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Item 2 (d) of the provisional agenda[1]

REPORT BY THE SECRETARIAT ON PREPARATORY WORK FOR THE MEETING

Submission by the European Community and the Member States of the European Union on best available techniques and best environmental practices for reducing and/or eliminating emission of persistent organic pollutant by-products[2]

Note by the secretariat

Subparagraph (a) of Section VI of the terms of reference for the Expert Group on Best Available Techniques and Best Environmental Practices contained in Annex VII of UNEP/POPS/INC.6/22 and also in Appendix 3 of UNEP/POPS/EGB.1/INF/7 lists as possible reference material for the first session of the Expert Group the submission by the European Community and the Member States of the European Union on best available techniques and best environmental practices for reducing and/or eliminating emission of persistent organic pollutant by-products. This submission was made to the sixth session of the Intergovernmental Negotiating Committee for an International Legally Binding Instrument for Implementing International Action on Certain Persistent Organic Pollutants which was circulated during the session as conference room paper UNEP/POPS/INC.6/CRP.6. The above referenced submission is provided in the appendix to the present note.

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[1] UNEP/POPS/EGB.1/1.
[2] This document has not been formally edited.

Appendix

Submission by the European Community and the member states of the European Union to the sixth session of the Intergovernmental Negotiating Committee for an International Legally Binding Instrument for International Action on Certain Persistent Organic Pollutants (previously UNEP/POPS/INC.6/CRP.6)

Best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emission of POPS by-products

A. Introduction

Polychlorinated-p-dibenzodioxins (PCDD), polychlorinated dibenzofurans (PCDF), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCB) are unintended by products formed in and released from thermal and chemical processes, especially under incomplete combustion or reaction conditions. They can be released from these processes into different media, via air and water, with wastes or they can have an impact to the environment as contaminants of chemicals and products. Releases to air are in most cases the dominant pathway.

The intention of the following paper is to present a first approach for a general concept on guidance for BAT and BEP for by product elimination/reduction addressed under Article 5 and Annex C of the Stockholm Convention on POPs annexed with examples of available measures and options which can be regarded as BAT and/or BEP.

This concept considers also some basic results of a "Regional Workshop on National Action on measures to reduce or eliminate the releases of by products from unintentional production as requested by the Stockholm Convention on POPs", which was held from 13 to 15 March 2002 in Bangkok to develop inter alia first ideas and elements of a future more comprehensive concept for implementing BEP and BAT according to Article 5 and Annex C of the Stockholm Convention. The aim of this workshop was also to discuss the issue with developing countries in the light of their specific situations. A separate document with conclusions and recommendations of this workshop will be presented to INC 6.
Therefore, the concept proposed in this document (Annex 1) consists of an integrated approach of both release reduction instruments with different options for action according to BAT and/or BEP to be implemented by making a choice depending on specific environmental, economical, infra structural and other relevant conditions.

The structure of the presented concept takes into account, that according to the Convention priority consideration should be given to alternative prevention/release reduction processes, techniques or practices that have similar usefulness but which **avoid the formation and release of by – products by preventive measures**.

It should also be pointed out, that during the above mentioned workshop developing countries **emphasized that an effective information exchange is needed to enable them to make an informed choice in the selection of BAT (and BEP) measures**. For the priority source categories in Annex C, Part II, such guidance may be developed as a list of appropriate technical measures with some information about benefits and drawbacks. For other source categories, such as listed in Part III, which may be dominant categories in some countries, a decentralized network of information and expertise may help Parties to get information on relevant and well documented experience of parties with release reduction measures that were successful under their specific conditions.

Experiences with an Information Exchange Mechanism were made in the European Union with the Integrated Pollution Prevention and Control (IPPC) Directive (= Council Directive 96/61/EC of 24 September 1996). Article 16(2) lays out the basics and the running process show, how to handle some main points of this issue:

- Organization of a procedure for such an Information Exchange Mechanism,
- Collection of available information as effective as possible,
- Consideration of specific legal, technical and economic backgrounds of different countries,

- Consideration of the available information in the process to determine *best* measures.

As a further pool of information Annex V of the POP Protocol of the UNECE LRTAP – Convention should be considered.

