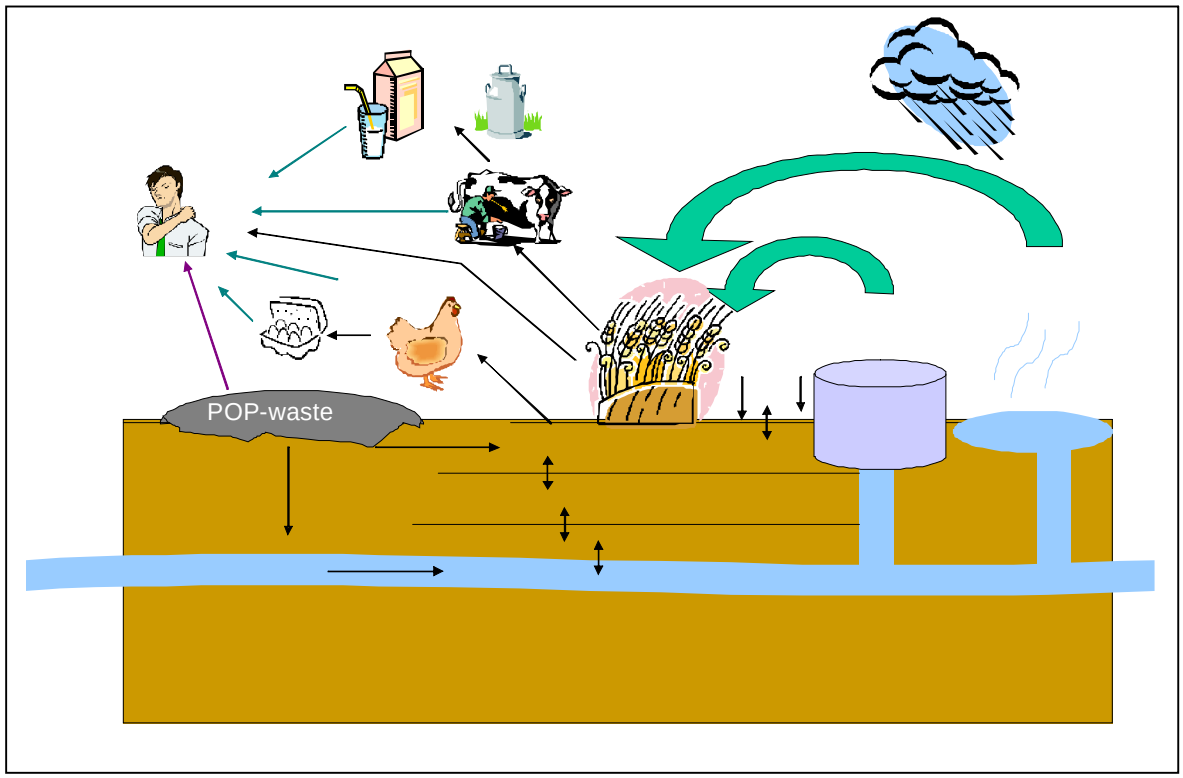
European Commission, Brussels

Study to facilitate the implementation of certain waste related provisions of the Regulation on Persistent Organic Pollutants (POPs)

REFERENCE: ENV.A.2/ETU/2004/0044

SUMMARY REPORT

August 2005



BiPRO
Beratungsgesellschaft für integrierte Problemlösungen

1 Background and Objectives

The background of the project is formed by several internationally binding instruments on POPs. Of most importance is the "Stockholm Convention" aiming at reducing and eliminating the production, use and releases of persistent organic pollutants. It includes specific provisions for the environmental sound management of wastes consisting of, containing or contaminated by POPs (hereafter called “POPs waste”). The European Regulation on persistent organic pollutants (2004/850/EC) implements the international commitments. Annex IV lists14 POPs substances and substance classes for which concentration limits must be adopted until the end of 2005. Above those limits the POPs content in waste shall be subject to destruction or irreversible transformation. Waste containing POPs above the concentration limits may be otherwise managed if destruction or irreversible transformation does not represent the environmentally preferable option. This derogation applies only to wastes which meet the maximum concentration limits to be laid down in Annex V and other conditions therein.

Against this background there are four major objectives of the project stated by the European Commission:

- compile and evaluate existing data on occurrence and levels of POPs in different waste categories and on existing concentration limits for POPs in waste.
- elaborate and apply a methodology to propose specific low and maximum concentration limits for the 14 POPs substances and substance classes laid down in the Regulation.
- elaborate and apply methodology, processes and criteria to assess the cases in which destruction or irreversible transformation do not represent the environmentally preferable option for management of waste with a POP content above the established limit values.
- to propose reference measurement methods for the determination of the 14 POPs substances and substance classes in waste.

The study results are based on a comprehensive data compilation carried out for European and other developed countries and on assessment methodologies developed during the project.

