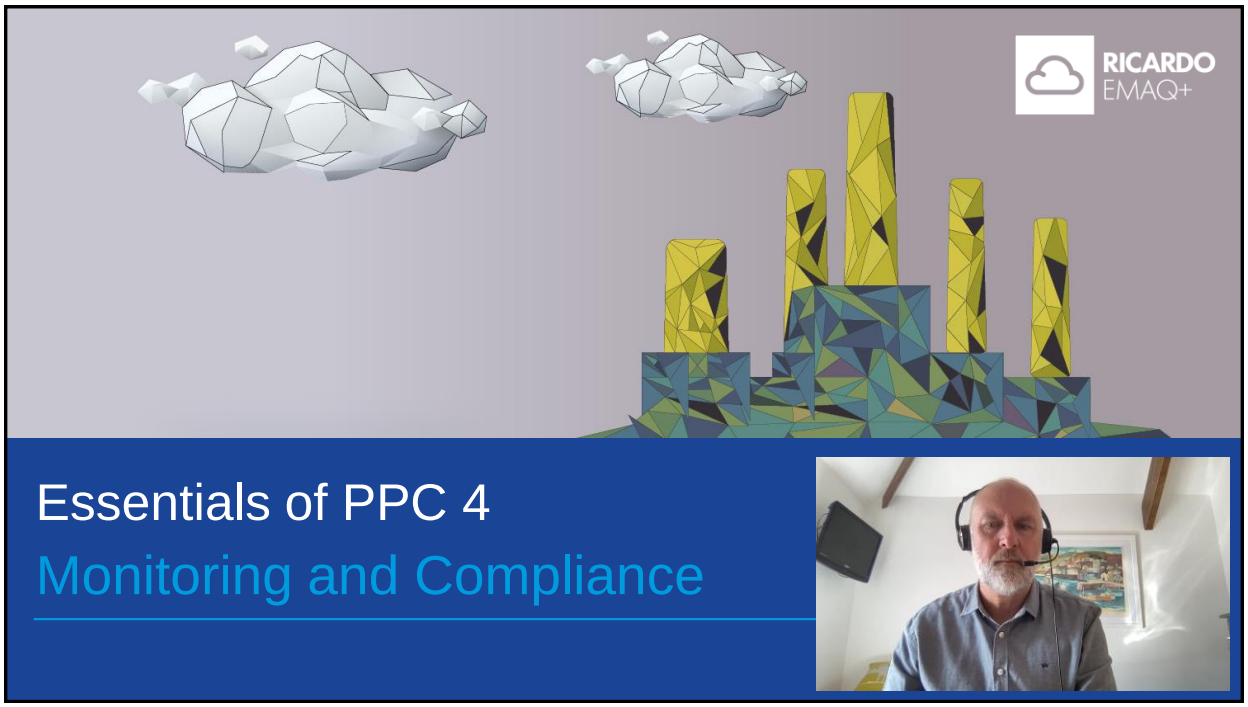
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Essentials of PPC 4
Monitoring and Compliance

1


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Robert Stewart

- Consultant >30 years
- Knowledge Leader for Industrial Regulation
- Supported LAs in Permitting
- Emission Monitoring
- Emission Inventories

01235 753620

emaq@ricardo.com

Tim Glews

- Formally Environmental Protection manager for Dudley MBC
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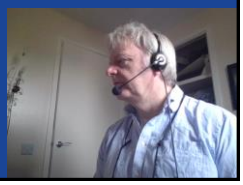

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4

Support to Local Authorities

At Ricardo we have a dedicated team of specialists and look forward to helping you with any of your air quality challenges:

Air quality services :

- ISO 17025 accredited **QA/QC audits** – required by LAQM TG (22)
- **Data management**, data collection, checking, validation, ratification
- **Local site operations**, calibrations/call outs
- **Web reporting -** for example : Air quality in England (airqualityengland.co.uk)
- **Routine data reporting** – weekly, monthly, quarterly, annual – for example : AQE Monthly Report (airqualityengland.co.uk)
- **Short term monitoring surveys** (site installation/decommissioning through to reporting)
- Long term station hire
- Advice on station installation, analyser procurement and, best practice
- **Low cost sensor measurements**, network management
- **Diffusion tube surveys**

Other services :

- **Expert Witness** and Expert Advice
- **LA-PPC/IPPC permit support**
- **Odour nuisance** support
- Air Quality **Modelling**
- **Real world vehicle emissions monitoring** aiding Action Planning
- **Mobile Monitoring** for point source and concentration contour mapping
- **Air quality forecasting** and public dissemination (via sms text, email, web, social media etc.)
- LAQM TG (22) Annual Status Reporting (ASR), Detailed Assessment
- CAZ/LEZ consultancy

For further information please get in touch with David Madle

07968707279 david.madle@ricardo.com

5

Programme for the day

Welcome and Introduction

Session 1: Monitoring and Sampling Techniques for Air

Session 2: Monitoring and Sampling Techniques for Water

Session 3: Monitoring and Sampling Techniques for Land

Session 4: Energy Efficiency, Resource Efficiency and Waste Minimisation

Session 5: Noise and Odour Monitoring and Compliance

Session 6: Case Study: Demonstrating and Checking Compliance

6

EMAQ - Essentials of PPC 4

- Today's Pollution Prevention and Control webinar provides "An introduction to Local Authority Pollution Prevention and Control" issues.
- It forms one of a series of five webinars offered by EMAQ on "The Essentials of PPC".
- The following introductory slides provide a short summary of the aims and scope of this series of five webinars from EMAQ.

7

EMAQ - Essentials of PPC 4

- This webinar builds on and strengthens core EMAQ materials and the professional experience of Ricardo and partner consultancies.
- It is expected that there will be a partnership between an individual attending the webinar and that individual's sponsoring authority or organisation.
- There are 5 "standalone" webinars that, together, comprise a complete 'Essentials of PPC' Training Course:

1. **Introduction to Local Authority Pollution Prevention and Control**
2. **Permitting and Regulation**
3. **Emissions and Control**
4. **Monitoring and Compliance**
5. **Management, Inspection and Enforcement**

8

EMAQ - Essentials of PPC 4

- The curriculum is based on the statutory duties imposed upon Local Authorities by the pollution prevention and control regime and takes into account legislation, statutory guidance and better regulation to provide a complete understanding of The Essentials of PPC for the officers attending the series of five webinars.
- It combines the knowledge and insight of the presenters with their practical experience of environmental permitting to achieve the following outcomes:
  - **Builds officers competence to effectively understand environmental permitting duties and to appreciate what constitutes best practice;**
  - **Builds the officers confidence to regulate effectively as an environmental permitting officer operating in an industrial setting;**
  - **Provides evidence of an officers ability to effectively implement Local Authority Pollution Prevention and Control as well as Integrated Pollution Prevention and Control measures;**

9

EMAQ - Essentials of PPC 4

Obtaining PPC credits

1. **Register and identify a "supervisor".**
2. **Attend the series of five webinars.**
3. **Demonstrate an understanding of the webinar material – via an on-line knowledge check,** (A PPC credit will be issued for successfully passing the knowledge check in addition to the CPD certificate.)
4. **Agree a development plan with a supervisor (or mentor) which, by the end of the five webinar programme, will show evidence of the officer having satisfactorily undertaken the following practical LA-PPC applications:**
   - determining permit applications;
   - setting permitting conditions for inclusion within a permit;
   - undertaking permit inspections and successfully reporting on the inspection;
   - risk assessing permitted activities to determine appropriate subsistence fee

   (supervisor to verify officers attainment)

10

EMAQ - Essentials of PPC 4

Obtaining a Certificate in Pollution Prevention and Control

- A certificate will then be issued to those officers who have:
  - Registered;
  - Gained all 5 credits for passing the individual knowledge tests;
  - Paid the fee to take the final on-line ‘proficiency test’;
  - Successfully sat the 'proficiency test' designed to show a co-ordinated knowledge of all aspects of the Essentials of the LA-PPC course;
  - Who’s Supervisor has:
    - verified the bona fides of the candidate and that the test was undertaken under the required conditions
    - confirmed that the candidate has had experience of the practical elements of PPC listed in their development plan

11

EMAQ - Essentials of PPC 4

Details of the knowledge checks and final proficiency test

- **Internet based knowledge checks and proficiency test**
- **On-line ‘knowledge checks’ to gain the PPC credit** obtained via 20 multi-choice questions
  - Delegates notified of a test window after completion of each webinar
  - 20 test questions to be completed in one unbroken 2 hour period
  - The pass threshold is 75%
  - Candidates have 3 opportunities to pass
- **Final PPC Proficiency Test** 20 multi-choice questions, drawn from the entire Essentials of LA-PPC syllabus
  - Delegates notified of a test window after completing all five webinars
  - 20 test questions to be completed within an unbroken 2 hour period
  - The pass threshold is 75%
  - Candidates will have 2 opportunities the proficiency test.
  - Supervisor will be asked first to verify the candidate’s identity and practical experience following the test

12

EMAQ - Essentials of PPC 4

Note on Scope of Today's Course

- The webinars in "The Essentials of PPC" course cover a very wide subject area and although the most important permitting related issues are addressed by the content of the webinars there may be issues on which delegates require more detail.
- For general questions concerning the course or administration of the webinars, please email EMAQ.
- For specific queries concerning LA – PPC, please take the opportunity to raise these issues with the presenter via an email to EMAQ
- EMAQ provide more detailed Advanced Technical webinars and seminars which build on the knowledge gained from the Essentials of PPC course, please see the annual training programme on the EMAQ web site for further details of what further advanced training is available.
- Thank you for supporting EMAQ, we hope that you enjoy your training.

