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Development of guidelines on best available techniques and provisional guidance on best environmental practices relevant to the provisions of Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants

DRAFT GUIDELINES ON BAT FOR
SMOULDERING OF COPPER CABLES

Note by the Secretariat

The attached was submitted by Mr. Patrick Finlay (Canada) who coordinated its development. This note and the attached have not been formally edited.

¹ UNEP/POPS/EGB.2/1.

Draft Guidelines on Best Available Techniques (BAT) for Smouldering of Copper Cables

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1.0 Process Description

Smouldering of copper cables involves the open burning of plastic coatings from electrical cable and wiring to recover scrap copper. This process is labour intensive, and performed by individuals or in small facilities without any abatement measures for air emissions. Smouldering is conducted in burn barrels or on open ground. No means of temperature control or oxygen addition are used to achieve complete combustion of plastic compounds.

The smouldering of copper cables is becoming prevalent in developing nations due to the recycling of computer scrap using manual methods. However, the process is not limited to developing countries and should be addressed on a global scale. Legislation has been implemented by many developed and developing countries to ban open burning, but the practice continues.

The *Technical Working Group of the Basel Convention on the Control of the Transboundary Movements of Hazardous Wastes and Their Disposal* states that “open burning is not an environmental[ly] acceptable solution for any kind of waste.”¹ The *United Kingdom Clean Air Act* states that “a person who burns insulation from a cable with a view to recovering metal from the cable shall be guilty of an offence...[and] shall be liable on summary conviction to a fine...”²

2.0 Sources of Unintentionally Produced POPs

The formation of polychlorinated dibenzoparadioxins (PCDD) and polychlorinated dibenzofurans (PCDF) may occur with trace oils and the presence of chlorine from plastics in the feed material. As copper is the most efficient metal to catalyse PCDD/PCDF formation, the burning of copper cables may be a critical source of PCDD/PCDF emissions.

2.1 Emissions of PCDD/PCDF

The incomplete incineration of chlorinated plastics causes PCDD/PCDF generation. Plastic coatings on copper cables consist mainly of polyvinyl chloride (PVC).

“During combustion, various ring-structure hydrocarbon species (referred to as “precursors”) are formed as intermediate reaction products. If chlorine is also present, these species can react with each other to form PCDD/PCDF. The most frequently

¹ United Nations Environment Programme, *Draft Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal*, December 2001, p. 46. URL: www.basel.int/meetings/twg/twg19/twg19_06.pdf.

² United Kingdom, *Clean Air Act 1993 (c. 11)*, Part IV, No.33 URL: http://www.hmsso.gov.uk/acts/acts1993/Ukpga_19930011_en_5.htm#mdiv33

*identified precursors are chlorobenzenes, chlorophenols, and chlorinated biphenyls. PCDD/PCDF may also be formed from the reaction of complex organic molecules and chlorine. Several studies have identified strong correlations between chlorine content and PCDD/PCDF emissions during combustion tests.”*³

Destruction of PCDD/PCDF requires temperatures above 850 °C in the presence of oxygen.⁴ Open burning in barrels or on the ground typically occurs in oxygen-starved conditions at low temperatures between 250 to 700 °C, which is insufficient for PCDD/PCDF elimination.⁵

2.2 General Information on Emissions from Smouldering of Copper Cables

Smouldering of copper cables releases various contaminants besides PCDD/PCDF, such as carbon monoxide (CO), sulphur dioxide (SO₂), polycyclic aromatic hydrocarbons (PAH), hydrogen chloride, heavy metals and ash. Incomplete incineration occurs because of the low burning temperature (250 to 700 °C), resulting in the generation of hydrocarbons and particulate matter. Lead stabilisers, often included into the PVC polymer matrix of the plastic cable coating, are released during smouldering. Lead coated copper cables are also burnt, releasing additional lead. Contaminants are emitted to air, water and soil.

3.0 New Copper Cable Recovery Facilities

The Stockholm Convention states that when proposals are considered to construct new facilities or significantly modify existing facilities using processes that release POPs, priority consideration should be given to alternative processes, techniques or practices that have similar usefulness but which avoid the formation and release of these chemicals.⁶

3.1 Alternate Processes to Smouldering Copper Cables

Smouldering of copper cables should not be conducted to prevent the generation of PCDD/PCDF. Alternate treatment processes to open burning are discussed below.