2 POP Mass Flows

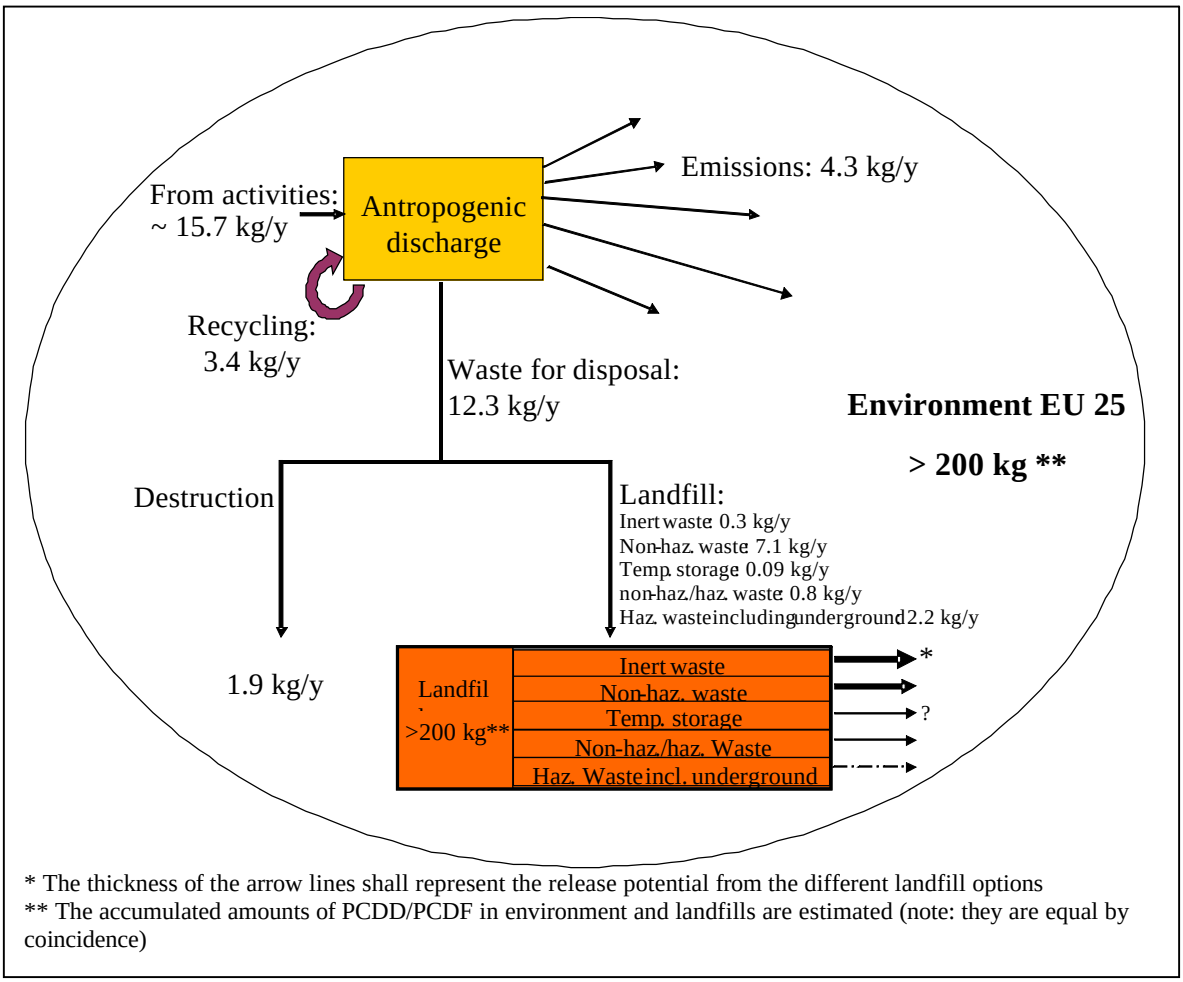
2.1 *PCDD/PCDF[1] quantities and concentrations*

PCDD and PCDF have never been produced intentionally but can be formed unintentionally during a number of production processes as well as via new formation from precursor substances in a specific temperature frame (200 – 450°C) during combustion processes in various industrial sectors (power production, waste incineration, metallurgical industry, cement production, domestic burning, etc.). New formation is especially important if certain catalysts (e.g. copper) or chlorine precursors are present in the feed material.

[1] Polychlorinated dibenzodioxins and polychlorinated dibenzofurans

Besides industrial and domestic "sectors" PCDD/PCDF originate from natural sources like forest fires or volcanic eruptions. PCDD/PCDF are ubiquitously present in the environment via emissions, long-range transport, atmospheric deposition and environmental cycling. In consequence they also occur in waste streams like municipal solid waste, municipal sewage sludge, compost or waste from agricultural production.

Investigated mass flows of PCDD/PCDF amount to a dimension of 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. Overall air emissions seem to be dominated by domestic combustion of coal and derivatives. Most important sectors for discharge of PCDD/PCDF via residues are municipal solid waste (35%), municipal solid waste incineration (16.5%), power production (18.6%) and the ferrous metal industry with electric arc furnaces (10.3%) and sinter plants (8.4%). Detailed results and material flows on macro and micro dimension are available in the report.



* The thickness of the arrow lines shall represent the release potential from the different landfill options
** The accumulated amounts of PCDD/PCDF in environment and landfills are estimated (note: they are equal by coincidence)

Figure 1-1: Major pathways and amounts of PCDD/PCDF distributed in EU 25

2.2 *PCB[2] quantities and concentrations*

PCB were produced from 1954-1980 in amounts of 1– 2 million tons and were used mainly in the northern hemisphere. The total amount produced in Europe has been estimated to about 700,000 t. PCB have been used for example as plasticisers in open applications mainly for construction purposes and as hydraulic or insulating oils in electric and mining equipment. Besides this PCB can form during thermal processes by the same mechanisms as PCDD/PCDF, however the importance of this pathway is relatively small.

PCB enter the waste regime mainly via long-lasting products and construction material reaching its waste stage. The dimension of the these mass flows can be added up to about 6,250 t/y.

