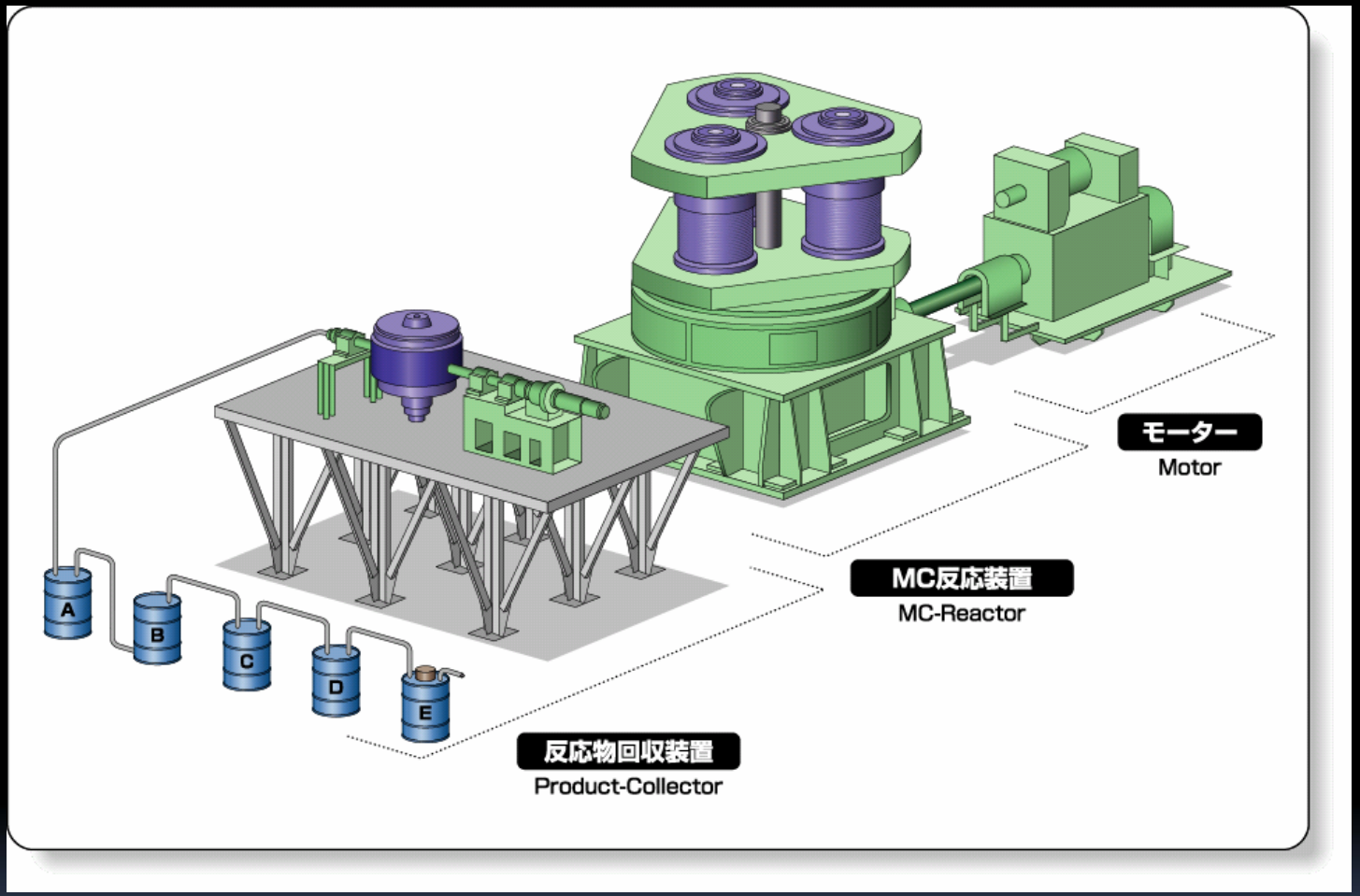




Sodium Reduction

This technology is considered well established and has been used commercially for a number of years for treating both low and high concentrations of PCBs contaminated oils.

Destruction efficiency (DE) values of greater than 99.999 percent have been reported for chlordane and hexachlorobenzene. For other POPs DE as well as DRE related to the SR process have not been reported.



Ball Milling

- Technology with a big potential for the future. Limited data available to evaluate DE or DRE values.

CMD
Copper Mediated Destruction

- Promissing technology, which is now in pilot operation used to clean up old environmental burden in Poland and can be potentially used to clean up contaminated site by DDT and lindane in Klatovy (Czech Republic). Advantage – cheap operation.

CMD Copper Mediated Destruction

Compound	Before destruction (ng/g)	After destruction (ng/g)
α-HCH	80	<1.5
β-HCH	56	<2.1
γ-HCH	5340	4,5
δ-HCH	38	<2.5
HCB	43	<0.6
o,p-DDE	385	<1.1
p,p´-DDE	2760	<1.4
o,p-DDD	183	<1.9
p,p´-DDD	175	<1.9
o,p-DDT	4040	<2.4
p,p´-DDT	2630	<6.6
Σ HCH	5514	4,5
HCB	43	BLOQ
Σ DDT	10173	BLOQ
Σ OCP	15730	4,5

CMD Copper Mediated Destruction

Compound	Gamadyn – before destruction (µg/g)	After destruction (µg/g)
γ-HCH	2910	<0.0033
p,p´-DDE	530	<0.015
p,p´-DDD+*op* DDT	5320	<0.023
p,p´-DDT	68900	<0.0095
Σ OCP	77660	<0.051

Non-combustion technologies

- There are available alternatives to waste incineration for destruction of POPs pesticides
- These alternative technologies were already used to clean up contaminated sites in Central and Eastern Europe
- Some of them are expensive, but there are also available emerging cheaper technologies close to commercial scale operation
- Use of these technologies in more operations will make them even more accessible to developing countries nad countries with economies in transition

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Thank you for your attention

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