³ US Environmental Protection Agency, *Locating and Estimating Air Emissions from Sources of Dioxins and Furans*, May 1997, p. 3-8. URL: www.epa.gov/ttnchie1/le/dioxin.pdf

⁴ European Commission, *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Non Ferrous Metals Industries*, December 2001, p. 133.

⁵ Saskatchewan Environment, *Health and Environmental Effects of Burning Municipal Solid Waste*, site referenced 2 September 2003.

URL: www.se.gov.sk.ca/environment/protection/air/Health%20effects%20burning.pdf

⁶ Stockholm Convention on Persistent Organic Pollutants, 2001. URL: www.pops.int/documents/convtext/convtext_en.pdf

1. Cable Chopping⁷

Cable chopping allows for the separation of plastic coatings from cables without the generation of PCDD/PCDF through thermal methods. This process is able to treat cables of mixed type and different gauges. The products recovered are granulated copper and PVC.

Cable chopping involves the following steps:

a. Pre-sorting

Pre-sorting according to cable type is crucial for efficient cable chopping operations, providing maximum value from recovered scrap with easier separation of plastics. Sorting criteria includes metal alloys (separating copper and aluminium cables), conductor diameter, cable length, and type of insulation. Long cable lengths are sheared to <1 m, while densely baled cable is broken up into loose streams. Treated cables can vary between thin gauge to 8 cm diameter. Unsuitable material such as superfine wire and grease or tar-filled cables should be removed.

“In the past PCB was added to PVC for certain cable systems for high voltage applications to improve insulation performance and to certain low voltage cables as flame retardant. The presence of these cable systems should be determined before starting the recycling process.”

b. Cable chopping

Cable chopping is used to reduce long cable sections into acceptable size for the granulator. This process is optional in smaller facilities. Less filter dust is produced in comparison with cable shredding.

c. Granulation

Granulation is conducted to free metals from plastic insulation and jacketing. Fine granulation is necessary to achieve sufficient liberation of metals from the plastic. However, small amounts of metals will remain locked in the plastic and be lost as waste.

d. Screening

Screening can be used to ensure adequate liberation of metals by particle size separation. Oversize material can be reprocessed in the granulator. Metal particles

⁷ United Nations Environment Programme, *Draft Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal*, December 2001, p. 42. URL: www.basel.int/meetings/twg/twg19/twg19_06.pdf.

can be recovered from the screen product by removal of lighter non-metallic particles using an aspirator. Dust collection and filtering should be conducted during screening.

e. Density separation

The recovery of metals is dependent on the efficiency of the separation technique and degree of liberation of the metal from plastics. Separation of metal particles can be conducted using density separation techniques such as fluidised bed separators. Dry electrostatic separators can provide increased recovery compared to density techniques.

2. Cable Stripping⁸

Cable stripping is a cheaper method for copper cable recovery compared to chopping, but at lower throughput. PCDD/PCDF generation is not of concern in this process. This technique is preferred in developing countries due to the lower cost. Pre-sorting of cables should also be conducted before stripping according to metal type, insulation material, conductor diameter and length.

Despite the lower production rate, copper can be completely recovered as no residual metal remains in the plastic insulation. Careful segregation by insulator type can produce waste material consisting of only one type of polymer, allowing for easier recycling of both the metal and plastic fractions.

Cable stripping machines can process only single strands of cable at rates up to 60m/min or 1,100kg/min with cable diameter ranging from 1.6mm to 150mm.

3. High Temperature Incineration⁹

High temperature incineration should only be used for treating cable that cannot be recovered by chopping or stripping. Materials such as fine wire and grease or tar-filled cables are burnt in controlled atmosphere incinerators to ensure complete combustion of plastics. Effective flue gas cleaning systems should be utilized.

Furnace off-gases contain contaminants such as PCDD/PCDF, carbon dioxide (CO₂), sulphur dioxide (SO₂), hydrogen chloride and fluoride, and dust. Because PCDD/PCDF adsorb on particulate matter, dust should be collected using efficient methods such as fabric filters and recycled to the furnace. Post-incinerator afterburning and quenching

⁸ United Nations Environment Programme, *Draft Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal*, December 2001, p. 44. URL: www.basel.int/meetings/twg/twg19/twg19_06.pdf.

⁹ United Nations Environment Programme, *Draft Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal*, December 2001, p. 46. URL: www.basel.int/meetings/twg/twg19/twg19_06.pdf.

should be considered if incineration is ineffective in eliminating PCDD/PCDF. SO₂, and hydrogen chloride and fluoride should be removed by wet alkaline scrubbing.