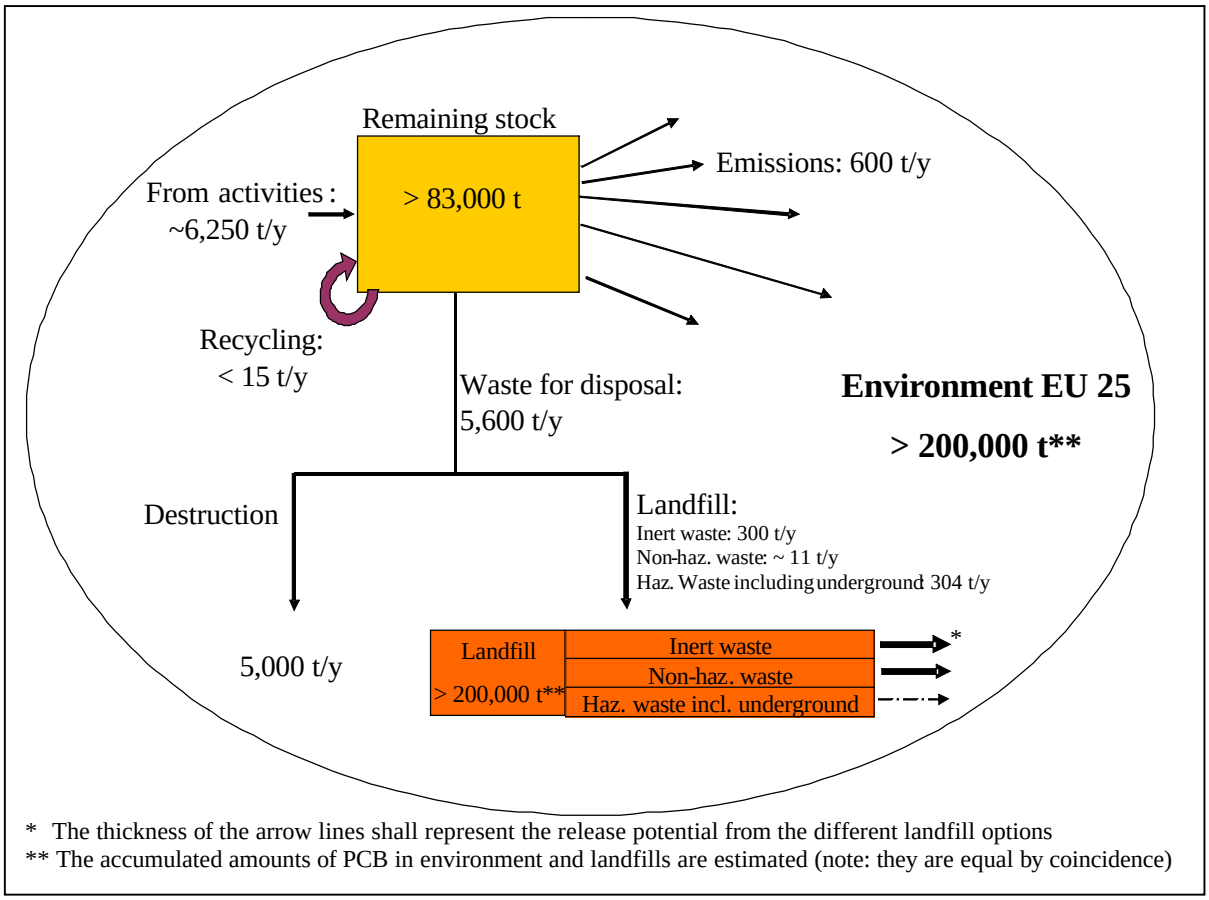


Figure 1-2: Major pathways and amounts of PCB distributed in EU 25

With respect to differences in contamination levels in environmental compartments and waste the following conclusions can be made:

PCB concentrations in a first group of wastes i.e. ashes, sewage sludge, compost range from 0.01-0.6 ppm. This is comparable or only moderately (1 order of magnitude) above levels observed in the soil compartment in Europe. In a second group of waste types including e.g. waste oil, shredder residues from end-of-life vehicles and white goods, levels in most cases are below10 ppm. For the plastic fraction of cable shredding and for ashes from domestic burning levels range from 10-30 ppm and are thus 2-3 order of magnitude higher than

[2] Polychlorinated Biphenyls

background concentrations observed in the environment. In a last group, which consists of C&D waste and PCB containing equipment concentration levels easily exceed 50 ppm and can reach concentrations of several thousands of ppm.

2.3 *POP pesticide quantities and concentrations*

POP pesticides like Aldrin, Dieldrin, Endrin, Chlordane, DDT, Heptachlor, Chlordecone, Mirex, Toxaphene have been largely produced and used as insecticides for crop and wood protection namely in the fifties and sixties of the past century and stockpiles are still existing in a number of countries. HCH including γ-HCH (Lindane) are discussed in the mass flow of other POPs as the mass for reasons of clarity, because a strict separation of quantities pertaining to pesticide use or to use as technical HCH/ non-pesticide use is not possible.

In addition there is ongoing production of DDT which is mainly used as precursor for Dicofol. Consequently two mass flows have to be distinguished for POP pesticides. However as production of DDT and use of Dicofol is not yet related to the waste regime only the reduction of stockpiles has currently to be considered. Provided a constant reduction over a period of ten years (2000-2010), this sector has a dimension of 537 t/y.

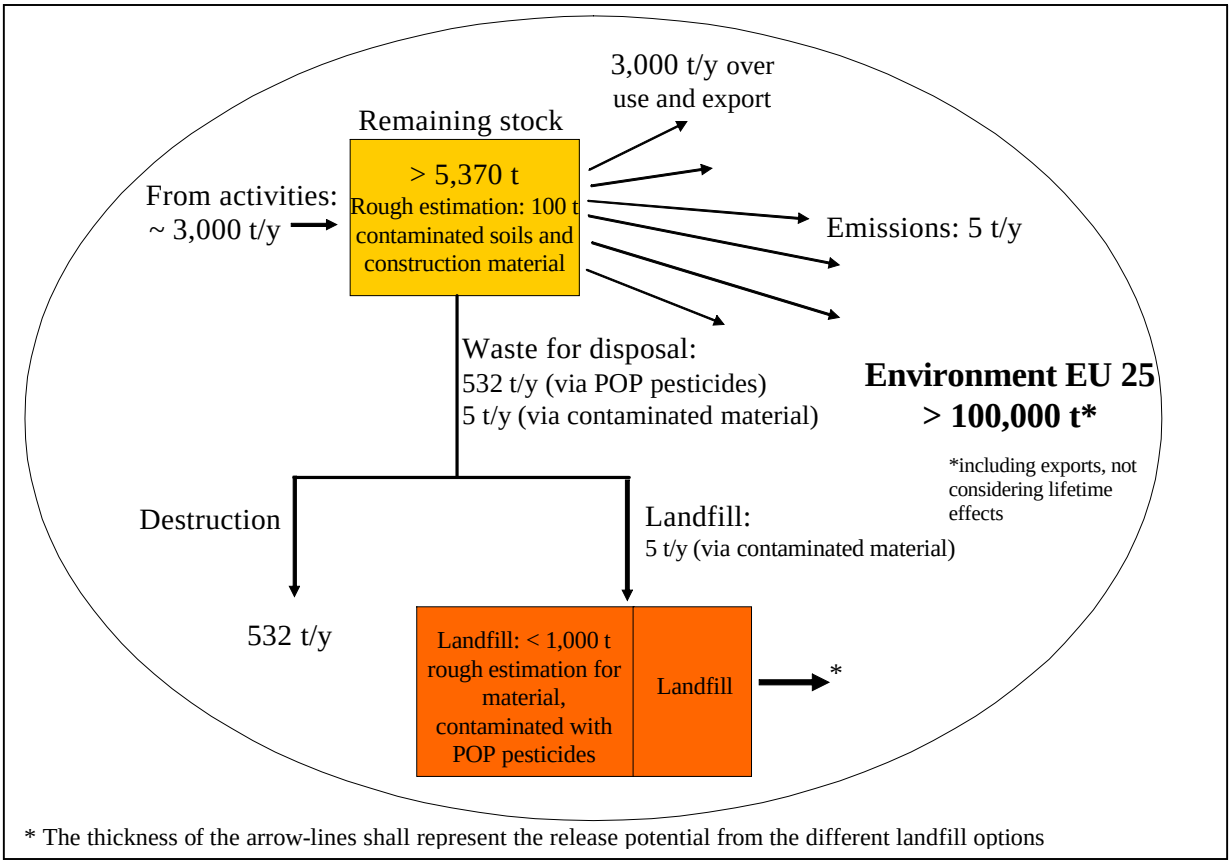


Figure 1-3: Major pathways and amounts of POP pesticides distributed in EU 25

2.4 *Other POP quantities and concentrations*

γ-HCH (Lindane) is still produced with an estimated volume of about 1,000 t/y for non-pesticide purposes. In addition HCHs including γ-HCH (Lindane) enters the waste regime via stockpiles from former production and use as pesticide and via contaminated soil and C&D waste from former storage or production sites. For reasons of clarity HCH has been completely included to the other POP mass flow, because a strict separation of quantities pertaining to pesticide use or to use as technical HCH is not possible. HCB is known to be formed in thermal processes like PCDD/PCDF and during chemical processes. However to date the importance of these sources is relatively low .