B. Structure of future guidelines

The guidance for decision on the adequate and effective measures to be installed and implemented according to BAT and BEP for release elimination/reduction of by products should be structured into a stepwise approach:

1.Step: *General guidance/considerations on BAT and BEP (annex 1)*

The concept contains possible options for measures (Annex 1). The intention of the concept is to provide a structure, which makes different options transparent and how it can be achieved to select the most appropriate options taking into account different environmental, economical, legal and infrastructural backgrounds. This concept is based on Annex C, part V, A and B, and complements it.

2.Step: *Specific guidance for main source categories (annex 2)*

The second step is based on the general concept of step 1 and illustrates how to reduce by–product emissions of a specific industrial source category listed in part II of Annex C– specifically presented in this paper by the example from metallurgical industry (Annex 2).

3.Step: *Establishment of an information network and decision criteria to decide on most effective and reasonable measures for BAT and BEP*

The experiences of the information exchange process of the IPPC Directive may serve as an example how the information could be provided in a manner, that authorities or other country specific bodies can decide on measures to be implemented according to BAT and/or BEP. Decision criteria may be:

a) technical feasibility;

b) costs, including environmental and health costs,

c) cost efficiency

d) efficacy (infra structural capacity: i.e. availability of well – trained staff etc.),

e) risk,

f) availability,

g) accessibility (dependent on financial assistance),

h) Operator friendliness,

i) positive or negative impacts on society including

- health, including public, environmental and occupational health,
- agricultural, including aquaculture and forestry,
- biota (biodiversity),
- economic aspects,
- movement towards sustainable development; and
- social costs.

j) Environmental performance standards (not only regarding the reduction potential for POPs but including other elements like waste, energy consumption etc.).

(The criteria above were discussed during the Regional Workshop in Bangkok with developing countries and are listed in the report about the conclusions and recommendation of the workshop to be submitted to INC 6 as a CRP by Thailand and Germany.)

C. Subsidiary Body to assist the efforts to develop provisional guidance on BAT and BEP

Document UNEP/POPS/INC.6/7 proposes to consider establishment of a subsidiary body to assist the Committee in the efforts to develop provisional guidance on BAT and BEP pursuant to Article 5 of the Convention for consideration at the first meeting of the Conference of the Parties.

The EU experience on information exchange mechanisms from the IPPC Directive shows, that **a body for coordination of BAT and BEP work is absolutely necessary.** In the IPPC process the information exchange is coordinated by an Information Exchange Forum (IEF). The amount of relevant information may be very large and need a complex discussion in the light of different economical, legal and infra structural situations and backgrounds of the countries.

For the purposes of the Stockholm Convention in order to fulfil requirements as established in resolutions 4 and 7 of the Diplomatic Conference, a subsidiary body to develop guidance on BAT and BEP, *i.e.*, a technical working group or a task force consisting of a limited number of experts from different regions including observers and English only as working language may be most appropriate way forward.

D. Mechanisms for information exchange to assist the developing countries

An important step for future work will be, especially for the purpose to provide up to date guidance to the developing countries, that industrialized countries should make their information on BAT and BEP measures accessible and transparent. It was a result of the Bangkok workshop, that developing countries are explicitly interested in such an information exchange mechanism to make also examples of BAT/BEP measures available that were developed and successfully applied by developed countries. Data provided by such a network should be assessed independently in order to avoid that private companies could use this forum to promote inappropriate release reduction measures.

The experience of the information exchange process of the IPPC Directive may serve as an example how it may work. Details, how to organize such a process should be discussed later.

Any information exchange process should take into account not only the experiences and knowledge of industrialized countries but also the specific background and experiences of developing countries. An important contribution of EU are the BAT Reference Documents (BREFs) according to the IPPC Directive (http://eippcb.jrc.es/).

