Pollution inventory reporting – incineration activities guidance note

Environmental Permitting (England and Wales) Regulations 2010

Regulation 60(1)

Version 4 December 2012

We are the Environment Agency. We protect and improve the environment and make it a better place for people and wildlife.

We operate at the place where environmental change has its greatest impact on people's lives. We reduce the risks to people and properties from flooding; make sure there is enough water for people and wildlife; protect and improve air, land and water quality and apply the environmental standards within which industry can operate.

Acting to reduce climate change and helping people and wildlife adapt to its consequences are at the heart of all that we do.

We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

Published by:

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1. Introduction

If we regulate your activity as an A1 installation under the Environmental Permitting (England and Wales) Regulations 2010 (EPR) you will need to submit data to the Pollution Inventory.

You need to report each year. The system opens for reporting on 1 January and the deadline for submitting is 28 February.

Our general guidance sets out how to report and provides information applicable to all business and industries.

In this guidance you will find helpful information specific to the incineration sector. The term incineration includes hazardous waste, clinical waste, municipal, animal carcass and sewage sludge incineration

You should report annual mass releases of specified substances to air, water and land, as well as off-site transfers of waste. The reporting of 'releases to land' applies only to pollutants in waste which is disposed of by 'land treatment' or 'deep injection'. If waste is treated in this way, substance specific releases must be reported by the operator of the installation producing the waste, regardless of the disposal location. Accidental releases of pollutants onto the soil on the site of a facility (for example spillages) do not have to be reported. This guidance note applies to air, water and off-site waste transfer only.

Pollution Inventory guidance: www.environment-agency.gov.uk/pi

Release estimation techniques (RETs) are described in our general guidance. See Table 1 below for a summary of our preferred RETs for incineration activities:

Table 1 RET preferences

Preference	Release estimation technique availability	Notes
1	CEMs data	Calculate release based on daily CEMs average and daily average flow, integrated over year. (Note: based on raw/as measured data without subtraction of confidence intervals).
2	Periodic monitoring (with abatement) data.	Calculate release based on average of periodic samples and annual flow.
3	Periodic monitoring (without abatement) data.	Calculate release based on mass balance or emission factors, and as in 2 above. Report higher value.
4	No monitoring data.	Calculate release based on mass balance or emission factors.
5	Alternative agreed technique.	If you deviate from the above arrangements you need to agree an appropriate technique with us.

2. Emissions to air

Incineration installations subject to Chapter IV of the Industrial Emissions Directive (IED), which supersedes the Waste Incineration Directive, are normally required to be monitored continuously for NO_x , total particulate matter, CO, TOC, HCl, HF and SO_2. Under certain circumstances, continuous monitoring of HF, HCl and SO_2 may not be required and periodic monitoring can be substituted. The specific requirements for continuous or periodic monitoring are laid down in the EPR permit. The permit also specifies frequencies for periodic monitoring for heavy metals, dioxins and furans, dioxin-like PCBs and PAHs. The frequencies required by Chapter IV of the IED are the minimum frequencies for such periodic measurements, but the permit may specify higher frequencies. Additionally, the EPR permit may set additional site specific monitoring requirements depending upon the local circumstances, which may include, where SNCR is in operation, N_2O and/or NH_3 releases depending on the reductant used.

2.1. Relevant pollutants

The main air emissions from waste incineration activities are shown in Table 2. Use the table as a guide only and check that there are no other pollutants emitted from your installation. See Appendix B for a summary of currently used RETs.