Hexabrominated Biphenyl (HxBB) was used as flame retardant in thermoplastics for electric isolation in cars and electronic devices up to the seventies mainly in the USA. Significant stocks can not be expected to occur in EU 25.

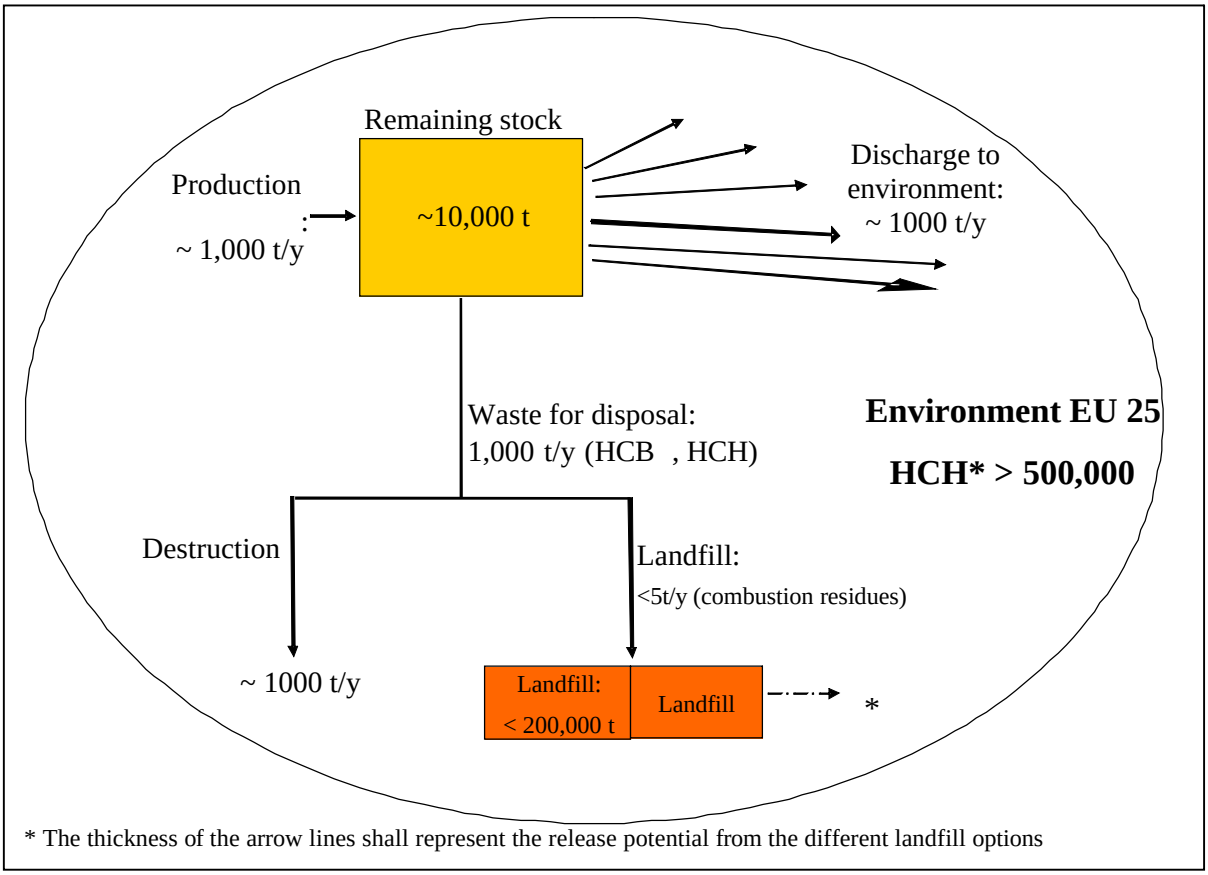


Figure 1-4: Major pathways and amounts of other POPs distributed in EU 25

Scarce contamination data for POP pesticides and other POPs suggest either high contamination in wastes or soil from contaminated sites (up to several hundred ppm) or low levels in the range of environmental contamination.

3 Legal framework

POP substances and POP containing preparations are subject to a number of regulations arising from different policy sectors and including international conventions as well as European and national legislation.

On the international level POPs are covered by Conventions focused either on environmental emissions and environmental and health protection or on transboundary transport and public information.

European waste legislation regarding POPs is relatively scarce. To date concentration limits for POP pesticides and PCDD/PCDF do only exist with respect to the classification as hazardous waste[3] and as regards PCDD/PCDF for emissions to air from waste incineration, setting a limit of 0.1 ng TEQ/Nm³. More limits exist only for PCBs - limiting recovery of waste oil at 50 ppm[4] and excluding wastes from inert waste landfills if the PCB content exceeds 1 ppm[5].

Additional legislation has been established in a number of Member States and is documented in the report.

4 Limit Values

4.1 Methodology

For the requirements laid down in the annexes to the European POP Regulation (2004/850/EC) two limit values are of major importance. For the purposes of this study the project team has distinguished between “low POP content limit” and “maximum POP content limit”:

The **“low POP content limit” (LPCL)** serves to classify whether a waste must be managed in accordance with Annex V of the Regulation. POP concentrations above the LPCL require the destruction/irreversible transformation of the POP content in the waste. Individual limits may be established for different POPs.

The “**maximum POP content limit”** restricts derogations from the obligation to destroy or irreversibly transform the POPs content in waste to those waste meeting these limit values. Also the maximum POP content limit can be different for different POPs.

A methodology (referred to as "Method 1") should enable the assessment of low POP content limits and maximum POP content limits. The application of this methodology should generate proposals of limit values for different POPs. A second methodology (referred to as "Method 2") has been designed to provide information on the environmental preferability of the operations listed in Annex V with respect to the management of certain waste codes.