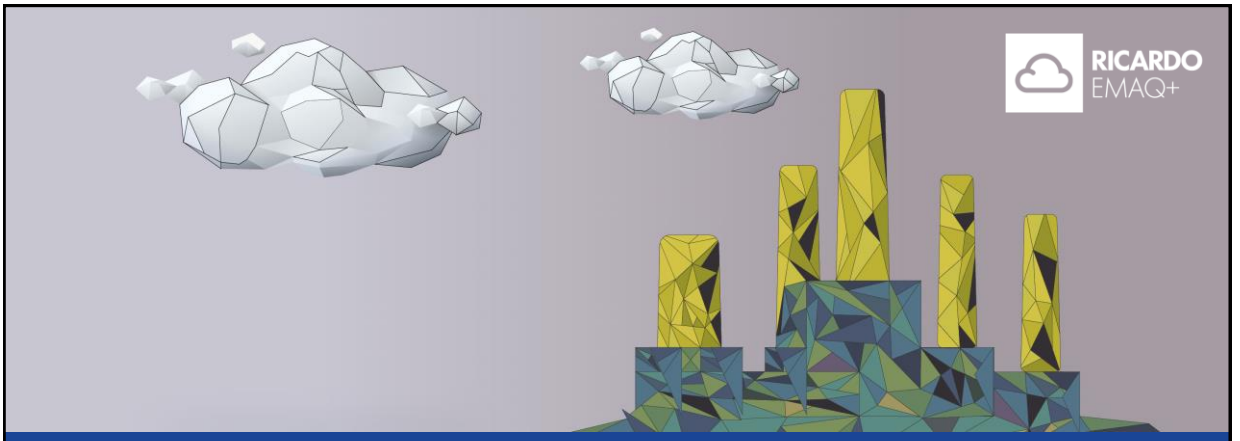
13

EMAQ - Essentials of PPC 4

Any Questions? Please email EMAQ+ at emaq@ricardo.com

Thank You

14



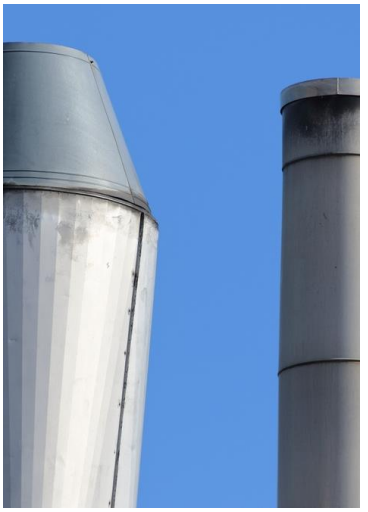
Essentials of PPC 4

Session 1: Monitoring and Sampling Techniques for Air

1

Contents

- Introduction to Monitoring, Sampling and Relevant Guidance.
- Common Features and Requirements for Emission Sampling Systems.
- Outline of Measurement Steps and Parameters.
- Monitoring techniques for each category.
- Outline of Computations and Correction Steps.
- More Complex Extractive Manual Sampling Systems (dioxins and VOC).
- Emission monitoring standards.
- MCERTS.
- Permit condition examples.



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Introduction to Monitoring, Sampling and Relevant Guidance

3

Monitoring and Sampling Techniques for Air

Introduction to Monitoring, Sampling and Relevant Guidance

Regulators, Operators and Monitoring Contractors need to bear in mind:

- What are the permit condition requirements?
- Sampling requirements for monitoring stack emissions to air from industrial installations in EA Guidance on .GOV: https://www.gov.uk/government/publications/monitoring-stack-emissions-measurement-locations#Overview (formerly TGN M1).
  Technical guidance for monitoring of stack emissions to air – https://www.gov.uk/guidance/monitoring-stack-emissions-technical-guidance-for-selecting-a-monitoring-approach (formerly TGN M2).
- Reporting must be in accordance with the permit conditions.

4

Monitoring and Sampling Techniques for Air

Introduction to Monitoring, Sampling and Relevant Guidance

Overview of stack emissions monitoring guidance:
https://www.gov.uk/government/collections/monitoring-stack-emissions-environmental-permits
https://www.gov.uk/government/collections/monitoring-emissions-to-air-land-and-water-mcerts#emissions-to-air

Quick Guides:

- RM-QG-11 – manual stack emissions monitoring (withdrawn but accessible on .GOV, largely superseded by online guidance).

Monitoring Technical Guidance Notes:

- Largely superseded by online guidance;
- TGN M20 – Quality assurance of continuous emissions monitoring systems.

MCERTS Method Implementation Documents (MIDs) http://www.s-t-a.org/?page=mids

- MID EN 14181.
- MID EN 13284-1, 13284-2.

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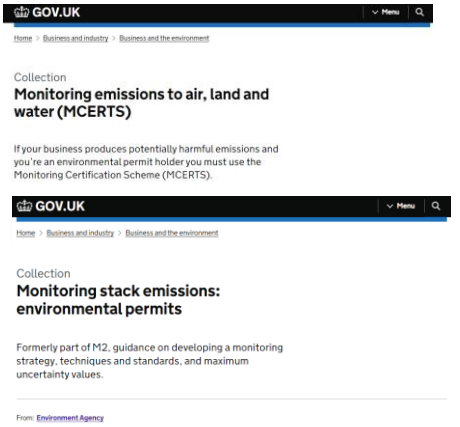
Monitoring and Sampling Techniques for Air

Introduction to Monitoring, Sampling and Relevant Guidance



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Common Features and Requirements for Emission Sampling Systems

7

Monitoring and Sampling Techniques for Air

Common Features and Requirements for Emission Sampling Systems

Standard emission monitoring methods require ***representative*** samples to be ***extracted*** from stacks or ducts, using a sample probe. The sampling probe is fitted to a sample collection system to remove the target species for later analysis. For some gaseous species the sampling systems can be linked to an analyser for immediate analysis.

8

Monitoring and Sampling Techniques for Air

Common Features and Requirements for Emission Sampling Systems

- Pollutant concentrations and mass flows may ***not be uniform*** across the sampling plane and there may be appreciable temporal / spatial variations, especially for particulate phase species.
- There may be obstructions causing flow disturbances up or down stream of the sampler and there may be inertial distortion effects. These can cause significant problems, especially for particulate species.
- These problems must be taken into account when choosing sampling positions, sampling points and planning the sampling strategy.
- For example, if target species exist in the particulate phase, then isokinetic, multiple point sampling is necessary, using a sharp sampling nozzle. Also, the sampling position must be well away from flow disturbances.

9

Monitoring and Sampling Techniques for Air

Common Features and Requirements for Emission Sampling Systems

- For purely gaseous species, isokinetic (and some of the other more taxing sampling requirements) can often be relaxed. Isokinetic sampling is where the sampling velocity (into the sample nozzle) matches the local flue gas velocity.
- Where condensation is likely to occur in the sampling device, prior to any particle filtration, then a heated sampling system will be required.
- Where the target species is reactive or easily adsorbed on to surfaces, then the sampler will need to be made of inert materials (e.g. glass, titanium, specialised steels or even PTFE).
- Sampled gas volumes will need to be metered and recorded, as well as sampler and stack temperatures, together with some ancillary stack gas measurements.
- Sampling rates will need to be monitored (e.g. to ensure isokinetic sampling is maintained for particulate sampling).

10

Monitoring and Sampling Techniques for Air

Common Features and Requirements for Emission Sampling Systems

In ***Manual*** methods, the sampled target species is extracted / sampled **periodically**. It is analysed ***later,*** and is collected:

- On to a weighed filter (for particulate species) - with later gravimetric or chemical analysis of the collected sample; or
- Into a suitable chemical absorbing solution for gaseous / vaporous species (after filtering out any particulates). Chemical / physical analysis of the recovered sample is carried out later;
- Adsorbed on to a suitable solid substrate (for some gaseous / vaporous species), with later de-sorption and analysis.

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11

Monitoring and Sampling Techniques for Air

Common Features and Requirements for Emission Sampling Systems

In ***Instrumental*** methods, the sampled gas is ***conditioned*** and passed to a ***calibrated*** instrumental detection cell for ***immediate*** analysis. Sampling / monitoring can be carried out **periodically** or **continuously,** depending on the compliance requirements of permit conditions.

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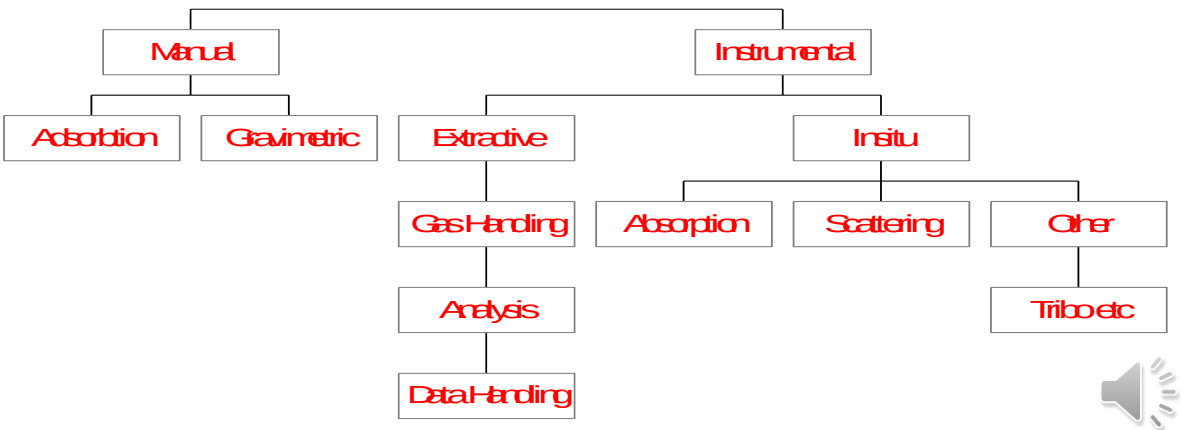
12

Outline of Measurement Steps and Parameters

13

Monitoring and Sampling Techniques for Air

Outline of Measurement Steps and Parameters



14

Monitoring and Sampling Techniques for Air

Outline of Measurement Steps and Parameters

For Manual Monitoring Methods:

- The sampled gas volume, $Vol._m$ (m^3) is measured, usually by a meter, but it might be deduced. Most samplers measure the dry gas volume.
- The mass of target species in the collected sample is determined by weighing, or by chemical analysis, W (mg.)
- And Measured Concentration (Cm) = W/Vol.m (in mg/m^3)

For Instrumental Monitoring Methods:

- The concentration of target gas species C_1 is determined continuously in vol/vol terms (ppm or percent).
- C_1 = (volume of pollutant gas)/ (volume of diluent gas + pollutant gas)