E. Conclusions

It is proposed:

- ***A Subsidiary Body/technical working group should be established as a limited group of experts with the mandate to develop guidance on BAT and BEP to be submitted to COP 1.***

This body should discuss the following issues

- ***A concept for guidelines for BAT and BEP should be developed as presented and exampled in Annexes 1 and 2 of this document. Detailed specific guidelines on BAT and BEP measures should be limited to major source categories as listed in Annex C, part II of the Convention,***
- ***The structure of an information exchange network for other sources like those listed in part III of Annex C to assist the developing countries in future should be developed and established.***
- ***Criteria for the selection of appropriate measures as outlined in section B of this paper should be developed and established.***

Annex 1

Concept for general guidelines on BAT and BEP measures

It should be emphasized in before, that this paper deals with industrial and/or manufactural installations within their regular process. The case of unintended releases by accidents is not a matter to be dealt with in this concept.

Nevertheless control and regulation of adequate process conditions as well the installation of automatic interruption devices in case of irregular process parameters, development of emergency plans and training of the staff how to react in the case of inadequate conditions prevent and reduce the risks of accidental releases from processes where POPs are used as intermediates or may be formed as contaminants during the production process, are important measures to prevent releases of this specific type.

It should also be noted that in this Annex the various measures listed are not exhaustive and present only first significant and illustrative examples.

*Explanation (no definition) of the terms **preventive** and **primary**: Both terms are used in the texts of annex 1 and 2 with the same meaning and both should express (as commonly used), that the formation of dioxins and furans is prevented in beforehand.*

In the context of all issues referring techniques and processes usually the term "primary" is used to distinguish end-of-pipe techniques from techniques applied to prevent dioxin formation.

Other measures more or less to be connected to measures of BEP and the more generally aspects could be mentioned as "preventive".

1. General preventive strategies to avoid or reduce impacts from products contaminated with by products

1.1. Total avoidance of production and use of potentially contaminated products.

Chemicals known to be highly contaminated with PCDD/F and phased out for production and use on a legally or voluntary basis in many industrialized countries are for example:

- Polychlorinated biphenyls (PCB),
- Pentachlorophenole (PCP),
- 2,4,5-Trichlorophenole (TCP),
- 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) and 2,4-Dichlorophenoxyacetic acid (2,4-D) and their esters,

  (Note: Agent Orange – was a 1:1-mixture of the n-Butylester of 2,4 – Dichlorophenoxyacetic acid and 2,4,5 – Trichlorophenoxyacetic acid).

1.2. Limitation of contaminants in products

1.2.1. Alternative production routes or avoidance of auxiliary substances in order to eliminate or minimize by – product contamination

- Production of chloranil – dyestuff via the hydrochinon route as alternative to the former chlorophenole route avoids formation of PCDD/F.

- Production of dicofol using chloral, monochlorobenzene and oleum instead of hydroxylation of DDT.
- The production of tetrachloroethene and carbon tetrachloride is performed on the basis of hexachlorbenzene by high – pressure chlorolysis. Chlorolysis on the basis of aliphatic chlorinated substances is an alternative to prevent the use and additional contamination of products and emission of hexachlorobenzene (HCB).

1.2.2. Primary measures by modification of process – techniques and - parameters to optimise reaction conditions in order to eliminate or minimize by – product contamination

- Hexachlorobenzene (HCB) is formed as a contaminant during the manufacture of several pesticides (atrazine, lindane, maleic anhydride, and propazine) and of chlorinated solvents, too (e.g. trichloroethene, tetrachloroethene and carbon tetrachloride) where it remains as an impurity. Formation can be minimized by control and regulation of adequate process conditions.
- Some POPs may be used as intermediates for the synthesis of other chemical products. Wherever a complete substitution of such processes is not possible process conditions are to be well controlled in order to minimize unintentional contamination of the products with POPs. Limit values for maximum content of POP by products can reflect best available techniques for such chemical processes (e.g. 0.1 g/kg HCB in chlorthalonil and 1g/kg HCB in quintozene).
- Reduction of application of chlorinated solvents (trichlororethene, tetrachloroethene etc.) results as a side effect also in a reduction of the whole amount of by – products (e.g. hexachlorobenzene, hexachlorobutadiene) formed in their production processes.

2. Releases from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BEP

BEP is a feasible instrument to prevent or minimize diffuse, non-industrial releases, like residential heating or releases from activities of small manufacturers (e.g. small metal producers or cable smoulders).