[3] Council Decision 2000/532/EC

[4] Waste Oil Directive (75/439/EEC).

[5] Council Decision 2003/33/EC (Acceptance criteria for landfills)

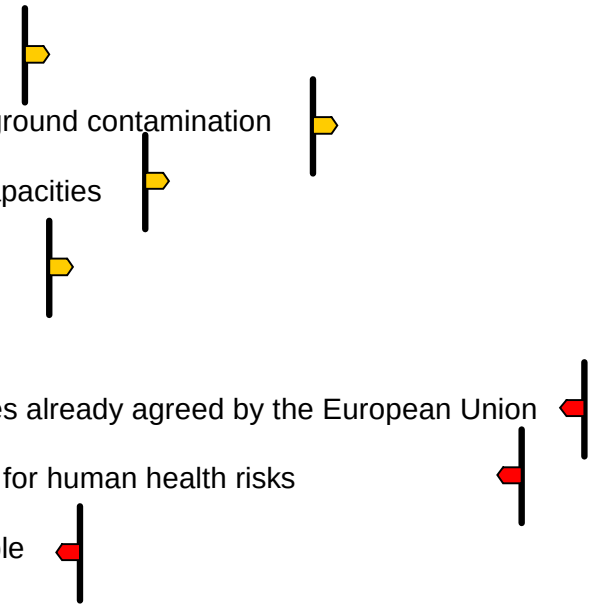
The basic principles of Method 1 are lower and upper limitation criteria limiting the range of feasible low POP content limits to propose.

Lower limitation criteria:

- A: Analytical potential
- B: Environmental background contamination
- C: Disposal/recovery capacities
- D: Economic feasibility

Upper limitation criteria:

- X: Z: Existing limit values already agreed by the European Union
- Y: Worst case scenario for human health risks
- Z: Precautionary principle



For the assessment of criterion A relevant measurement techniques and corresponding limits of detection and quantification for all POPs are described in the report. Beyond that it is recommended to further develop sampling and analysis standards, update the results and mandate CEN with the development of European standards. Criterion Y includes various environmental aspects and criteria.

A strict application of criterion X (precautionary principle) requires the proposal of the lowest possible value as low POP content limit. Thus it works as a target function and reduces the range of possible limits to the highest "lower limitation" criterion. A less strict application enables a second option for the low POP content limit.

Based on the evaluation of the different limitation criteria the following low POP content limit values are suggested:

4.2 LPCL for PCDD/PCDF

For PCDD/PCDF the proposal of a LPCL is complex, because results from lower and upper limitation criteria lead to controversial requirements. There is a contradiction between the requirements from the upper limitation criteria Y (unacceptable risks) with the lower limitation criteria C (disposal capacities) and D (economic feasibility).

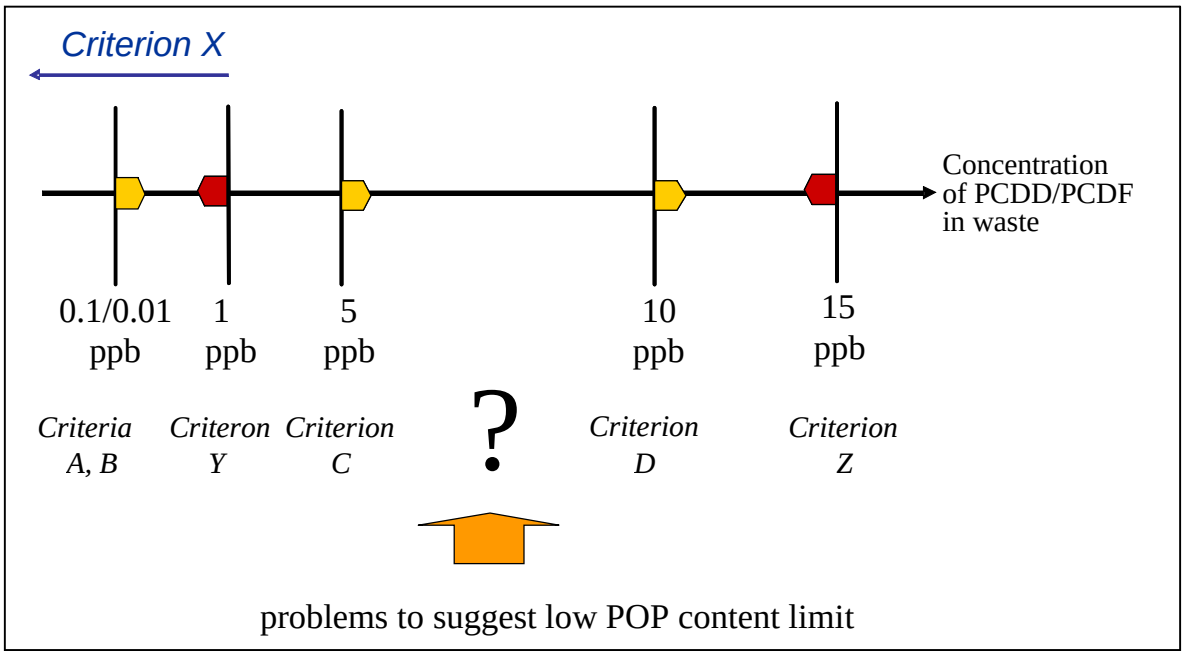


Figure 1-5: Problems to suggest a low POP content limit

Two solutions to solve this conflict are suggested:

1. Stabilisation and solidification is required as additional prerequisite for the recovery / recycling of wastes following Art. 7 Nr. 6 of the POPs Regulation for wastes exceeding 1 ppb PCDD/PCDF concentration thus banning R10 operation or other uses where the material is directly put only or mixed with soil (e.g. road basement, etc.). If this condition is applied the result for the upper limitation criteria for PCDD/PCDF concentration would be 15 ppb. According to the precautionary principle this would result in a recommended low POP content limit of 10 ppb (see Figure 1-6) as option 1 and of 15 ppb as option 2.

2. The result of 1 ppb for PCDD/PCDF contamination is kept as a result from upper limitation criterion Y. Annex V of the POPs Regulation is correspondingly amended to include further recycling/recovery options (e.g. secondary metallurgical processes) in order to ascertain economic feasibility and sufficient disposal capacity (see Figure 1-7). In this case option 1 and option 2 equally result in a low POP content limit value of 1 ppb.