15

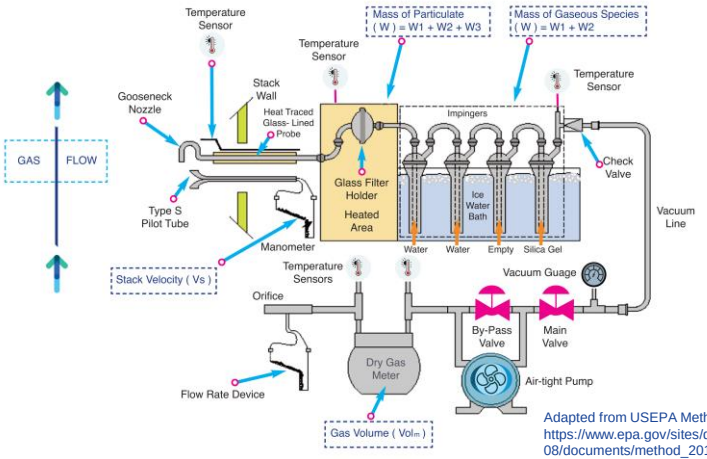
Monitoring Techniques for Each Category

16

Monitoring and Sampling Techniques for Air

Manual Particulate Sampler

Manual Particulate sampler



Adapted from USEPA Method 201A: https://www.epa.gov/sites/default/files/2017-08/documents/method_201a.pdf

17

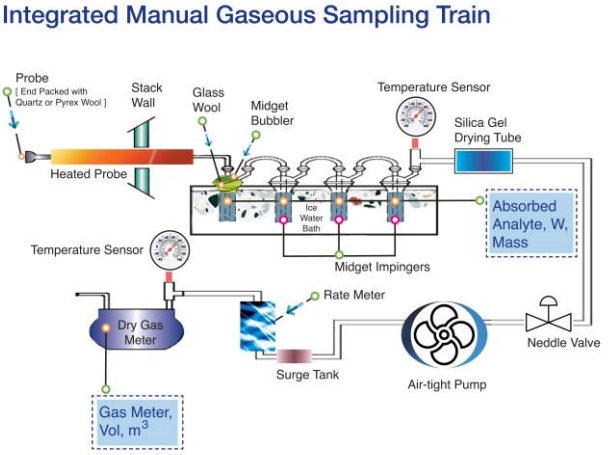
Monitoring and Sampling Techniques for Air

Manual Particulate Sampler

18

Monitoring and Sampling Techniques for Air

Integrated Manual Gaseous Sampling Train

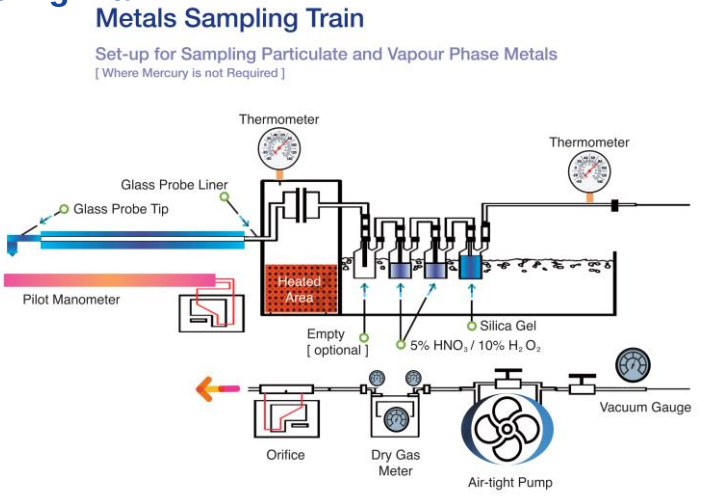


Adapted from USEPA Method 6, Figure 6.1- https://www.epa.gov/sites/default/files/2017-08/documents/method_6.pdf

19

Monitoring and Sampling Techniques for Air

Metals Sampling Train



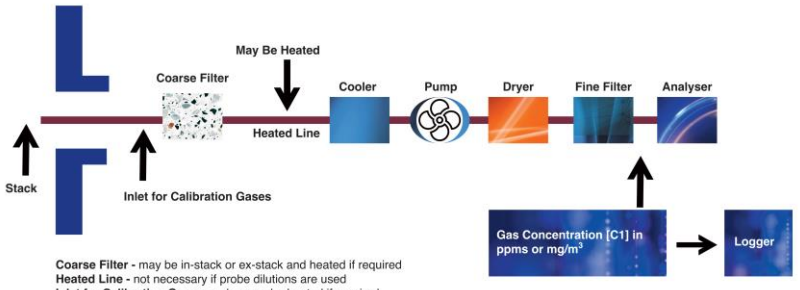
Adapted from US EPA Method 0010: https://www.epa.gov/sites/default/files/2015-12/documents/0010.pdf

20

Monitoring and Sampling Techniques for Air

Instrumental Monitoring Systems

On - Line Extractive Sampling of Gases



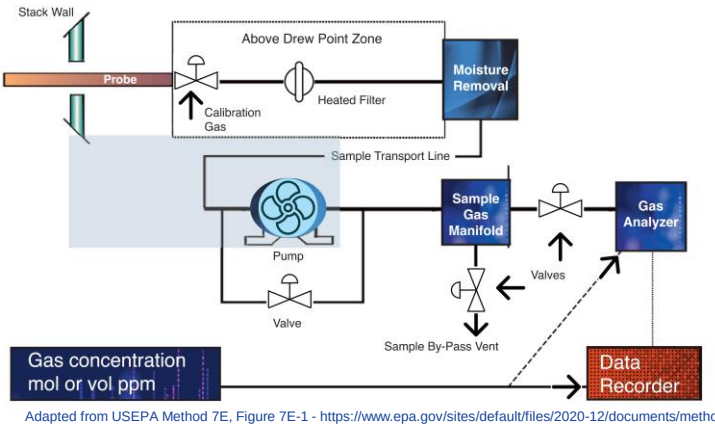
Coarse Filter - may be in-stack or ex-stack and heated if required
Heated Line - not necessary if probe dilutions are used
Inlet for Calibration Gases - valve may be heated if required
Cooler - moisture removal
Pump - should be lined with an inert material
Dryer - may not be required

21

Monitoring and Sampling Techniques for Air

Instrumental Monitoring Systems

Instrumental Monitoring Systems



Adapted from USEPA Method 7E, Figure 7E-1 - https://www.epa.gov/sites/default/files/2020-12/documents/method_7e_2.pdf

22

Outline of Computations and Correction Steps

23

Monitoring and Sampling Techniques for Air

Outline of Computations and Correction Steps

Measurements and parameters to consider

- The flue gas velocity and temperatures are measured at the sample point.
- The actual flue gas velocity **Vs**.(m/s) is computed.
- The sampling plane cross section area, **A** (m^2) is determined by measuring the duct dimensions.
- Ancillary gas data is measured [stack moisture, O_2, (or CO_2) and static pressure] These, together with meter temperature and pressure are often needed for later correction of gas flows, velocities and concentrations to permit reference conditions (see later).

24

Monitoring and Sampling Techniques for Air

Outline of Computations and Correction Steps Determination of Pollutant Concentrations

- For Instrumental measured gas concentrations, **C_1** (ppm) has to be converted to mass/vol concentrations **C** (mg/m^3).
- For Manual methods, the sampled concentration of lab determined target species is calculated directly from:

  C_m = W / Vol.$_m$ (mg/m^3).
- Concentrations are now corrected to reference conditions, **Cref** (e.g. mg/m^3 at STP dry, 11% O_2):

  C_{ref} = C_m x **Various Correction factors** (mg/m^3).

25

Monitoring and Sampling Techniques for Air

Outline of Computations and Correction Steps – Determination of Gas Flow and Emission Rates

- The actual average flue gas velocity **Vs.av** (m/s) is computed.
- The average actual flue gas flow rate, Qs.av (m^3.s^{-1}) is computed from:

  Qs.av = **Vs.av** x **A** (m^3.s^{-1})
- The average flue gas flow rate is corrected to reference conditions, **Qref.av** (m^3.s^{-1}, e.g at STP dry):

  Q**ref.av = Qs.av** x **Various Correction factors** (m^3.s^{-1})
- The pollutant emission rate (**E**) can now be computed from:

  E = **C_{ref}** x **$Q_{ref.av}$** **(mg/s)**

26

Monitoring and Sampling Techniques for Air

More Complex Extractive Manual Sampling Systems

27

Monitoring and Sampling Techniques for Air

More Complex Extractive Manual Sampling Systems

- Species that can exist simultaneously in several phases (multiple phase species) such as **dioxins, metals, VOC,** etc all require special extractive sampling approaches.
- In some cases, a portion of the sampled target species could be associated with the **solid particulate phase**, whilst other portions may be present as particulate **liquid droplets**; and some portions may be present as **vapours**.
- Changes in sampler temperatures could drive the target species from one phase to another. For example, this could result in condensation losses, or sampled fractions slipping from one part of the sampler collection system to another, and possibly being lost.
- In some cases, high temperatures and inappropriate sampler materials could result in ***de novo synthesis*** of the target species (e.g. this can occur in dioxin sampling).
- The standard sampling method and sampling system will have been designed to ensure that such losses and de novo synthesis gains are minimised.

28

Monitoring and Sampling Techniques for Air

Dioxins Sampling

- **Crematoria, incinerators, processes with combustion steps, or metal melting processes, (especially those involving scrap) all have the potential to emit dioxins.**
- **These compounds are multi-phase, being liquid droplets and vapours at normal stack temperatures.**

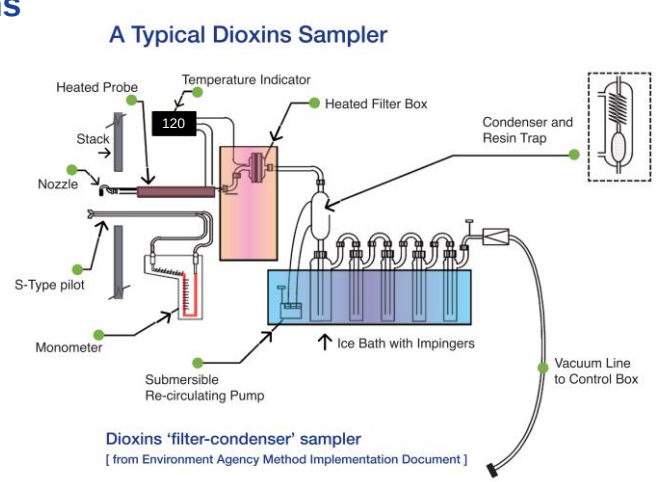
Therefore:

- Both phases must be sampled simultaneously into the same sampling train incorporating particle and vapour phase sections.
- An extractive manual train is employed.
- Includes a probe, filter (for particles) and a series of cooling and gas absorbing sections for collecting dioxin vapours.
- As particles are present, inertial and flow disturbance effects must be addressed as for particles, and isokinetic sampling is also necessary.