This may be an important aspect considering the background of developing countries, where family scale manufacturers contribute more to the production of different products and are sometimes structured different than in industrialized countries. For these sources BEP measures may be the most effective approach to reach a considerable amount of release reduction with less economical expense. This does not mean that the following management measures are less important in industrialized countries and for big manufacturers.

2.1. General Management options for minimization of by – product releases

- Efficient use of energy and resources results in reduced releases into the environment referring all pollutants and all media, including by – products. Especially the use of low – waste technologies may reduce the amount of wastes, which have to be disposed of.
- Information and training of the personnel are also key elements to ensure adequate operation and maintenance of the equipment all times, keeping all equipment in adequate working order and as designed operating conditions. This ensures the understanding of the operating procedures, closely monitoring and control of processes.
- Establishing of an environmental management system (e.g. ISO 14 000 series) to ensure regulated and controlled production and application processes.
- The development and application of codes of environmental practice which covers all aspects of the activity in the product's life. This includes all measures, which aim to avoid the distribution of chemicals into the environment, where it is not explicitly intended by the activity.

- The application of labels or other information tools informing users of the environmental risks or of the environmental friendliness of the product (e.g. green labels) related to a product, its use and ultimate disposal.
- Developing and establishing of simplified but effective management systems to ensure environmentally sound regulated and controlled production and application processes for smaller manufacturers.

2.2. Management of feed material by substitution of the use of chlorinated substances in production- or combustion processes as a preventive measure against by- product formation

- Mechanical recovery of copper from cables instead of thermal copper recovery.
- Use of nitrogen/chlorine mixtures instead of hexachloroethane in the smelting of secondary aluminium in order to minimize formation of hexachlorobenzene.
- Phasing out of chlorinated or brominated scavengers (e.g. dichloro- and dibromoethane) and other halogenated additives in fuels.
- Bleaching of pulp and paper with chlorine dioxide or active oxygen as oxidants instead of elemental chlorine or chemicals generating elemental chlorine.
- Avoidance of waste oil or treated wood as fuels for drying food or feed
- Separation of accompanying products and /or cleaning of the material, where appropriate, in secondary metal production in order to avoid precursors for by product formation
- Provision of information and education to the public and to users about the environmental consequences of the application of preserved or coated wood and other waste material in residential combustion for heating and cooking purposes.

2.3. Management of feed material as a primary measure for waste reduction and encouragement of recycling

- Avoidance of applications of chlorinated solvents, cooling agents and lubricants, where appropriate, in order to reduce the amount of waste or to avoid its formation totally. Technical solutions to reduce losses of these products during use should be favored.
- Putting in place appropriate waste management systems for used chemicals to ensure the environmentally sound disposal,
- Application of economic instruments to encourage the recycling of used products (e.g. for recovery of spent solvents, catalysts or other auxiliary substances)
- Training of staff with respect to understanding the correct procedures and importance of waste collection, recycling and environmentally sound disposal.

2.4 Modification of process – techniques and - parameters to optimise combustion and/or reaction conditions

- Modification, control and regulation of process parameters in order to ensure appropriate temperature, turbulence and residence time in the reaction chamber.
- Installation for automatic interruption of process and training of responsible persons how to react in cases of inadequate process parameters.

3. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BAT

Technical release reduction measures are to be installed especially at stationary sources on the basis of an integrated approach. *Integrated* means, that releases into all environmental media (waste gas and water, wastes, energy demand etc.) should be considered and all technical aspects - to prevent the formation of releases in the installations and the emission as well - should be combined. Consequently an integrated approach includes substitution measures and changes of process techniques assisted by end of pipe techniques.

Application of end of pipe techniques may be the only adequate solution for existing installations, whereas an entirely integrated industrial concept may be more widely applied at new ones.

3.1. Integrated measures by optimisation of process techniques

The measures listed under this point should be understood as a concept especially for incineration processes. In fact, it is a release prevention and reduction concept for all industrial sources where thermal procedures are applied. The reaction/combustion conditions should be optimized in a way to prevent the formation of by products from the beginning.

- Measures to control and optimise physical parameters of the combustion or processing conditions (e.g. temperature stages, cooling rate, O_2 content, etc.)