On the basis of solution one, the upper limitation due to Criterion Y will shift to 15 ppb. As criterion X (precautionary principle) demands to propose the lowest possible value as low POP content limit, this results in a proposed limit of 10 ppb. In case of a different application of the precautionary principle a limit of 15 ppb would result as alternative limit proposal under solution one.

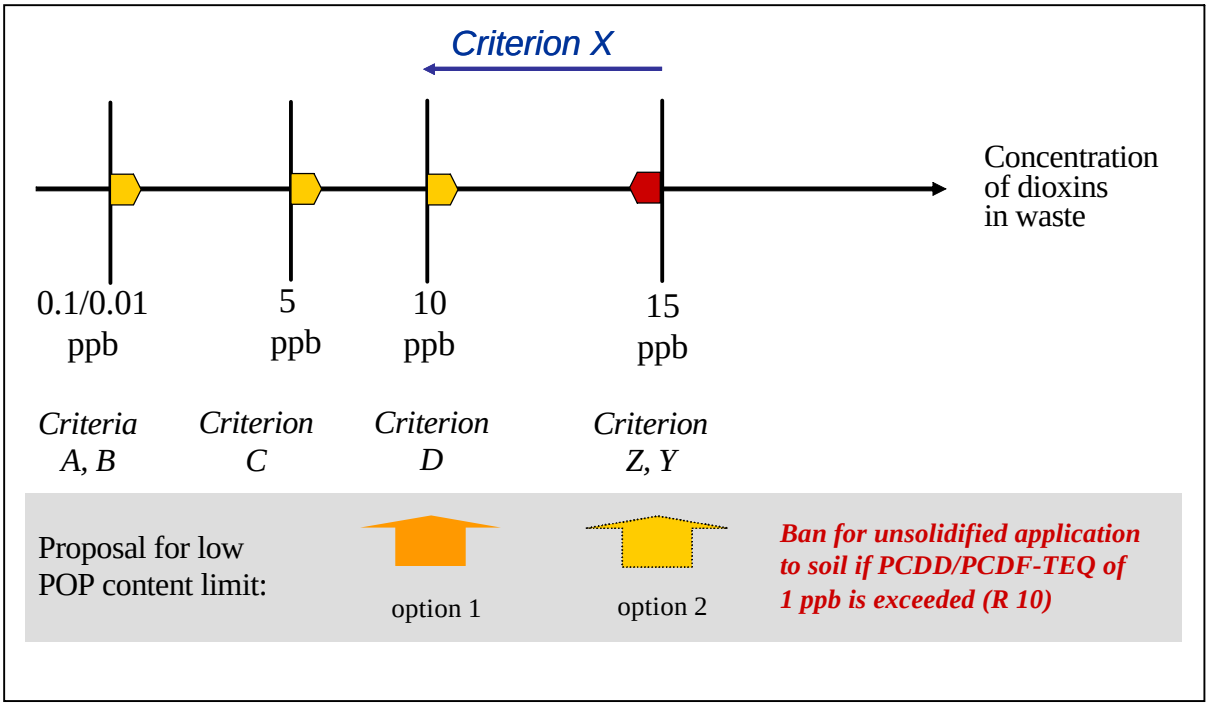


Figure 1-6: Recommended low POP content limit for PCDD/PCDF (expressed as I-TEQ) provided that unsolidified application to soil is banned (e.g. R 10)

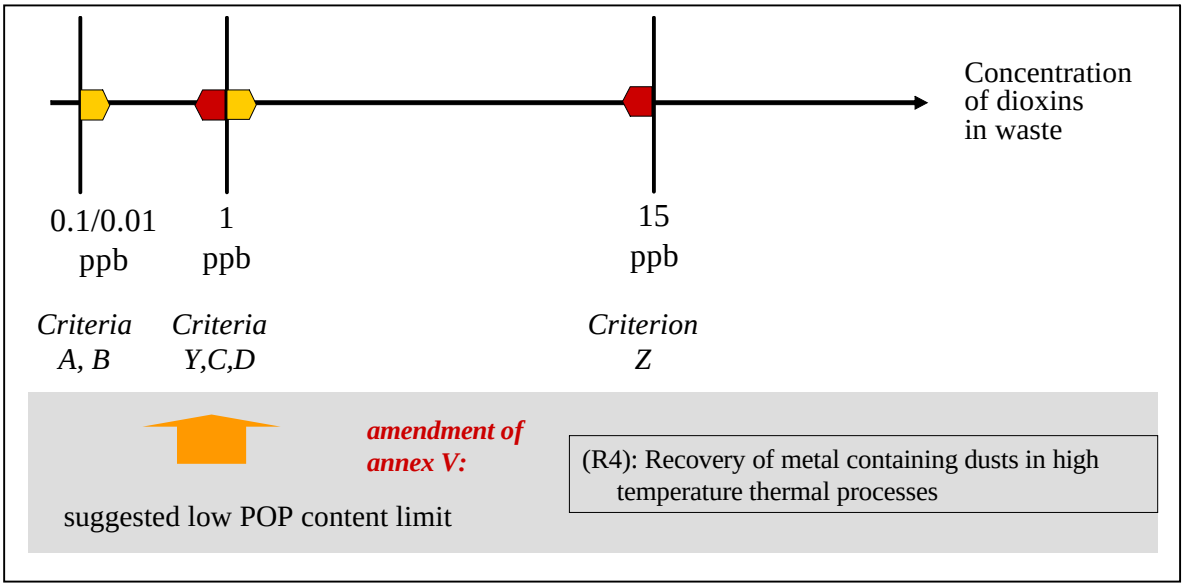


Figure 1-7: Recommended low POP content limit for PCDD/PCDF (expressed as I-TEQ) provided Annex V to the POP regulation is amended accordingly