29

Monitoring and Sampling Techniques for Air

A Typical Dioxins Sampler



30

Monitoring and Sampling Techniques for Air

Important Points - Dioxin Sampling

Other minimum criteria need to be satisfied, e.g:

- Minimum sampling times, sample volumes and detection criteria.
- Inert or special sampling materials required (eg glass, quartz, titanium, PTFE, low organic content background filters).
- Flexible extended sampling lines between the probe and sampler collection components are **not** allowed.
- Suitable absorbing solutions / resins with high vapour retention efficiency.
- Absorber temperatures to be kept low and filters just above dew point.
- Careful recovery procedures required.
- Special sample digestion techniques needed.
- Sensitive and specific analysis techniques required.

31

Monitoring and Sampling Techniques for Air

The CEN Method (BS EN 1948: Part 1)

Three generic sampling systems allowable:

- The filter / condenser method (widely used in the U.K.), and the USEPA M23 sampler system conforms to this;
- The dilution sampling technique;
- The water cooled probe approach;
- All have been validated on waste incinerators at dioxin levels of about 0.1 ng TEQ m^{-3} and dust concentrations ranging from 1 to 15 mg m^{-3}.

32

Monitoring and Sampling Techniques for Air

Other Key Sampling Requirements

- Specified sampler standards spikes must be employed.
- Leak check criteria of 5% of normal flow rate to be satisfied.
- Filter must be maintained below 125^{o}C (on filter/condenser method).
- Filter must be maintained below 40^{o}C (on dilution method).
- Filter efficiency to be > 99.5% for 0.3 micron particles.
- Ad/absorbers efficiency to be > 90% for gaseous dioxins.
- Condensers to be maintained below 20^{o}C.
- Control sampler blank required before each campaign.
- If sampler parts are reused then rinsing's must be stored and analysed if the dioxin emission limit is exceeded.
- Maximum sampling time is 8 hours.

33

Monitoring and Sampling Techniques for Air

Monitoring VOC Emissions

- CEN has produced source reference methods for monitoring VOC emissions.
- Two have specifically been developed for demonstrating compliance with the SED stack emission limits.
- CEN/TS 13649:2014:
  - Manual periodic sampling of flue gases, with adsorption on to activated carbon tubes;
  - Sample later desorbed by solvent extraction and sample analysed for speciated VOC components by, e.g. GC-MS, GC-FID etc.

34

Monitoring and Sampling Techniques for Air

Reference Source Compliance Methods - VOC

- CEN/TS 13649 scope is 0.5 - 2000 mg/m3.
- General sampling requirements are:
  - Use inert materials, glass, stainless, PTFE or PPF;
  - Line to be short as possible;
  - Condensation to be prevented;
  - Particles to be removed.
- Sampler arrangement depends on following gas conditions:
  - Temperature;
  - Closeness to saturation;
  - Expected concentrations.

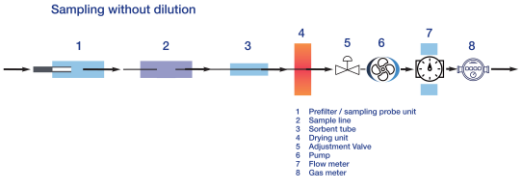
35

Monitoring and Sampling Techniques for Air

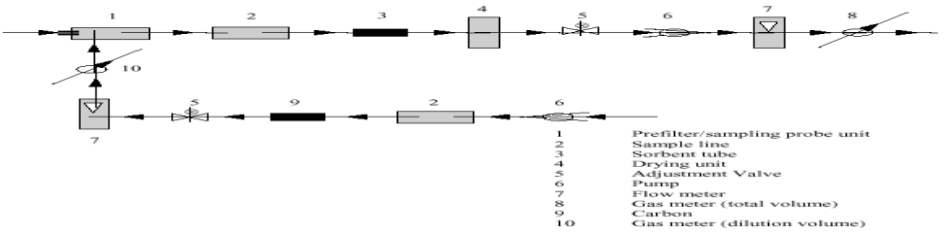
Reference Source Compliance Methods - VOC

CEN/TS 13649 Sampler arrangement includes:

Sampling without dilution



Sampling with dynamic dilution



36

Monitoring and Sampling Techniques for Air

Reference Source Compliance Methods - VOC

CEN/TS 13649 Sampler arrangement includes:

- Sampling with dilution into part-filled bags;
- Absorption temperatures ≤ 40°C;
- Sampling time typically 10- 30 minutes but ≥ 5 minutes;
- Desorption Efficiency ≥ 80%.

37

Monitoring and Sampling Techniques for Air

Method Choice

- Has operator/contractor agreed to use **standard** source monitoring methods?

Austria, Belgium, Czech Republic, Denmark, Finland
France, Germany, Greece, Iceland, Ireland
Italy, Luxembourg, Netherlands, Norway, Portugal
Spain, Sweden, Switzerland, United Kingdom

- Priority should be given to International standards (BS EN methods, then BS ISO). This to be followed by other National Methods (e.g. EPA).
- Processes covered by EU Directives must use EN methods.

38

Monitoring and Sampling Techniques for Air

Emission Monitoring Standards

39

Monitoring and Sampling Techniques for Air

Emission Monitoring Standards (Selected Examples)

Compound	Standard Number	Description	MID
Alternate reference method procedure	CEN/TS 14793	Intralaboratory validation procedure for an alternative method compared to a reference method	
Asbestos	BS 6069-4.2	Method for the determination of asbestos plant emissions by fibre count measurement	
Calibration of CEMS	BS EN 14181	Quality assurance of an AMS	MID 14181 (TGN M20)
Carbon Monoxide (CO)	BS EN 15058	Determination of the mass concentration of carbon monoxide (CO). Reference method: non-dispersive infrared spectrometry	
CEMS sampling	BS ISO 10396	Sampling for the automated determination of gas emission concentrations for permanently-installed monitoring systems	
Dioxin 1 sampling	BS EN 1948-1	Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs. Sampling of PCDDs/PCDFs	MID 1948
Dioxin 2 extraction	BS EN 1948-2	Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs. Extraction and clean-up of PCDDs/PCDFs	MID 1948
Dioxin 3 quantification	BS EN 1948-3	Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs. Identification and quantification of PCDDs/PCDFs	MID 1948
Dioxin 4 PCB sampling and analysis	BS EN 1948-4	Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs. Sampling and analysis of dioxin-like PCBs	

40

Monitoring and Sampling Techniques for Air

Emission Monitoring Standards (.GOV resource)

GOV.UK Menu

Home > Business and industry > Business and the environment

Guidance

Monitoring stack emissions: techniques and standards for periodic monitoring

This index will help you choose an appropriate periodic monitoring technique and standard for monitoring stack emissions to air (formerly part of M2).

From: Environment Agency
Published 18 December 2019
Last updated 17 November 2022 — See all updates

GOV.UK Menu

Home > Business and industry > Business and the environment

Guidance

Monitoring stack emissions: techniques and standards for CEMS and automated batch samplers

Formerly part of M2, index of techniques for measuring substances using continuous emissions monitoring systems (CEMS) and standards for automated batch samplers.

From: Environment Agency
Published 18 December 2019

41

Monitoring and Sampling Techniques for Air

Emission Monitoring Standards (.GOV resource)

Contents

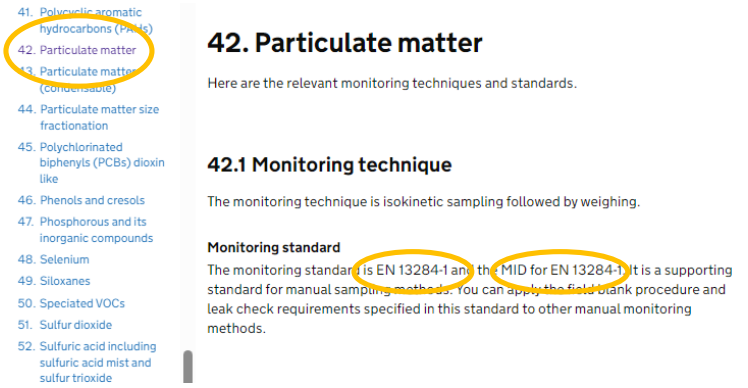
1. Aldehydes (excluding formaldehyde)
2. Amines and amides
3. Ammonia
4. Arsine (also known as arsane)
5. Benzene
6. Bioaerosols
7. Biomass (biogenic) and fossil derived carbon dioxide (ratio)
8. Carbon dioxide
9. Carbon monoxide
10. Carbon disulfide
11. Carbonyl sulfide
12. Carboxylic acids
13. Chlorine dioxide
14. Chlorofluorocarbons
15. Chromium (VI)
16. Cresols
17. Dioxins and furans
18. Ethylene dichloride
19. Formaldehyde
20. Flow
21. Gas velocity
22. Halogens and halides
23. Homogeneity test
24. Hydrogen chloride
25. Hydrogen cyanide
26. Hydrogen fluoride
27. Hydrogen sulfide
28. Isocyanates
29. Mercury
30. Mercaptans (thiols)
31. Metals (total)
32. Methane
33. Methanol
34. Moisture
35. Nitric acid vapour
36. Nitrogen monoxide and nitrogen dioxide
37. Nitrous oxide (dinitrogen monoxide)
38. Odour
39. Oil mist
40. Oxygen
41. Polycyclic aromatic hydrocarbons (PAHs)
42. Particulate matter
43. Particulate matter (condensable)
44. Particulate matter size fractionation
45. Polychlorinated biphenyls (PCBs) dioxin like
46. Phenols and cresols
47. Phosphorous and its inorganic compounds
48. Selenium
49. Siloxanes
50. Speciated VOCs
51. Sulfur dioxide
52. Sulfuric acid including sulfuric acid mist and sulfur trioxide
53. Stibine (also known as stibane)
54. Tar and bitumen fume
55. Temperature
56. Tetrachloromethane
57. Thiols
58. Tin
59. Total cyanide
60. Total organic compounds
61. Total reduced sulfur compounds (TRS)
62. Total sulfur
63. Total VOCs
64. Trace metals
65. Vinyl chloride monomer
66. VOCs (speciated)
67. VOCs (total)
68. Water vapour (moisture)
69. Zinc

Monitoring stack emissions: techniques and standards for periodic monitoring - GOV.UK (www.gov.uk)

42

Monitoring and Sampling Techniques for Air

Emission Monitoring Standards (.GOV resource)



43

MCERTS

44

Monitoring and Sampling Techniques for Air

MCERTS

- MCERTS is the Environment Agency's Monitoring Certification Scheme
- Its purpose:
  - To promote the production of quality monitoring data
  - Provide a key foundation for the EA's policy of operator self-monitoring
- Defra, in '**The Environmental Permitting General Guidance Manual on Policy and Procedures for A2 and B Installations**' (April 2012) recognises and encourages the use of MCERTS.
- However, they also recognise that if the use of MCERTS CEMS instruments would incur significant additional expense for little improvement in data quality, they would not normally represent BAT for LA-PPC (Part B).
- Use of accredited organisations and MCERTS-certified personnel for stack emission monitoring is desirable but not mandatory for LA-PPC (Part B).
- However, the requirement for MCERTS to be used for monitoring and analysis is often written into Part B permit conditions, therefore making it a legal obligation for the operator.