Incinerated scrap metal has lesser value due to oxidation from thermal treatment. A high potential for PCDD/PCDF generation exists with incineration. Cable chopping and stripping are preferred to high temperature incineration as these processes are more economical and environmentally sound. Cable types unsuitable for chopping or stripping can also be treated in primary or secondary copper smelters.

3.2 Performance Requirements for New Copper Cable Recovery Facilities

New copper cable recycling facilities should be designed and operated to achieve reductions in emissions levels as shown:

- <0.1 ng /Nm³ TEQ for PCDD/PCDF

Methods to achieve targeted emissions level (for cable incineration):

- high efficiency dust removal systems (e.g. fabric filters)

- <5 mg/Nm³ for particulate matter

Methods to achieve targeted emissions level (for cable chopping, stripping or incineration):

- high efficiency dust removal systems (e.g. fabric filters)

5.0 Summary of Measures

Table 5.1 Measures for New Copper Cable Recovery Facilities

Measure	Description	Considerations	Other comments
<i>New Copper Cable Recovery Facilities</i>			
Alternate Processes	Various recommended treatment processes should be considered to replace open burning.	Processes to be considered include: - Cable chopping - Cable stripping - High temperature incineration for material unsuitable for chopping or stripping	Incineration is considered to be BAT in configuration with suitable gas collection and abatement.
Performance Requirements	New copper cable recycling facilities should be permitted to achieve stringent performance and reporting requirements associated with BAT.	Consideration should be given to the alternate processes listed above.	Performance requirements for achievement should include: - 0.1ng /Nm ³ TEQ for PCDD/PCDF - 5 mg/Nm ³ for particulate matter

Smouldering of copper cables should not be conducted as this practice generates PCDD/PCDF emissions. Open burning should never be considered as an acceptable means of waste treatment. Guidelines and legislation against the smouldering of copper cables has been implemented on federal, state, provincial, territorial and municipal levels by many countries.

Examples of such guidelines and legislation include:

- a. United Nations Environment Program, *Draft Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal*.¹⁰
- b. United Kingdom, *Clean Air Act 1993 (c. 11)*, Part IV, No.33.¹¹
- c. Hong Kong, *Air Pollution Control Ordinance (Open Burning) 1996*, Chapter 3110, Section 4.¹²

6.0 Performance Standards

Performance standards and timelines for achievement for new and existing copper cable recycling facilities are recommended as shown:

Type	Suggested Timeline	Emission Limit
New	Entry into force	<0.1 ng TEQ/Rm ³
Existing	Within 10 years of entry into force	<0.1 ng TEQ/Rm ³

7.0 Performance Reporting

Performance reporting is recommended as follows:

Annual isokinetic emission testing should be conducted at secondary copper smelters and reported to the appropriate national or sub-national authority for:

- Polychlorinated dibenzoparadioxins;
- Polychlorinated dibenzofurans;
- Hexachlorobenzene; and
- Polychlorinated biphenyls.

¹⁰ United Nations Environment Programme, *Draft Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal*, December 2001. URL: www.basel.int/meetings/twg/twg19/twg19_06.pdf

¹¹ United Kingdom, *Clean Air Act 1993 (c. 11)*, Part IV, No.33. URL: http://www.hmso.gov.uk/acts/acts1993/Ukpga_19930011_en_5.htm#mdiv33

¹² Hong Kong, *Air Pollution Control Ordinance (Open Burning) 1996*, Chapter 3110, Section 4. URL: <http://www.justice.gov.hk/home.htm>

Annual emission testing frequency could be reduced or suspended once emissions are shown to be 'eliminated'¹³ on a continued and consistent basis.

This is considered as BAT for performance reporting.

Where isokinetic emission testing for the above substances is not possible (e.g., analytical capacity is not readily available), emission factors associated with a similar plant type and operation, is suggested as an interim performance reporting requirement until such time as annual emissions testing and analysis is available.

¹³ The Government of Canada has established levels of quantification (LOQ) for virtual elimination of PCDD/PCDF, HCB and PCBs in air as follows: <32 pg Rm³ TEQ, <6 ng/Rm³ HCB, and <2 ng/Rm³ PCB, respectively. Consideration should be given to appropriate emissions levels associated with elimination of these substances.