4.3 LPCL for Polychlorinated Biphenyls (PCB)

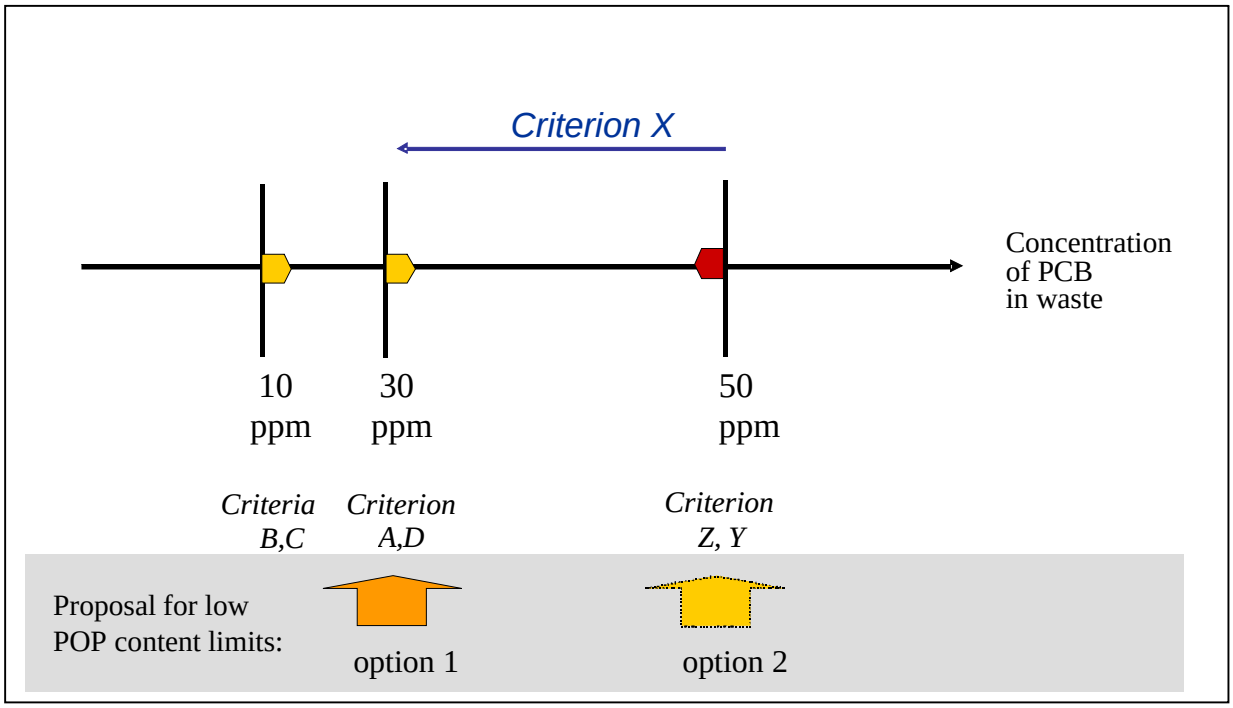


Figure 1-8: Recommended low POP content limit for PCB (total expressed as Sum 6 x 5) based on assessment method 1

The result of the limitation criteria is shown in Figure 1-8.

For PCB therefore a low POP content limit of 30 ppm is recommended as option 1, based on a total PCB calculated as Σ 6 Congeners multiplied by 5. An alternative option 2 might be a low POP content limit of 50 ppm.

4.4 LPCL for POP Pesticides

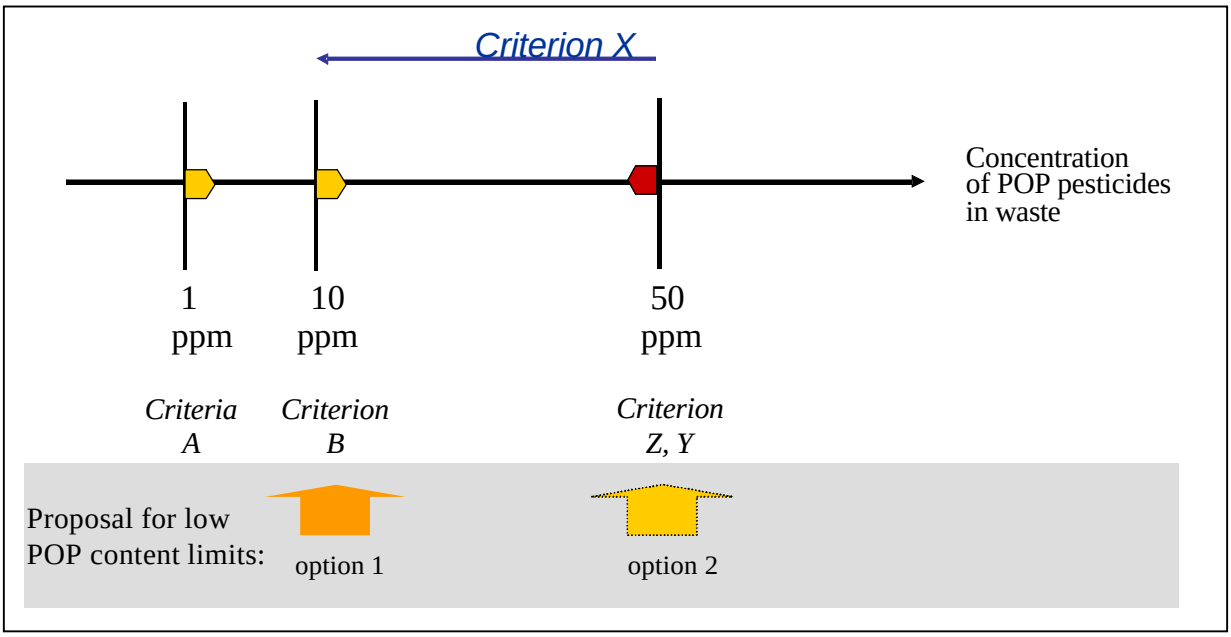


Figure 1-9: Recommended low POP content limit for POP pesticides and other POPs based on assessment method 1

Following the results of the limitation criteria (Figure 1-9). For POP pesticides a low POP content limit of 10 ppm is recommended as option 1. For option 2 a limit value of 50 ppm results.