45

Monitoring and Sampling Techniques for Air

MCERTS for Air Monitoring

- **Competency standards for emission monitoring (accredited laboratories and certified staff).**
- **Continuous monitoring of industrial chimneys, stacks and flues.**
- **Monitoring ambient air quality.**
- **Monitoring with isokinetic samplers.**
- **Portable equipment for emissions monitoring.**

MCERTS for Soil Analysis

- **Chemical testing of soil.**

MCERTS for Water Monitoring

- **Competency standard for inspectors and organisations.**
- **Equipment for continuous monitoring discharges to rivers, smaller watercourses and the sea.**
- **Direct toxicity assessment of effluents.**
- **Portable equipment for monitoring water.**
- **Sampling and chemical testing of water.**
- **Self monitoring of effluent flow.**
- **Radioanalytical testing of water.**

MCERTS for Environmental Data Management Software

- **Performance standards and test procedures for environmental data management software.**

46

Monitoring and Sampling Techniques for Air

MCERTS for CEMS

- List of certified instruments is on the web-site
  http://www.csagroupuk.org/services/mcerts/mcerts-product-certification/mcerts-certified-products/
- Testing is carried out on large combustion plant and incinerators.
- Extrapolation to other processes is allowed.

47

Monitoring and Sampling Techniques for Air

MCERTS Manual Stack Emission Monitoring

- **Two components:**
  - Performance standard for laboratories;
  - Performance standard for personnel.
- **UKAS accreditation of laboratories to ISO 17025 for the MCERTS standard.**
- **Certification of personnel by Sira Certification Service operating to ISO 17024.**

48

Monitoring and Sampling Techniques for Air

MCERTS Performance Standard for Organisations

- Ethical requirements for independence and environmental awareness.
- Selection of appropriate methods following international standards.
- Use of Agency Method Implementation Documents, where available.
- Estimation of measurement uncertainty.
- Use of appropriate sampling / monitoring equipment.
- Planning of a measurement campaign:
  - Site review;
  - Risk assessment;
  - Site specific protocol.
- Reporting of results.
- Use of MCERTS certified personnel.

49

Permit Condition Examples

50

Monitoring and Sampling Techniques for Air

Permit Condition Examples

Example of a typical emissions monitoring condition

Emissions of substances to the external air listed in ***Table 1*** shall be controlled.

All point source emissions from the permitted activity shall comply with the emission limit values and provisions with regard to releases detailed in ***Table 1***. Monitoring of emissions shall be carried out according to the method specified in ***Table 2*** or by an equivalent method agreed and confirmed in writing, by the regulator.

The reference conditions for emission limit values specified in ***Table 1*** are : 273.1K, 101.3kPa, dry gas, and 6% oxygen for solid fuel firing, and 3% oxygen for liquid and gas fuels.

51

Monitoring and Sampling Techniques for Air

Permit Condition Examples

Table 1 – Emission Monitoring Requirements

Substance	Emission limit value	Type of monitoring	Frequency
Organic compounds	50 mg/m^3	Quantitative	Annual test
Nitrogen oxides	400 mg/m^3	Quantitative	On commissioning and after substantial change
Carbon monoxide	No limit	Quantitative	Continuous and annual test
Particulate matter	150 mg/m^3	Quantitative	Continuous and annual test
Oxygen	No limit	Quantitative	Continuous and record

52

Monitoring and Sampling Techniques for Air

Permit Condition Examples
Table 2 – Emission Measurement Methods

Substance	Measurement method
Organic compounds	BS EN 12619
Nitrogen oxides	BS EN 14792
Carbon monoxide	BS EN 15058
Particulate matter	BS ISO 9096
Oxygen	BS EN 14789

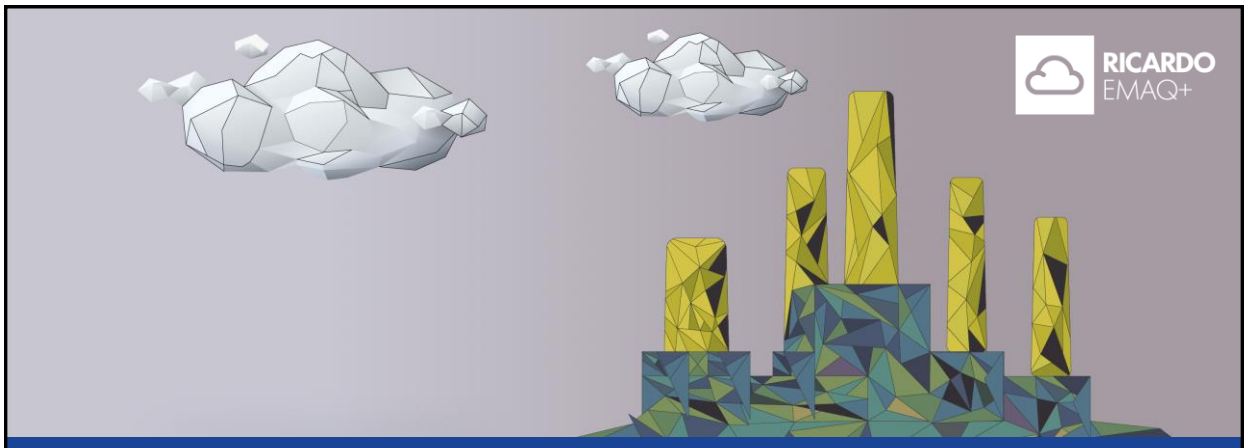
53

Monitoring and Sampling Techniques for Air – End of Session 1

Any Questions? Please Email EMAQ to receive a response emaq@ricardo.com .

Thank You

54



Essentials of PPC 4

Session 2: Monitoring and Sampling Techniques for Water

1

Contents

- How the Environment Agency Set Discharge Limits.
- Discharge to Sewers.
- The Operator's Role.
- The Regulator's Role.
- Monitoring and Modelling of Pollutants.
- Sampling Techniques.
- Analytical Methods.
- Measuring Water Flow.
- Regulation 59 EP Regs Notice – Prepared by Environment Agency.
- Example Permit Conditions.
- Results; Pre and Post Sampling.

2

How the Environment Agency Set Discharge Limits

3

Monitoring and Sampling Techniques for Water

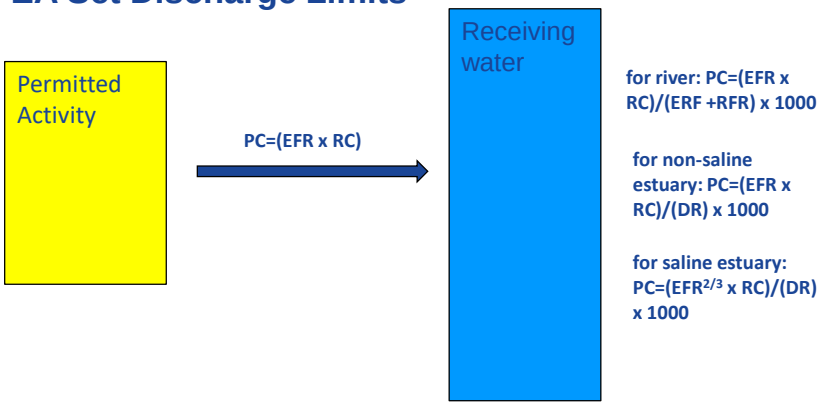
How the Environment Agency Set Discharge Limits

- **Water discharges and impacts are assessed in a similar way as for impacts on air quality and is needed for A2 permitted activities:**
  - Submit substance concentration and emission release data;
  - Compute the process contribution to the release medium after dispersion;
  - Compare both short term and long term PC against environmental benchmarks (EAL or EQS);
  - Screen out insignificant releases;
  - Model remaining releases and compare with environmental benchmarks;
  - If EAL or EQS breached, then not normally acceptable.
- **There are variants to deal with discharges to:**
  - River;
  - Estuary;
  - Coastal waters.
- **These also take into account whether discharge is via sewage treatment works.**

4

Monitoring and Sampling Techniques for Water

How the EA Set Discharge Limits



for river: PC=(EFR x RC)/(ERF +RFR) x 1000

for non-saline estuary: PC=(EFR x RC)/(DR) x 1000

for saline estuary: $PC=(EFR^{2/3} \times RC)/(DR) \times 1000$

PC=process contribution (µg/l), EFR = effluent flow rate (m^3/s), RC =conc. in effluent (µg/l), DR = dispersion rate (m^2/s), RFR = river flow rate (m^3/s)

5

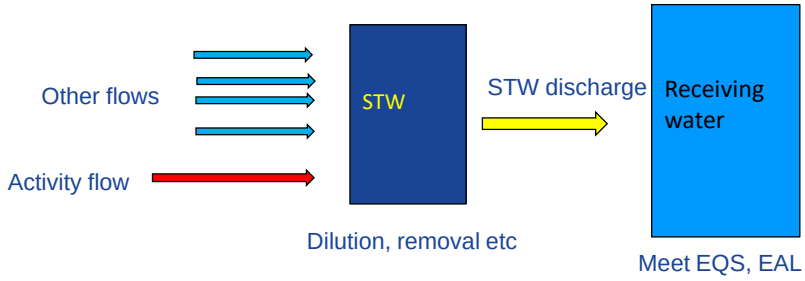
Discharge to Sewers

6

Monitoring and Sampling Techniques for Water

Discharge to Sewers

Where a release takes place first to sewer and is then treated at a sewage treatment works, the release rate can be modified to take account of pollutants removed during treatment. The pollutant may undergo physical, chemical and biological changes, which affect its form and concentration in the effluent and subsequent environmental impact on the receiving water. The extent of removal during sewage treatment will depend on the interaction between the properties of the substance, the degree of treatment and operational characteristics of the works. **It is the sewerage undertakers responsibility to treat the effluent once it leaves the installation site.**



7

The Operator's Role

8

Monitoring and Sampling Techniques for Water

The Operator's Role

Operators are required to:

- Take all the appropriate preventive measures against pollution, in particular through application of **B**est **A**vailable **T**echniques;
- Ensure that no significant pollution is caused;
- Comply with permit condition requirements;
- Ensure that any monitoring is carried out correctly. Using a MCERTS / UKAS accredited laboratory. Check monitoring plan to ensure that the accreditation also covers the test method / analysis;
- Report the results of monitoring in the agreed format.