Table 2 Main air pollutants emitted by incineration activities and their main sources

Main air pollutants	Main sources
Cd	Flue gas in MSW incinerators from batteries, accumulators, paints and plastics. Hazardous wastes including effluent treatment sludges and drummed waste from metal plating works.
CO	Flue gas as a result of incomplete combustion of waste. For example, if spontaneously evaporating or rapid-burning substances are present, or when combustion gas mixing with the supplied oxygen is poor.
CO_2	Flue gas as a result of complete combustion of organic material. Between 0.7 and 1.7 tonnes of CO_2 is generated per tonne of MSW combusted.
Dioxins and furans	Flue gas as a result of re-combination reaction of carbon, oxygen and chlorine. Also found in boiler ash, bottom ash, fly ash and sorbents. Dioxin and furan releases should be reported as I-TEQ and WHO-TEQ equivalents as calculated to fulfil the requirements of your EPR permit.
HCl	Flue gas from wastes containing chlorinated organic compounds or chlorides.
HF	Flue gas from fluorinated plastic or fluorinated textiles in MSW and a variety of fluorinated compounds in HWI.
Hg	Flue gas from MSW containing batteries, thermometers, dental amalgam, fluorescent tubes or mercury switches. In HWI from coking plant tars, waste from chlorine alkaline electrolysis, caustic oil sludge from refineries and other chemicals containing mercury. Also found in bottom ash, fly ash

	and sorbents. In SSI, Hg from sewage (especially dental amalgam).
Metals (Heavy metals and compounds other than Hg and Cd) As, Pb, Cr, Cu, Ni, Sn,	Flue gas as particulate matter usually as metal oxides and chlorides. Also found in bottom ash, fly ash and sorbent.
NH_3	Flue gas where SNCR is used and NH_3 is used as a reducing agent. This arises through overdosing.
NO_x	Flue gas as both thermal and fuel NOx. In MSW incinerators the proportion of thermal NOx is very relevant with each type of grate having an inherent background NOx level. It is often more significant than fuel NOx.
N_2O	Principally from SNCR. Modern MSW incinerators have low combustion-originated N_2O but, depending on reagent, significant emissions resulting from SNCR.
PAHs	Flue gas as products of incomplete combustion. Also found in bottom ash, fly ash and sorbents.
Dioxin-like PCBs	Flue gas from most municipal waste streams and some industrial wastes. Higher concentrations in some hazardous waste streams. Also found in bottom ash and APC residues.
Particulate matter (including PM_{10})	Flue gas as fine ash from the incineration process entrained in the gas flow. Also fugitive releases of dust from waste storage areas.
SO_2	Flue gas where sulphur is present in the waste stream. Common sources of sulphur in some waste streams are: waste paper; plaster board (calcium sulphate), and sewage sludges.
VOCs (Total Organic Carbon)	Flue gas from incineration of organic waste. Also fugitive releases from waste storage areas.

2.2. Emission sources

2.2.1. Point source emissions

These emissions are exhausted via a stack or vent, that is, a single point source into the atmosphere. Abatement equipment, for example scrubbing units, fabric filters (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere. Point source (main stack) emissions are usually the most significant emission source (in terms of annual mass releases) for combustion activities taking place within a variety of furnace types at incineration facilities.

2.2.2. Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack.

Fugitive dust and VOC emissions will be minimised where combustion, flue gas treatment processes and plant in general (including storage areas) operate at negative pressure.

 Some examples are:

- the loading and unloading of transport containers
- storage areas (for example, bays, stockpiles, and so forth)
- transferring material between vessels (for example, silos, volatile liquids such as SLF)
- conveyor systems
- pipework and ductwork systems (for example, pumps, valves, flanges)
- abatement equipment by-pass
- accidental loss of containment from failed plant and equipment
- oil and ammonia storage tanks
- poor building containment and extraction
- use of poorly sealed waste charging systems

You only need to report fugitive emissions that leave the installation to the PI. You do not need to report contained spills but do need to report vapour emissions that may have dispersed.

2.2.3. Emission factors

General

Provided that unit operations remain consistent, representative monitoring data can be used to generate site specific emission factors. The emission factor will be the ratio of the measured or calculated pollutant emission to the process activity (for example, waste feedstock flow rate). Site-specific emission factors should be periodically verified to ensure their continued validity, especially where waste feedstock quality varies throughout the year. Where different waste feedstocks are used, the emission when using each waste feedstock separately should be determined, and the results added together.