4.5 LPCL for other POPs

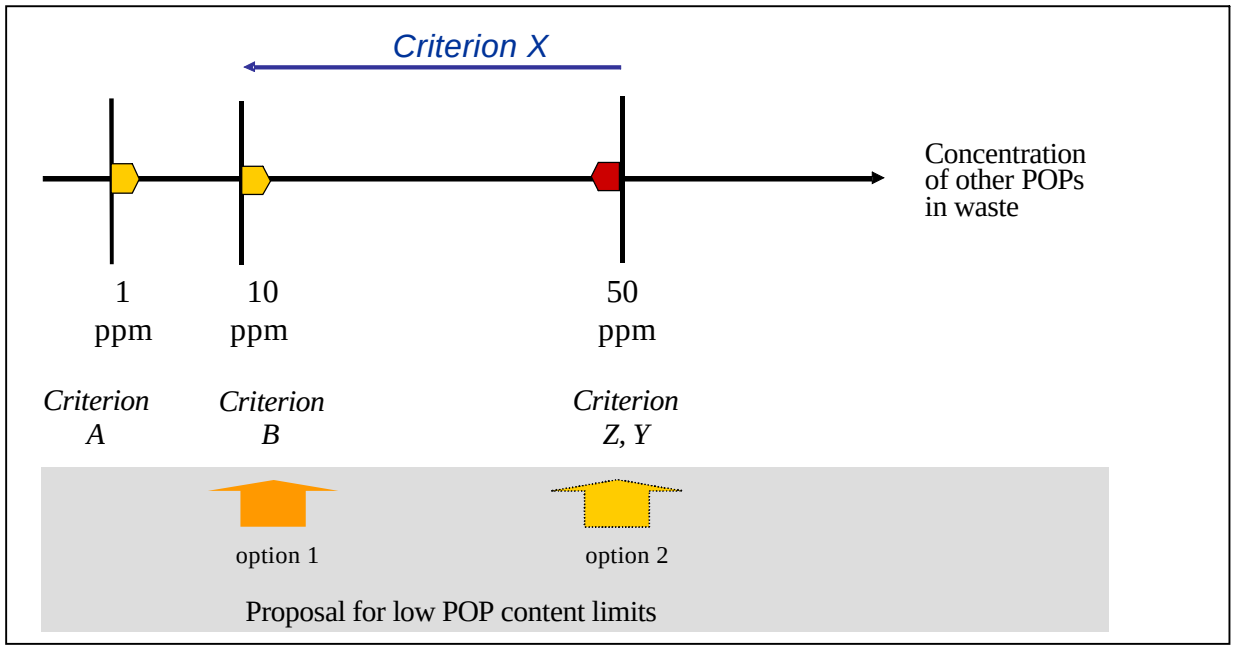


Figure 1-10: Recommended low POP content limit for POP pesticides and other POPs based on assessment method 1

For other POPs 10 ppm as option 1 is recommended and 50 ppm results as option 2.

4.6 Maximum POP content limits

These limits are exclusively deducted from the upper limitation criterion “Potential risks to human health and the environment. The evaluation of results from leaching tests and information on permeability of sealing layers and mobility of POPs in soil resulted in the following proposal for maximum POP content limits for non hazardous and hazardous landfills, provided the provisions of the landfill directive and appropriate technical requirements (e.g. solidification by a leachate rate below 0,01%/100 years) are fulfilled:

PCDD/PCDF: 5,000 ppb

PCB: 2,000 ppm

POP pesticides: 5,000 ppm

other POPs: 5,000 ppm

Based on current knowledge the long-term safety of salt mines and deep hard rock mines seems such that no reasons for restrictions for any of the pollutant classes have been identified for these disposal routes.

5 Conclusions and Recommendations

The developed methodology provides favourable options for the low POP content limit values. Option I follows a more restrictive approach with a broader coverage of waste flows and higher economic impacts, option II includes less wastes and shows less consequences. For PCDD/PCDF a third option is relevant with a different legal approach.

It is recommended that the low POP content limit values are established within the ranges that are defined by the options.

		Option 1	Option 2
PCDD/PCDF	**A**	10 ppb*	15 ppb*
	B	1 ppb**	1 ppb**
PCBs***		30 ppm	50 ppm
POP pesticides		10 ppm	50 ppm
Other POPs		10 ppm	50 ppm

* Ban of unsolidified application to soil if PCDD/PCDF concentration of 1 ppb is exceeded (R10); solidification is fulfilled if a leachate rate of 0,01%/100 years is not exceeded

** Annex V , part 1 amended: (R4) for waste codes 100207 (-08), 100504 (-03), 100603 (-04) following Decision 2000/232

*** total PCB in terms of Σ Cong. x 5

Obviously also an appropriate combination of options is possible. Concerning the proposal for PCB it is alternatively possible to apply the analytical method based on sum 7 approach. In this case the suggested low POP content limit values have to be adapted correspondingly (7 ppm and 11.7 ppm).

Another option to include the operation R4 in Annex V part 1 is to specify the corresponding processes of secondary metallurgical industry. In this case it might not be necessary to include specific waste codes in Annex V part 1. In order to facilitate the implementation of the EU POP Regulation and focus monitoring and control of wastes to the relevant sectors, a categorisation of the waste codes listed in the European waste list[6] has been proposed in the project. The categorisation has been made in view of their potential to contain POPs in concentrations exceeding the limit values to be established under the European POP Regulation.

The grouping will categorise all waste codes in one of the following groups:

[6] Decision 2000/532/EC

- Group A: low likelihood to exceed the low POP content limits
- Group B: high likelihood to exceed the low POP content limits
- Group C: uncertain risk

While little testing effort is foreseen for group B, testing will be required in group C in particular if disposal/recovery as non POP waste is intended.

If testing is required testing and sampling has to assure that a representative information on the contamination level throughout the whole batch of waste can be taken as granted and has to respect state of the art. If possible schemes under 2003/33/EC should be used.

To support implementation of the method to define environmental preferability the following reporting format is proposed as a tool for reporting from Member States to the Commission:

Notification of treatment and disposal of POP waste authorized as environmentally preferable to destruction or irreversible transformation	
Commission (Competent body with address):	To be forwarded to (Contact Member States):
Notifying authority (Name, address): Contact person: Tel.: Fax: e-mail	Date:
Waste generator (Name, address) Contact person: Tel.: Fax: e-mail	Waste disposer (Name, address) Contact person: Tel.: Fax: e-mail
Site of generation and process:	Actual site of disposal/recovery:
General description of waste: Waste code: Origin: Contamination: Amount:	Intended disposal route: Intended date or period of disposal
Measurement information: Measurement data: Measurement methods	Technology and precautionary measures applied, incl. pre-treatment and/or solidification or stabilisation measures: Tests on leakage rate available: Measurement data: Measurement methods:
Transport to disposal/recovery site (distance, means):	Considered benchmark: Specifications:
Additional specification regarding waste handling:	

Table 1-1: Draft reporting format

Annex to reporting format: Environmental Preferability against benchmark

	Performance related to benchmark			
	credits	***weight***	***total performance***	***evidence and justification***
① POP emissions				
Air				
Leachate				
Waste				
② Other emissions				
CO_2 emission for destruction/solidification				
CO_2 emission for transport				
Other emissions (Greenhouse gases, heavy metals, acidifying gases)				
③ Risks, uncertainties				
legal compliance				
long term safety				

Table 1-2: Draft reporting format - Performance matrix for justification of alternative waste management operations under Annex V to the EU POP regulation

It is recommended to discuss the reporting format with Member States and include remarks and additional ideas before launching its application. However, the reporting format should in any case enable the comparability of decisions and should be suitable for building up a database to enable the European wide support of authorities.