- Modification of process techniques to optimise thermal conditions to minimize by – product formation (usually from 850°C or higher, assessment of oxygen supply depending on the heating value and consistency of the wastes, sufficient residence time - 850°C for ca. 2 s -- and turbulence of the gas, avoidance of cold gas regions in the incinerator, etc.).

- Flue gas measures to prevent the de novo synthesis at about 250 to 450°C (quenching, adding of inhibitors, dust collection systems for temperatures between 800 and 1000°C, e.g. ceramic filters and cyclones, low-temperature electric discharge systems and avoidance of fly ash deposition in the flue gas exhaust system)

3.2 Cleaning of the flue gas

- Conventional dust precipitators for the reduction of particle-bound by products;
- Selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR);
- Adsorption with activated charcoal or coke in fixed or fluidised systems;
- Different types of adsorption methods and optimised scrubbing systems with mixtures of activated charcoal, open hearth coal, lime and limestone solutions in fixed bed, moving bed and fluidised bed reactors,
- H_2O_2-oxidation,
- Catalytic combustion methods using different types of catalysts (i.e. Pt/Al_2O_3 or copper-chromium catalysts with different promoters to stabilize the surface area and to reduce ageing of the catalysts).

3.3 Treatment of residuals from the cleaning process.

- Catalytic treatment of filter dusts under conditions of low temperatures and lack of oxygen,
- Scrubbing of filter dusts by the 3-R process (extraction of heavy metals by acids and combustion for destruction of organic matter),
- Vitrification of fabric filter dusts,

Emerging Techniques:

- Immobilisation,
- Use of plasma technology.

Annex 2

Concept for specific guidelines on BAT and BEP measures

(Example: Metallurgical industry)

The intention of this annex is to illustrate the general concept presented with the first step in annex 1 by some measures to be used to reduce by–product emissions at a specific industrial source category – metallurgical industry.

The example represents only a first draft of a guideline on this sector rather than a full and comprehensive scale of available measures, which would fill a much more complex compendium, as can be seen from the already available BAT reference documents (BREFs) for this industrial sector. But the intention is to explain and make transparent some more general points of the concept by presenting some concrete available measures. It should be noted, that the list presented below contains only techniques for abatement, but not any description of the basic process techniques.

Main sources of by – products in metallurgical industries:

a) Production of steel

b) Sinterplants,

c) Secondary production of copper,

d) Smelting plants in the secondary aluminium industry,

e) Secondary zinc production

By–products are released mainly into the air and with wastes into the environment. Waste water is not a relevant source of by product emissions from this type of industrial installations.

Applying an appropriate selection of the general measures listed in Annex 1 and the specific measures mentioned below help to achieve emission values below 0.1 ng TE/m3 PCCD/PCDF in waste gas.

a) Production of steel

1. General preventive strategies to avoid or reduce impacts from products contaminated with by products

1.2. Alternative production routes or avoidance of auxiliary substances in order to eliminate or minimize by – product contamination.

Cold-air furnaces and rotary tube furnaces (melting of cast iron) have higher by product emissions than hot blast cupola furnaces, electric furnaces and electric arc furnaces.

2.2. Management of feed material by substitution of the use of chlorinated substances in production- or combustion processes as a preventive measure against by- product formation

The feedstock to electric arc furnaces often contains oils, emulsions or greases. General primary measures for by product reduction may be sorting, de-greasing and de-coating of scraps, which may contain plastics, rubber, paints, pigments and vulcanizing additives.

3. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BAT

3.1. Integrated measures by optimisation of process techniques

For electric arc furnaces used in secondary steel production separate collection and purification of waste gas streams to reduce the volume stream as low as possible should be applied. Especially emissions from loading and discharging should be collected and purified separately from each other.

The following measure are used to reduce the formation of dioxin and furans within the process:

- to make sure that flue gas temperatures stayed above 600°C and that at the end direct suction it is cooled down fast below 200°C
- use of a quenching system to cool down the flue gas from temperatures of between 700°C and 1,600 °C to around 200°C.