Emission factors are usually expressed as the mass of a substance emitted per unit of activity multiplied by the unit mass, volume, distance, or duration of the activity emitting the substance. In some cases, and particularly in the case of SO_2, the emission factor is based on waste feedstock analysis data.

In the case of new or modified processes, you can obtain initial emission factors from manufacturers' data and carry out sampling during commissioning to confirm the assumed values.

Carbon dioxide factors

Incinerators are currently exempt from EU ETS reporting requirements. You can use the methodology shown in our general guidance to estimate carbon dioxide emissions from incinerators.

Waste feedstock analysis and process stream data

The use of waste feedstock analysis and process stream data to determine emissions is similar to the use of emission factors.

For MSW incineration, analysis of fuel is not used for calculation of emissions. Either analysis is not carried out, is too variable, is too unreliable or cannot be related to emissions.

The basic equation used in waste feedstock analysis emission calculations is:

(1) $E = Q_f$ x [Op hours] x [PC_f/100] x (MM_p / EM_f)

Where:

E	= emission of pollutant, kg/yr
Q_f	= waste feedstock use (kg/hr)
PC_f	= pollutant concentration in the waste feedstock (%)
Op hrs	= operating hours per year, hr/yr
MM_p	= molar mass of pollutant as emitted after combustion
EM_f	= relative atomic mass of polluting element as present in waste feedstock

Equation 1 is the method usually used for calculating SO_2 emissions where it is normally assumed that all of the sulphur in the waste feedstock is converted to SO_2.

Where the pollutant concentration in the waste feedstock is consistent over the averaging period (that is, one year), equation 1 can be written as:

(2) $E = M$ x [PC_f/100] x (MM_p / EM_f)

Where:

E	= emission rate of pollutant in kg/yr
M	= mass of waste feedstock burnt in one year (kg/yr)
PC_f	= pollutant concentration in the waste feedstock (%)
MM_p	= molar mass of pollutant as emitted after combustion
EM_f	= relative atomic mass of pollutant as present in waste feedstock.

You can use Equation 1 for volatile elements such as fluorine and chlorine as well as trace metallic pollutants, although some of these species are retained in the plant, either in the ash or in abatement equipment. You should apply appropriate retention factors.

When using Equation 1 or Equation 2, you should be aware that the amounts of pollutants present in the waste feedstock can vary significantly.

Fugitive emissions

See appendix C for methodologies and factors used to determine fugitive emissions.

2.2.4. Normalisation

Take care in all calculations to ensure that the emission concentration and flow rate are compatible. For example, normalised emission concentrations should be multiplied by normalised volumetric flow rates or actual, measured emission concentrations multiplied by actual, measured volumetric flow rates. Normalised emission rates are quoted in terms of a standard oxygen concentration, and are usually dry gas, at a temperature of 273K and a pressure of 101.3 kPa. See appendix A for formulae for conversion between normalised and actual emission concentrations.

3. Emissions to water

Emissions of substances to water can be either direct to controlled waters or indirect, following transfer to off-site effluent treatment plant.

Guidance on what constitutes an emission or a transfer is contained in the general PI guidance document.

3.1. Relevant pollutants and emission sources

Water discharges from incineration processes arise from the air abatement equipment (for example, wet scrubbers), storm water, cooling water, boiler blow-down, incoming waste handling areas, ash and other residue handling areas, accidental emissions of raw materials, products or waste materials, fire fighting and from on-site effluent treatment. Table 3 illustrates the main pollutants emitted to water and their main sources. Suspended solids are not a PI reportable substance. Check that there are no other substances emitted from the process, including in association with suspended particulate. See Appendix B for methodologies used to determine emissions to water.