9

The Regulator's Role

10

Monitoring and Sampling Techniques for Water

The Regulator's Role

Regulators (Local Authority) are required to:

- Ensure that consultation required by the Memorandum of Understanding with the Environment Agency takes place;
- Include all requirements to control discharges to watercourses specified by the Environment Agency into permit conditions;
- Include any other permit conditions which the regulator determines are necessary – site specific issues;
- Inspect the permitted activity to ensure compliance with permit condition requirements;
- Review the permit conditions as is necessary;
- Maintain regular communications with the Environment Agency with respect to discharges to watercourses for all A(2) permitted activities.

11

Monitoring and Modelling of Pollutants

12

Monitoring and Sampling Techniques for Water

Monitoring and Modelling of Pollutants

- In most instances suitable monitoring should be adequate for setting and checking compliance with permit conditions.
- In complex situations where flooding could occur it may be necessary for the operator to undertake more complex water modeling to illustrate the fate of pollutants during flooding situations. Such modeling will consider:
  - The frequency that the discharge will be influenced by flooding;
  - The area influenced by the flooding;
  - The pollutant concentrations across the flooding zone;
  - Compliance with EAL or EQS across the flooding zone;
  - Where modeling is required a LA should expect input from a specialist water modelling software;
  - **Modelling is likely where known ground contamination is likely to be become mobile during a flooding incident.**

13

Monitoring and Sampling Techniques for Water

Monitoring and Modelling of Pollutants

- Guidance on monitoring water pollutants is given on .GOV.UK (formerly in the EA's M18 "Monitoring of Discharges to Water and Sewer")
  Monitoring discharges to water: guidance on selecting a monitoring approach - GOV.UK (www.gov.uk)
- Guidance defines:
  - Quality criterion that should be applied to pollutant monitoring – covered by MCERTS scheme.
  - The international standard methods that should be used:
    - Standard methods required by relevant EU Directives;
    - CEN standard for the relevant pollutant or parameter;
    - ISO standards;
    - National standards (SCA blue books + BSI).
  - Validation methodology – generally carried out by the test house providing the service linearity, calibration, uncertainty, interference, field of application etc].
  - Sampling approaches – continuous or periodic.
  - Test report requirements.

14

Sampling Techniques

15

Monitoring and Sampling Techniques for Water

Sampling Techniques

- Discharge sample points must be at a location that ensures that the sample is **truly representative** of the discharge. For example, a sampling position in a pipe or channel must be sufficiently far downstream of the last inflow that mixing of the two streams is complete.
- Samples at an outfall should be taken from regions of high turbulence and good mixing, usually at the centre of the discharge. Solid materials will have little chance to settle out here.
- Samples in channels should be collected away from the sides and bottom of the channel to avoid contamination of the sample with sediment and biological growths.
- When sampling from chambers (e.g. manholes), it is necessary to ensure that measures are taken to avoid contamination of the sample by the disturbance of deposits from the cover when the cover is lifted and to prevent contamination of the sample from the chamber walls and any bottom deposits.
- When **automatic samplers** are employed for **composite sampling** care should be taken to ensure the sample probe is deployed taking the above factors into consideration. Also it is important to ensure that the probe remains in the effluent flow during the entire period each sample is being taken i.e. variations in effluent flow should not result in the sample probe being left dangling in the air or in contact with the bottom of the channel.

16

Monitoring and Sampling Techniques for Water

Sampling Techniques

Care should be taken to avoid sample degradation. Online guidance (formerly in M18) sets out examples of best practice for sample preservation:

Determinand	Preservation	Notes
Ammonia (total)	Keep in the dark and cool at 5±3°C, target timescale for delivery to lab within 24hrs.	Samples with low concentrations should be analysed immediately. If acidified to pH 1 to 2 with sulfuric acid can be stored at < 5°C for 21 days.
BOD	Keep in the dark at 5±3°C, deliver to lab within 24hrs.	For best results start analysis within 24 hrs of sampling. If using a cooled composite sample, ensure analysis starts within 48 hrs of first aliquot.
COD	Keep in the dark, deliver to lab within 24hrs.	If unable to analyse immediately, stabilise with sulfuric acid to pH <2 and analyse within 6 months.
Cyanide	Sodium hydroxide, ensure pH >12 and keep cool in the dark.	Analyse within 14 days.
Sulfide	Sodium carbonate and zinc acetate.	Analyse within 7 days.
Suspended Solids	Cool to 5±3°C.	Analyse within 2 days of sampling.
Mercury	Potassium dichromate and nitric acid.	Alternative preservation may be employed if specified in laboratory method.
Metals	If analysing dissolved fraction Immediate on-site filtration may be required.	Ensure that any material precipitated after filtration is re-dissolved in the laboratory.
Phenols by GC	Acidify with sulfuric acid to pH <4, use amber bottles.	Analyse within 21 days.
Phenols (colorimetric)	Phosphoric acid to pH <4.	Analyse within 21 days.
TOC	Acidify to pH 1 to 2 with sulfuric or phosphoric acid. Keep in the dark, at 5±3°C deliver to lab within 24hrs.	Analyse within 7 days. If samples can loses volatile components on acidification, then keep cooled and analyse immediately.
VOCs (volatile organic compounds)	Keep in the dark at 5±3°C at all times. Use appropriate sampling vials.	Analyse within 24hrs. If samples acidified to pH 1 to 2 with nitric or sulfuric acid, they are stable for 7 days.

17

Analytical Methods

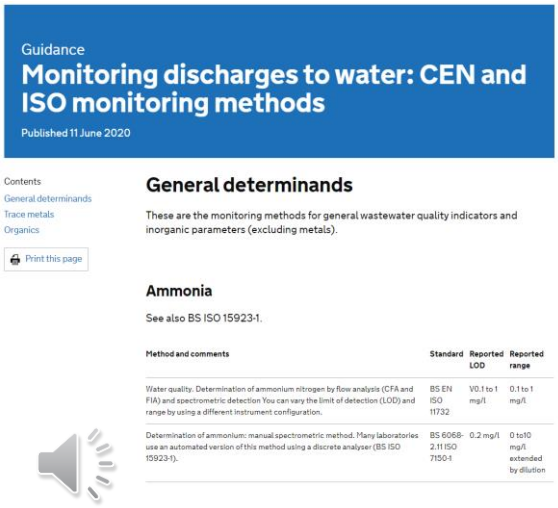
18

Monitoring and Sampling Techniques for Water

Analytical Methods

Test methods covering the common pollutants. See .GOV.UK, example page below.

https://www.gov.uk/government/publications/monitoring-discharges-to-water-cen-and-iso-monitoring-methods/monitoring-discharges-to-water-cen-and-iso-monitoring-methods



Guidance

Monitoring discharges to water: CEN and ISO monitoring methods

Published 11 June 2020

Contents

General determinands

Trace metals

Organics

Print this page

General determinands

These are the monitoring methods for general wastewater quality indicators and inorganic parameters (excluding metals).

Ammonia

See also BS ISO 15923-1.

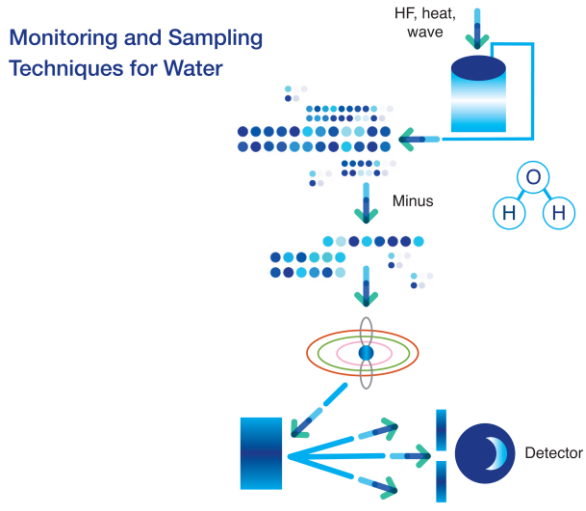
Method and comments	Standard	Reported LOD	Reported range
Water quality. Determination of ammonium nitrogen by flow analysis (CFA and FIA) and spectrometric detection You can vary the limit of detection (LOD) and range by using a different instrument configuration.	BS EN ISO 11732	V0.1 to 1 mg/l	0.1 to 1 mg/l
Determination of ammonium: manual spectrometric method. Many laboratories use an automated version of this method using a discrete analyser (BS ISO 15923-1).	BS 6068-2.11 ISO 7150-1	0.2 mg/l	0 to10 mg/l extended by dilution

19

Monitoring and Sampling Techniques for Water

Analytical Methods

Example analytical method:
Water quality, determination of 33 elements by inductively coupled plasma atomic emission spectroscopy (ICPAES) BS EN ISO 11885:2009.



20

Monitoring and Sampling Techniques for Water

Analytical Methods

Metallic Species that can be Analysed by ICPAES

Points to consider in selection test method:

- Upper and lower limit of detection;
- Linearity;
- Interference – in example method due to spectral interferences are caused by background emission from continuous or recombination phenomena, stray light from the line emission of high concentration elements, overlap of a spectral line from another element, or unresolved overlap of molecular band spectra. Example for ICPAES Zinc analysis can be distorted by Ni, Cu, Fe.