3.2 Cleaning of the flue gas

For electric arc furnaces used in secondary steel production the following measures are available:

- Enclosure of the furnaces.
- Use of a fabric filter or an electrostatic precipitator in combination with coke dust injection.

b) Sinter plants

2. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BEP

2.2. Management of feed material by substitution of the use of chlorinated substances in production- or combustion processes as a preventive measure against by- product formation

Halogen in feed material either as salt content in coke breeze or in the ore or as halogenated compounds in added recycled material (e.g. millscale, blast furnace top gas dust, filter dusts and sewage sludges) results in the increased formation of by products in the sinter process. However, there is no clear link between the chlorine content of the feed materials and emissions of by product. The avoidance of contaminated residual material and de-oiling or degreasing of millscale prior to its introduction into the sinter plant may, therefore, result only in an insignificant decrease of by product formation.

3. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BAT

3.1. Integrated measures by optimisation of process techniques

As a preventive measure recirculation of waste gas reduces by product emissions significantly. Furthermore, the overall waste gas flow is reduced significantly, thereby reducing the cost of installing additional end-of-pipe control systems.

3.2 Cleaning of the flue gas

The most effective by product emission reduction can be achieved using a combination of different secondary measures, as follows:

- Installing fabric filters, eventually in combination with electrostatic precipitators or electrostatic precipitators with the injection of adsorptive agents (mixtures from limestone and coal, coke dust, activated carbon or open-hearth coal) into the waste gas.

- Scrubbing methods have been developed which include pre-quenching of the waste gas, leaching by high-performance scrubbing and separation by drip deposition. Addition of suitable adsorption agents like lignite coal, cokes or coal slack enhance the reduction efficiency.

c) Secondary production of copper

2. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BEP

2.2. Management of feed material by substitution of the use of chlorinated substances in production- or combustion processes as a preventive measure against by- product formation

The following measures are suitable for reducing by product emissions:

- Pre-sorting of scrap;

- Pre treating scrap, for example stripping of plastic or PVC coatings, pretreating cable scrap using only cold/mechanical methods.

3. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BAT

3.1. Integrated measures by optimisation of process techniques

The following measures are suitable for reducing by product emissions:

- Quenching of hot waste gases (providing utilization of heat), to reduce residence time in the critical region of temperature in the waste gas system,

- Using oxygen or oxygen-enriched air in firing, or oxygen injection in the shaft kiln (providing complete combustion and minimization of waste gas volume).

3.2 Cleaning of the flue gas

The following measures are suitable for reducing by product emissions:

- Adsorption in a fixed bed reactor or fluidized jet stream reactor with activated charcoal or open-hearth coal dust and

- Catalytic oxidation.

d) Smelting plants in the secondary aluminium industry

2. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BEP

2.2. Management of feed material by substitution of the use of chlorinated substances in production- or combustion processes as a preventive measure against by- product formation

Available measures are to be considered:

- Improving the pre-sorting of scrap aluminium from shredders by using swim-sink separation techniques and grading through whirling stream deposition and
- Improving the pre-cleaning of scrap aluminium by swarf decoating and swarf drying.

These measures may help to treat low-grade scrap in modern fluxless smelting installations (which avoid halide salt fluxes). Otherwise, low-grade scrap is to be handled in rotary kilns.

The use of hexachloroethane in the aluminium industry should be avoided. The melt can be treated alternatively for example with nitrogen/chlorine mixtures in the ratio of between 9:1 and 8:2 using a gas injection equipment for fine dispersion and pure nitrogen pre- and post-flushing and vacuum degassing. Chlorine (mixed with nitrogen) is required for the removal of magnesium and other undesired components.

3. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BAT

3.1. Integrated measures by optimisation of process techniques

Available measures are to be considered:

- Waste gases from smelting furnaces and converters are usually removed together, but minimizing and separately removing and purifying differently contaminated waste gas flows from different inputs can be effective (e.g. separate removing of waste gas streams from dross processing and machine turnings),
- Ensuring turbulence of waste gas aiming at the avoidance of particle deposition,
- Rapidly passing the critical temperature range (250 – 450°C).

3.2 Cleaning of the flue gas

The by product emission depends on the type of smelting aggregates, materials used and waste gas purification techniques employed. In summary, single- and multi-stage fabric filters with the addition of limestone/activated carbon/open-hearth coal in front of the filter are available.

e) Secondary zinc production

3. Emissions from stationary sources, small manufacturers or other fugitive anthropogenic sources with emphasis on BAT

3.2 Cleaning of the flue gas

Usually secondary zinc smelters are equipped with dust removing installations like baghouses. These facilities have very high efficiencies (up to 99,9 %).