Table 3 Main water pollutants generated by incineration activities

Main water pollutants	Main sources
Dioxins and furans	Scrubber liquor, releases from ash quenching
Ethylene dichloride	Scrubber liquor, releases from ash quenching
Metals	Waste storage, scrubber liquor, releases from ash quenching
PAHs	Scrubber liquor, releases from ash quenching
Suspended solids	Raw material preparation, storage and handling, scrubber liquor, releases from ash quenching
TOC	Waste storage, scrubber liquor, releases from ash quenching

Note: At some installations waste water will pass through an on-site effluent treatment plant prior to discharge into controlled waters.

The resulting discharges of the above substances depend on the 'in process' preventative measures (good housekeeping, re-use) and the presence and technical standards of waste water treatment facilities.

You should consider all emission sources to water and characterise the flows and emission concentrations from each source.

4. Off-site waste transfers

Wastes must be classified by the List of Wastes Regulations 6-digit code(s) and by the relevant Waste Framework Directive disposal or recovery code(s) (D&R).

There is no reporting threshold for hazardous wastes, which are indicated by an asterisk in the List. For all other List/D&R code combinations, a reporting threshold of 5 tonnes applies.

Any transfer of waste off-site to a third party is covered by the Duty of Care provisions of the Environmental Protection Act 1990. This includes the requirement to describe the waste and record the quantity. Use the data you generate to comply with Duty of Care requirements to complete your PI return.

4.1. Relevant wastes

In general the waste streams from incineration facilities comprise:

- Bottom ash (approx. 25% by weight and 10% by volume of input for a modern Municipal Waste Incinerator MWI), (19 01 011 – where bottom ash contains dangerous substances and 19 01 12 where it does not)
- Fly ash (19 01 13 where fly ash contains dangerous substances and 19 01 14 where it does not) (where fly ash is combined with APC residues, include it in the mass of APC residue.)
- Air pollution control (APC) residues (commonly combined with fly ash and then approx. 2.5% by weight of waste input for a modern MWI) (19 01 07)
- Rejected feedstock wastes (chemical or physical incompatibility, for example large objects)
- Recovered waste fractions, for example steel and aluminium extracted from ash. (19 01 02 ferrous materials removed from bottom ash)

Appendix A Normalisation of emission concentrations

In many cases, pollutant emission concentrations to air are reported as normalised concentrations, the actual measured emission concentration having been adjusted to a normalised temperature (273K), oxygen, pressure and/or water vapour concentration. In calculating mass emissions to air, it is important that either the actual release concentration is multiplied by the actual volumetric flowrate, or the normalised concentration is multiplied by the normalised volumetric flowrate

The following equations can be used to correct measured concentrations and flowrates for temperature, oxygen, pressure and water vapour content.

Concentrations

To correct for moisture concentration to dry (0% oxygen)

$$C_d = C_m \times (100/(100 - \%H_2O))$$

Where: C_d is the dry concentration

C_m is the measured concentration
$\%H_2O$ is the measured water vapour percentage

To correct the % oxygen to dry basis (if required – may already be measured dry)

$$O_2(dry) = O_2m \times (100/(100 - \%H_2O))$$

Where: $O_2(dry)$ is the dry oxygen percentage
O_2m is the measured oxygen percentage

To correct to normalised oxygen concentration

$$C_{corr} = C_d \times (20.9 - O_2norm)/(20.9 - O_2(dry))$$

Where: C_{corr} is the corrected concentration for oxygen concentration
O_{2norm} is the stated normalised oxygen percentage

To correct for temperature

$$C_{normT} = C_{corr} \times ((273 + T_m)/273)$$

Where: C_{normT} is the normalised concentration for temperature
T_m is the measured temperature in degrees centigrade

To correct for pressure

$$C_{norm} = C_{normT} \times (101.3/P_m)$$

Where: C_{norm} is the normalised concentration
P_m is the measured pressure in kPa