TABLE 1. WAVELENGTHS, ESTIMATED INSTRUMENT DETECTION LIMITS, AND RECOMMENDED CALIBRATION

Analyte	Wavelength (nm)	Estimated Detection Limit (pg/L)	Calibrate tp (mg/L)
Aluminum	308.215	45.0	10
Antmony	206.833	32.0	5
Arsenic	193.759	53.0	10
Barium	493.409	2.3	1
Beryllium	313.042	0.27	1
Boron	249.678	5.7	1
Cadmium	226.502	3.4	2
Calcium	315.887	30.0	10
Cerium	413.765	48.0	2
Chromium	205.552	6.1	5
Cobalt	228.616	7.0	2
Copper	324.754	5.4	2
Iron	259.940	6.2	10
Lead	220.353	42.0	10
Lithium	670.784	3.7[d]	5
Magnesium	279.079	30.0	10
Manganese	257.610	1.4	2
Mercury	194.227	2.5	2
Molybdenum	203.844	12.0	10
Nickel	231.604	15.0	2
Phosphorus	214.914	76.0	10
Potassium	766.491	700e	20
Selenium	196.090	75.0	5
Silica (SiO2)	251.611	26 f (SiO2)	10
Silver	328.068	7.0	0.5
Sodium	588.995	29.0	10
StronCum	421.552	0.77	1
Thallium	190.864	40	5
Tin	189.980	25	4
Titanium	334.941	3.8	10
Vanadium	292.402	7.5	2
Zinc	213.856	1.8	5

The wavelengths listed are recommended because of their sensitivity and overall acceptability.

Other wavelenths may be substituted if they can provide the needed sensitivity and are treatedwith the same corrective techniques for spectral interferance.

21

Monitoring and Sampling Techniques for Water

Analytical Methods

QA for analytical methods

A test analysis report should ideally include:

- **Calibration Blank - A volume of reagent water acidified with the same acid** matrix as in the calibration standards. The calibration blank is a zero standard and is used to calibrate the instrument;
- **Calibration Standard (CAL) - A solution prepared from the dilution of stock** standard solutions. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration;
- **Field Reagent Blank (FRB) – A sample (an 'aliquot') of reagent water or other blank matrix** that is placed in a sample container in the laboratory and treated as a sample in all respects.

22

Measuring Water Flow

23

Monitoring and Sampling Techniques for Water

Measuring Water Flow

- When considering water emissions it is important to know what the flow rate is.
- The H1 procedure for water is based on the mass of pollutant emitted [Mass Emission (mg/s) = Conc. (mg/m^3) x flow (m^3/s)].
- Dry weather flow is particularly important, i.e. the baseline flow that arises when there has been no rain. During dry weather the receiving water is also likely to have a low flow, therefore the mass contribution from the process to the receiving water is likely to be greatest due to the reduced dilution factor.

24

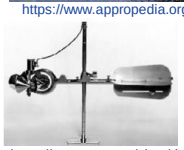
Monitoring and Sampling Techniques for Water

Measuring Water Flow
Examples of liquid flow measurement techniques:

Weir meter: The level of the water is measured at a designated point behind a hydraulic structure (e.g. using bubblers, ultrasonic, float, and differential pressure are common methods). This depth is converted to a flow rate according to a theoretical formula of the form $Q = KH^X$ where Q is the flow rate, K is a constant, H is the water level, and X is an exponent which varies with the device used; or it is converted according to empirically derived level/flow data points (a "flow curve").

https://www.appropedia.org/File:Weir.jpgc

Pygmy meter: a wheel is rotated by water flow and the rate of the rotation signifies the water velocity. It is primarily used in measuring discharge.



https://www.epa.gov/sites/default/files/2016-05/documents/tech_notes_3_dec2013_surface_flow.pdf

Vortex meter: velocity is proportional to the downstream frequency of the vortex flow and is read on a digital readout. It is used for measuring flow in pipes.

© ShutterStock. Image available here

25

Regulation 59 EP Regs Notice – Prepared by Environment Agency

26

Monitoring and Sampling Techniques for Water

Regulation 59 EP Regs Notice – Prepared by Environment Agency

Foundry X discharges directly to a local river. During dry weather maximum flow is 50 m^3/day, the river has a dry weather flow 1000 m^3/day.

EQS set by EU directive

Max load. for this river EQS x flow

What the EA considers acceptable for this type of river

What is already present

Units	Pollutants	EQS	max	Acceptable level	Background conc.	river	allowable	limit
		mg/l	mg or ug	mg or ug	mg/l	mg or ug	mg or ug	mg/l
mg/L	BOD	6000	6000000	545454.5	540	540000	5455	109
mg/L	Total hydrocarbon oil (THC)	10	10000	1000	0.75	750	250	5
mg/L	Total suspended solids (TSS)	25	25000	12500	10.2	10200	2300	46
mg/L	Ammoniacal nitrogen expressed as N (N)	15	15000	7500	6.8	6800	700	14
mg/L	Dissolved iron (Fe)	1000	1000000	166666.7	166	166000	667	13
ug/L	Zinc (Zn)	500	500000	83333.33	58	58000	25333	507
ug/L	Chromium (Cr)	100	100000	6666.667	1.6	1600	5067	101
ug/L	Copper (Cu)	100	100000	6666.667	1.7	1700	4967	99
ug/L	Lead (Pb)	125	125000	6250	1.5	1500	4750	95
ug/L	Nickel (Ni)	150	150000	7500	2.5	2500	5000	100

What this river can cope with as a total

What this river can cope with as a conc

27

Monitoring and Sampling Techniques for Water

Regulation 59 EP Regs Notice – Prepared by Environment Agency

Permit conditions for releases to water from Part A(2) installations or mobile plant

To: West Midlands Borough Council

The Environment Agency considers that the following emission limit values or conditions are necessary for permit XYZ for Foundry X in order to prevent or reduce emissions into water.

Effluent emissions from final point of discharge to water serving the emission points to water shall consist only of trade effluent, namely compressor cooling water, wet cyclone dust arrestor effluent, cast cooling water and site drainage. The nature and composition of the effluent shall be such that it does not exceed the following concentrations of the substances and chemicals:

Rate of Discharge -	**Not to exceed 50m^3 dry weather flow in any 24 hour period**
Temperature of Discharge -	**Shall not exceed 25°C**
pH of Discharge -	**To fall within the range pH 5 to pH 9**
BOD –	**25 mg/litre**
Total hydrocarbon oil (THC)	**5 mg/litre**
Total suspended solids (TSS)	**45 mg/litre**
Ammoniacal nitrogen expressed as N (N)	**15 mg/litre**
Dissolved iron (Fe)	**10 mg/litre**
Zinc (Zn)	**500µg/litre**
Chromium (Cr)	**100µg/litre**
Copper (Cu)	**100µg/litre**
Lead (Pb)	**100µg/litre**
Nickel (Ni)	**100µg/litre**

28

Example Permit Conditions

29

Monitoring and Sampling Techniques for Water

Example Permit Conditions

2.16: Effluent emissions from the final point of discharge to water serving the emission points to water shall consist only of trade effluent, namely compressor cooling water, wet cyclone dust arrestor effluent, cast cooling water and site drainage. The nature and composition of the effluent shall be such that it does not exceed the concentrations of the substances and chemicals listed in Table 5 below:

Pollutant	Concentration (mg/L)
Rate of Discharge	Not to exceed 50m^3 dry weather flow in any 24 hour period
Temperature of Discharge	Shall not exceed 25^{o}C
pH of Discharge	To fall within the range pH 5 to pH 9
BOD	25
Total hydrocarbon oil (THC)	5
Total suspended solids (TSS)	45
Ammoniacal nitrogen expressed as N (N)	15
Dissolved iron (Fe)	10
Zinc (Zn)	500µg/litre
Chromium (Cr)	100µg/litre
Copper (Cu)	100µg/litre
Lead (Pb)	100µg/litre
Nickel (Ni)	100µg/litre

All effluents are controlled, as a minimum, to avoid a breach of water quality standards. The Environment Agency or the regulator may require monitoring, calculations and/or modelling to demonstrate this, where the discharge is to controlled waters. All monitoring to be carried out using methods to be agreed in writing by the regulator.

30

Monitoring and Sampling Techniques for Water

Example Permit Conditions

The operator shall carry out regular monitoring of the discharge noted in condition 2.16 of this permit as follows:

- 4 samples shall be taken each year, one every quarter;
- All samples shall be analysed for suspended solids and biochemical oxygen demand;
- All samples shall be analysed at a UKAS accredited laboratory;
- A record shall be made of any visible oil in the discharge at the time of sampling.

The operator shall report their monitoring results to the regulator within 60 days of a sample being taken.

A sample shall consist of results for each of the criteria listed in table 5 of condition 2.16 of this permit.

All results shall be recorded in the permitted activity site logbook.

31

Results – Pre and Post Sampling

32

Monitoring and Sampling Techniques for Water

Results - Pre and Post Sampling

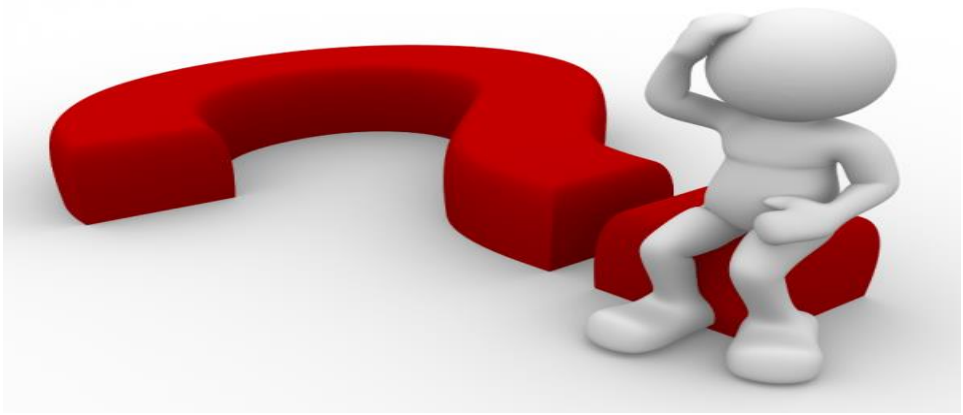
- Pre-sampling:
  - List of dates for the proposed tests;
  - Location where the sampling will be carried out;
  - Methodology that is to be deployed.
- Post Sampling:
  - Confirmation that the tests/analysis carried out by an MCERTS/UKAS test house;
  - Reference to the method or standard used, along with any deviations;
  - Report containing the findings of the analytical results, along with uncertainties and list of factors which may have affected the results;
  - In the event that the concentration are high (but not exceeding the limits) an action plan demonstration how the operator intends to reduce the emission concentrations.

33

Monitoring and Sampling Techniques for Water – End of Session 2

Any Questions? Please Email EMAQ to receive a response emaq@ricardo.com .