To be completed.

4. Table listing and comparing different reduction measures

The following table is part of Annex V of the UNECE POP – Protocol. It should only be seen as an example, how technical and other measures could be summarized in combination with information regarding effectiveness, costs and other decision criteria which may be relevant for the Parties. For the purposes of the Stockholm Convention the table should be updated, complemented and modified taking into account the criteria and the concept for BAT and BEP which will be developed by a future subsidiary body.

Table : Comparison of different options for metallurgical industry to reduce by product emissions[1]

Management options	**Emission level (%)[2] a/**	**Estimated costs**	*Process conditions*
Sinter plants Primary measures:			
- Optimization/encapsulation of sinter conveying belts;		Low	Not 100% achievable
- Waste gas recirculation e.g. emission optimized sintering reducing waste gas flow by ca. 35% (reduced costs of further secondary measures by the reduced waste gas flow), cap. 1 million Nm^3/h;	40	Low	
Secondary measures:			
- Electrostatic precipitation + molecular sieve;	Medium efficiency	Medium	
- Addition of limestone/activated carbon mixtures;	High efficiency (0.1 ng TE/m^3)	Medium	
- High-performance scrubbers - existing installation: AIRFINE (Voest Alpine Stahl Linz) since 1993 for 600 000 Nm3/h; second installation planned in the Netherlands (Hoogoven) for 1998.	High efficiency emission reduction to 0.2-0.4 ng TE/m^3	Medium	0.1 ng TE/m^3 could be reached with higher energy demand; no existing installation
Non-ferrous production (e.g. copper) Primary measures:			
- Pre-sorting of scrap, avoidance of feed material like plastics and PVC-contaminated scrap, stripping of		Low	

[1] The table is taken from Annex V of the UNECE LRTAP – Convention – Protokoll of POPs originally without any updating.
[2] Remaining emission compared to unreduced mode.

coatings and use of chlorine-free insulating materials;			
Secondary measures:			
- Quenching the hot waste gases;	High efficiency	Low	
- Use of oxygen or of oxygen-enriched air in firing, oxygen injection in the shaft kiln (providing complete combustion and minimization of waste gas volume);	5 – 7 (1.5-2 TE/m^3)	High	
- Fixed bed reactor or fluidized jet stream reactor by adsorption with activated charcoal or open-hearth coal dust;	(0.1 ng TE/m^3)	High	
- Catalytic oxidation; and	(0.1 ng TE/m^3)	High	
- Reduction of residence time in the critical region of temperature in the waste gas system.			
Iron and steel production Primary measures:			
- Cleaning of the scrap from oil prior to charging of production vessels;		Low	Cleaning solvents have to be used.
- Elimination of organic tramp materials such as oils, emulsions, greases, paint and plastics from feedstock cleaning;		Low	
- Lowering of the specific high waste gas volumes;		Medium	
- Separate collection and treatment of emissions from loading and discharging;.		Low	
Secondary measures:			
- Separate collection and treatment of emissions from loading and discharging; and		Low	

- Fabric filter in combination with coke injection.	< 1	Medium	
Secondary aluminium production Primary measures:			
- Avoidance of halogenated material (hexachloroethane);		Low	
- Avoidance of chlorine-containing lubricants (for instance chlorinated paraffins); and		Low	
- Clean-up and sorting of dirty scrap charges, e.g. by swarf decoating and drying, swim-sink separation techniques and whirling stream deposition;			
Secondary measures:			
- Single- and multi-stage fabric filter with added activation of limestone/ activated carbon in front of the filter;	< 1 (0.1 ng TE/m^3)	Medium/high	
- Minimization and separate removal and purification of differently contaminated waste gas flows;		Medium/high	
- Avoidance of particulate deposition from the waste gas and promotion of rapid passing of the critical temperature range; and		Medium/high	
- Improved pretreatment of aluminium scrap shredders by using swim-sink separation techniques and grading through whirling stream deposition.		Medium/high	