Volumetric flowrates

To correct for moisture concentration to dry (0% oxygen)

$$Q_d = Q_m \times ((100 - \%H_2O))/100)$$

Where: Q_d is the dry volumetric flowrate
Q_m is the measured volumetric flowrate
$\%H_2O$ is the measured water vapour percentage

To correct the % oxygen to dry basis (if required – may already be measured dry)

$$O_2(dry) = O_{2m} \times (100/(100 - \%H_2O))$$

Where: $O_2(dry)$ is the dry oxygen percentage
O_{2m} is the measured oxygen percentage

To correct to normalised oxygen concentration

$$Q_{corr} = Q_d \times (20.9 - O_2(dry))/(20.9 - O_{2norm})$$

Where: Q_{corr} is the corrected volumetric flowrate for oxygen concentration
O_{2norm} is the stated normalised oxygen percentage

To correct for temperature

$$Q_{normT} = Q_{corr} \times (273/(273 + T_m))$$

Where: Q_{normT} is the normalised volumetric flowrate for temperature
T_m is the measured temperature in degrees centigrade

To correct for pressure

$$C_{norm} = C_{normT} \times (P_m / 101.3)$$

Where: C_{norm} is the normalised volumetric flowrate
P_m is the measured pressure in kPa

Appendix B Incineration source factors

The table below shows the pollutants potentially emitted from typical incineration processes. For pollutants not contained within this table a return of not applicable (n/a) is in most cases to be expected, to indicate that this pollutant is not knowingly discharged by the site.

Emissions to Air

Determinand	Method[1]	Emission source	Literature reference	Factors and guidance
Benzene	C	Waste combustion		
Benzo(a)pyrene	M	Waste combustion	BS ISO 11338	BS ISO 11338 for extractive monitoring
Butadiene	C	Waste combustion		
CO	M	Waste combustion	CEN/ISO/	Continuous and periodic monitoring carried out for all
			MCERTS	incinerators covered by WID. BS EN14181 for CEMs.
				Standard Reference Method BS EN15058. (ISO12039) formerly relevant)
	C	MSW combustion	Environment Agency (2000)	0.197 kg/t of MSW combusted
	C	SSW combustion	USEPA 1995	1.1 kg/t of SSW combusted (fluidised bed)
			USEPA 1995	15.5 kg/t of SSW combusted (multiple hearth)
	C	CW combustion	USEPA 1995	1.48 kg/t of CW combusted (controlled air)
CO_2	C	Waste combustion	EU ETS M&R	Although incinerators are not subject to the EU ETS
			Methodology	requirements the EU ETS methodology is considered
			(2004/156/EC)	best practice.
CH_4 **(see note 2)**	C	MSW combustion	Environment Agency (1997)	0.0008 kg/t of MSW combusted
	C	SSW combustion	USEPA 1995	0.39 kg/t of SSW combusted in multiple hearth (controlled)

Dioxins & Furans	M	Waste combustion	BS EN1948	Periodic monitoring required for WID incinerators.
HCl	M	Waste combustion	MCERTS/BS EN	BS EN14181 for CEMs and BS EN1911 (or demonstrated equivalent) for periodic monitoring carried out for all incinerators covered by WID
	C	MSW combustion	USEPA 1996	3.2 Kg/t of MSW combusted
	C	SSW combustion	USEPA 1995	0.05 Kg/t of SSW combusted on fluidised bed (controlled)
	C	CW combustion	USEPA 1995	16.8 Kg/t of CW combusted (uncontrolled)
Fluorine and inorganic compounds – as HF	M	Waste combustion	ISO/USEPA	BS EN14181 for CEMs and USEPA Method 26A for periodic monitoring. Not all WID incinerators are required to monitor HF continuously.
NH_3	M	SNCR nitrogen oxide abatement	MCERTS certified equipment	Continuous or periodic monitoring may be required depending upon BAT assessment. US EPA Method 26. VDI 2461 or ASTM D6348-03 potentially relevant to periodic monitoring.
NMVOCs	M	Waste combustion	MCERTS/BS EN 12619	CEM and extractive monitoring required under WID. BS EN14181 for CEMS.
	C	MSW combustion	Environment Agency (2000)	0.0308 kg/t of MSW combusted
	C	SSW combustion	USEPA 1995	0.84 kg/t of SSW combusted in multiple hearth (uncontrolled)
	C	Fugitive VOC		
		Releases		
NOx	M	Waste combustion	CEN/ISO/MCERTS	Continuous monitoring carried out for all incinerators covered by WID. BS EN14181. Standard Reference Method BS EN14792.

				(BS ISO 10849 for CEM & BS ISO 11564/ISO 10849 for extractive monitoring. Of former relevance)
N$_2$O **(see note 3)**	M	Waste combustion		Extractive monitoring required for WID. (ASTM D634803, ISO 10849, VDI2469-1)
	C	MSW combustion	IPCC (2000)	0.03 kg/t of MSW combusted
	C	SSW combustion	IPCC (2000)	0.8 kg/t of SSW combusted
PAHs **(see note 4)**	M	Waste combustion	BS ISO	BS ISO11338 for extractive monitoring
PCBs	M	Waste combustion	CEN/BS EN	BS EN1948 for dioxin like PCBs extractive monitoring.
Total Particulate Matter	M	Waste combustion	BS ISO/BS EN	Continuous monitoring carried out for all incinerators covered by WID. BS EN13284-2 for CEMs and BS EN13284-1 SRM.
	C	MSW combustion	USEPA 1996	12.6 kg/t of MSW combusted (uncontrolled)
	C	SSW combustion	USEPA 1995	233 kg/t of SSW combusted (uncontrolled)
	C	CW combustion	USEPA 1995	2.33 kg/t of CW combusted (uncontrolled)
PM$_{10}$ (also PM$_{2.5}$)	C	MSW combustion	(Environment Agency 2000)	0.022 kg/t of MSW combusted
	C	SSW combustion		0.075 kg/t of SSW combusted
	C	CW combustion	CORINAIR (1999)	0.27 kg/t of CW combusted
SOx	M	Waste combustion	CEN/ISO/MCERTS	BS EN14181/BS 6069 (ISO 7935) for CEMs and BS EN14791 (SRM). BS ISO11632/BS ISO 6069 alternatives for extractive monitoring.
	C	MSW combustion	(Environment Agency 2000)	0.076 kg/t of MSW combusted
	C	SSW combustion	USEPA 1995	2.3 kg/t of SSW combusted in multiple hearth (venturi scrubber)

	C	SSW combustion	USEPA 1995	0.15 kg/t of SSW combusted in fluidised bed (uncontrolled)
	C	CW combustion	USEPA 1995	1.09 kg/t of CW combusted in controlled air (uncontrolled)
Metals				
As	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Cd	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Cu	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Cr	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Hg	M	Waste combustion	BS EN	BS EN13211 for extractive monitoring (or in series with other metals by BS EN14385 subject to adaptation).
Mn	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Ni	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Pb	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Sb	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
V	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring.
Zn	M	Waste combustion	BS EN	BS EN14385 for extractive monitoring **(see note 5)**.

Notes:

1. In method column M=measurement, C=calculation, E=estimation (engineering judgement).

2. Option exists for methane emissions to be included in future phases of the EU ETS – estimation methodologies may warrant re-evaluation when EU monitoring and reporting decisions are published.

3. Option exists for N_2O emissions to be included in future phases of the EU ETS – estimation methodologies may warrant re-evaluation when EU monitoring and reporting decisions are published.

4. From 2006 the PI Schedule requires reporting of the annual emissions of listed individual PAH compounds (with individual reporting thresholds) rather than a PAH total.

5. Although not specifically validated for zinc. BS EN14385 will be applicable in most cases (see Environment Agency "Metals" Method Implementation Document).

Releases to controlled waters and transfers in wastewater

Wherever possible data should be net of incoming cooling water quality but where this would result in a negative return (that is, removal of pollutants from incoming waters) make a n/a return unless alternative local arrangements have been made with us.

The list of reference methods is not exhaustive, other analytical methods may be appropriate

Determinand	Method	Emissions Source	Literature Reference	Factors and Guidance
As	M	Effluent Treatment Facilities	BS EN ISO 11969	Monthly flow proportional sampling
Cd	M	Effluent Treatment Facilities	BS EN ISO 17294	Monthly flow proportional sampling
Chlorides (as total Cl)	M	Effluent Treatment Facilities	Chloride in Waters. Sewage and Effluents 1981 SCA blue book.	
Chloroform	M	Effluent Treatment Facilities	BS EN ISO 10301	
Cr	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling
Cu	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling
Ethylene dichloride	M	Effluent Treatment Facilities	BS EN ISO 10301	
Hg	M	Effluent Treatment Facilities	BS EN 13506	Monthly flow proportional sampling
Naphthalene	M	Effluent Treatment Facilities	BS ISO 17993 USEPA Method 0610	
Ni	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling
PAHs*	M	Effluent Treatment Facilities	BS ISO 17993 USEPA method 0610	
Pb	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling
PCBs	M	Effluent Treatment Facilities	USEPA methods 0680, 1668	

TOC	M	Effluent Treatment Facilities		Continuous monitoring
Tributyl Tin	M	Effluent Treatment Facilities	BS ISO 18073:2004	
Zinc	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling

* Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(123-cd)pyrene

Appendix C: Dioxins and furans

This family of compounds is known chemically as polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Each compound is made up of two benzene rings interconnected by oxygen atoms. Each individual PCDD or PCDF is termed a congener (there are 210 congeners in total). In reporting dioxin and furan releases, only the mass of PCDD and PCDF with chlorine atoms in the 2, 3, 7 and 8 positions (which are of particular environmental concern) should be included. The 17 **relevant PCDD and PCDF congeners** are listed below.

Congener	WHO-TEF	I-TEF
PCDDs		
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	1	0.5
1,2,3,4,7,8-HxCDD	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.1
OCDD	0.0003	0.001
PCDFs		
2,3,7,8-TCDF	0.1	0.1
2,3,4,7,8-PeCDF	0.3	0.5
1,2,3,7,8-PeCDF	0.03	0.05
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01
OCDF	0.0003	0.001

The two ways we want you to report the toxicity of dioxin releases are International toxicity equivalents (I-TEQs) and World Health Organisation toxicity equivalents (WHO-TEQ). Each dioxin congener is assigned a toxic equivalency factor (I-TEF for the International scheme and WHO-TEF for the WHO scheme). The 2,3,7,8-TCDD isomer is the most toxic, and is assigned a TEF of 1.0. The remaining 2,3,7,8-positional congeners are then assigned lower relative TEFs.

The toxicity mass of a particular substance relative to 2,3,7,8-TCDD can then be expressed by multiplying the mass of those 2,3,7,8-positional congeners present in the mixture by their respective TEFs. The resulting toxic equivalents (TEQs) are expressed as masses in the same way that the individual congeners are expressed.

You must give the total quantity of dioxins and furans in terms of their I-TEQs and WHO-TEQs.

TEFs for each of the 17 relevant 2,3,7,8-positional congeners of PCDDs and PCDFs are presented in the table above. All other congeners that may be present in a sample are not reported.

Worked example - calculating Dioxin and furan releases

If monitoring data representative of annual releases are available, you can get the TEQ of the mixture by summing the individual TEQs as follows:

Step 1: Calculate the TEQ for each congener released. Multiply the concentration (per m_3) of each released congener by its TEF and then by the total volume released in that year (in m_3) to provide the TEQ.

Step 2: Calculate the total TEQ released. Add together the TEQs of all the congeners released.

Carry out Steps 1 and 2 for both sets of TEFs

.

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