Thank You



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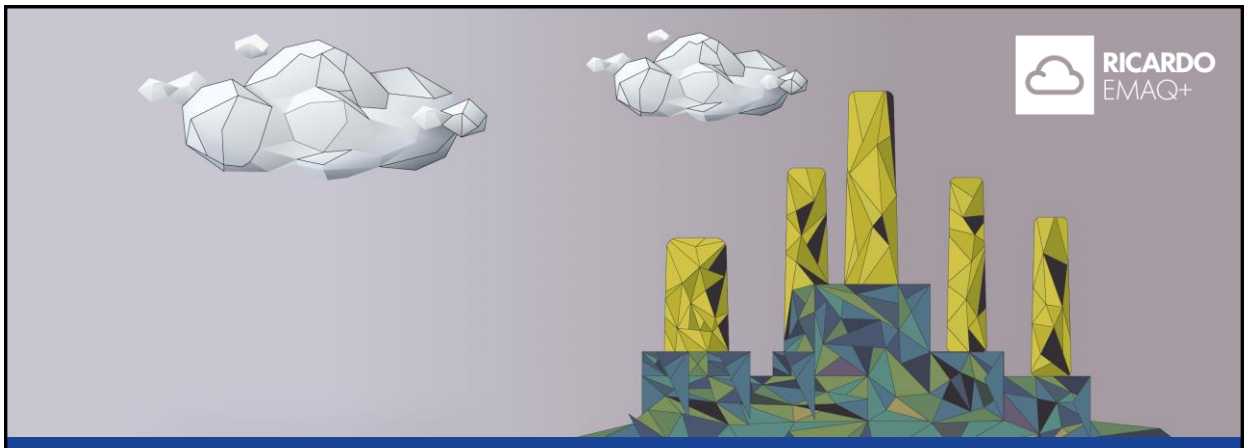


Essentials of PPC 4

Session 3: Monitoring and Sampling Techniques for Land

1

Contents

- Background – Approach to Land Contamination.
- Background - Regulation of Land Contamination.
- The nature of releases to land.
- Baseline site report.
- Extracts from a site report.
- Sampling, analysis and reporting.

2

Background – Approach to Land Contamination

3

Monitoring and Sampling Techniques for Land

Background – Approach to Land contamination

- Releases to land from A(2) permitted activities are regulated by permit conditions where the pollutants arise from the regulated activity. LA-IPPC allows the regulator to apply controls on contaminated land to return the regulated site to a satisfactory state (having regard to the state of the site before the permitted activity was put into operation).
- Part A(2) regulation focuses on the **prevention and remediation** of land contamination arising from the permitted activity, from the point the installation is permitted to the point it ceases operation.
- A permit should have adequate provision for monitoring the site condition prior to closure, either via the surrender or revocation route.
- Contaminated land issues are also dealt with under Part IIA of EPA 1990, this could be used to deal with historic contamination from an site previously occupied by a prescribed activity which ceased operating before a permit could be issued.

4

Background – Regulation of Land Contamination

5

Monitoring and Sampling Techniques for Land

Background - Regulation of Land Contamination

- EP Regulations requires authorities to accept the surrender of a permit if they are satisfied that the necessary measures have been taken:
  - a) to avoid any pollution risk resulting from the operation of the installation (*routine ongoing compliance)*; and
  - b) to return the regulated site to a satisfactory state, having regard to the state of the site before the installation was put into operation (*decommissioning*).
- The **"state"** referred to in (b) is the state when the permit was issued.
- See Schedule 5, pt1(14) of the EP (EandW) Regulations 2016 (as amended).

6

Nature of Releases to land

7

Monitoring and Sampling Techniques for Land

Nature of Releases to Land

- Accidental releases to land from raw materials, product, wastes or residues from the permitted activity, and the consequence, e.g. fire fighting water run-off.
- Surface or foul water drainage can cause release to land as well as run-off from hardstanding or roofed areas, especially where no interception is provided.
- In addition, abatement technologies for air and water discharges can generate pollutant and reagent materials which could be released to land.
- Contamination of the land can be a problem in itself or as a reservoir of polluting potential for groundwater and the wider aquatic environment.

8

Baseline Site Report

9

Monitoring and Sampling Techniques for Land

Baseline Site Report

- An A(2) Permit application requires that a site report is provided – this should describe condition of the site and identify any substance in/on/under the land that may pose a pollution risk.
- Sets out the initial condition of the land for the activity site and should include history and any existing measures to mitigate earlier releases to land. Can be a basic desk study and if history/use suggests a more detailed survey is needed this can be a permit condition or required as a part of the permit application before determination is made.
- Site report serves as a reference point – particularly relevant at closure (revocation / surrender). It should also aid setting of permit conditions for local environmental factors.

10

Monitoring and Sampling Techniques for Land

Baseline Site Report

- The site report should cover all of the land on which any of the permitted activities may take place. Note that if an A(2) permitted activity is extended a site report for the additional land is needed as a part of the permit variation procedure.
- The site report will reflect the complexity of the activity and site specific conditions of the site.
- A phased approach is commonly adopted with an initial desk study followed as necessary by more detailed work (up to intrusive sampling surveys of the site).
- Intrusive site investigation is normally a last resort. It is costly, time consuming and may result on the contamination of the surface of the land which was not contaminated previously!

11

Monitoring and Sampling Techniques for Land

Baseline Site Report

Sources of contamination– identify what substances are already in, on or under the land and which have the potential to cause harm or pollution of controlled waters due to past activities. Also, substances that are anticipated (to the extent possible) will be used in or produced by the permitted activity in the future.

Pathways for contamination– the means by which a substance may come into contact with or otherwise affect a receptor on, under or through the site of the permitted activity.

Receptors/targets of contamination– whatever is vulnerable to the adverse effects of the substances that will be used or generated on the site of the permitted activity – for example, people, animals, vegetation, building materials, services, etc.

12

Monitoring and Sampling Techniques for Land

Baseline Site Report

The application site report provides the LA with a reference baseline for judging whether there has been any additional pollution while operating under an LA-IPPC permit:

- Ongoing inspections and monitoring provide evidence of compliance / or non-compliance! during the operation of the permitted activity;
- The GOV.UK website provide guidance on site inspections and on circumstances where an intrusive site investigation may be required at the permit application stage;
- An intrusive report (if required) might be specified as a permit condition where the regulator considers the desk report, site history or (absence of) site controls suggest that it is justified.

13

Monitoring and Sampling Techniques for Land

Baseline Site Report

An intrusive site report may **not** be necessary where:

- The operator employs adequate preventive measures (e.g. bunding and appropriate impervious surfacing);
- There is a programme for integrity testing of (for example) drain systems, pipelines, underground storage vessels, etc;
- Good housekeeping has prevailed during the permitted period;
- The site does not have a (known!) history of pollution incidents or spillages.

14

Extracts from a Site Report

15

Monitoring and Sampling Techniques for Land

Extracts from a Site Report – Date sources used

Information was obtained from the following sources:

- Envirocheck Report Reference XXX, Landmark Information Group, dated 19 May 2009 (see Appendix A).
- Environment Agency Groundwater Vulnerability Map XXX (1:100,000 scale), as supplied by Envirocheck Report.
- Environment Agency Website – *'What's in Your Backyard'* and flooding data sources (May 2009).
- Multi-Agency Geographic Information for the Countryside (MAGIC) mapping website at www.magic.gov.uk (June 2008).

Results of Intrusive investigations conducted in 2006 by XXX on the site of XXX

16

Monitoring and Sampling Techniques for Land

Extracts from a Site Report – Background Sources

Discharge Consents
Four discharge consents are noted within 663m to 970m of the centre of the site, all of them are active. The first consent is for the XXX for the discharge of other matter/surface water into the balancing lagoon of XXX Brook. The second consent is for the XXX for the trade discharges of cooling water into the balancing lagoon of XX Brook. The third consent is for the XXX for the sewage/final treated effluent discharges into the YY Brook. The fourth consent if for the XX for the agricultural/livestock farming discharges into groundwater (each approximately within 100m of the centre of the site).

Local Authority and Environment Agency Pollution Controls
There are no current integrated pollution controls (IPCs) and integrated pollution prevention and controls (IPPCs) recorded within 1km of the site.

There are no local authority controls within 1000m of the centre of the site.

Environmental Designations
The site and surrounding are lies in a groundwater and Nitrate Vulnerable Zone.

The site itself does not lie in any other areas under any environmentally sensitive designation nor does the immediate surrounding area, according to MAGIC, the governmental mapping website.

There are no Sites of Special Scientific Interest, Ramsar sites, Special Areas of Conservation or Special Protection Areas within 1km (up to 2km) of centre of the site.

Licensed Waste Management Facilities
The Envirocheck report states that there are no integrated pollution control registered waste sites within 1km of the centre of the site.

COMAH, NIHHS and PHSC
There are no control of major accident hazard sites (COMAHs) within 1km (up to 2km) of the site.

There are no notifications of installations handling hazardous substances (NIHHS) within 1km of the centre of the site.

There are no planning hazardous substance consents (PHSC) within 1km of the site.

17

Monitoring and Sampling Techniques for Land

Extracts from a Site Report – Background Condition

General geology
The Envirocheck report states that the BGS geological maps show the site area to be underlain by Oxford Clay and Kellaways Beds (reference to a BGS map 1:625,000 scale).

Information obtained during the Intrusive Site Investigation conducted by XXX in 2006 at the XXX Site shows that the whole site is underlain by boulder clay, which is in turn underlain by Oxford Clay with Kellaway Beds. Oxford Clay is mainly greenish or bluish grey, which becomes brown on weathering and is shaley and laminated in places. This clay is likely to be approximately 30m thick (based on the British Geological Survey borehole log within the GIBB Environmental Report dated July 1999). The Kellaway Beds are sandy beds overlying bluish clay. The sandy beds are well developed in this area and may be consolidated into irregular concretionary masses. The report is presented in the Appendix B.

Hydrogeology
The Groundwater Vulnerability Map Sheet XXX (as referenced in the Envirocheck report) confirms the site falls in an area considered to be a Non-Aquifer (negligibly permeable). Map for the site indicates that the Oxford Clay and Kellaway Clay are classified as a non-aquifer, because these formations are considered to contain insignificant quantities of groundwater. Furthermore these formations are also considered to have negligible or low permeability and are likely to prevent the downward infiltration of potential contaminants, which maybe present at the surface. The report also indicates that the soils have no leaching potential and are not classified

Sustainable groundwater was not encountered during this investigation. In addition the WSP report states that groundwater was not generally encountered during their investigation of the Yarlswood IDC site.

There are 7 groundwater abstraction points within 2km of the site. The closest is located approximately 1550m ... .

There are 4 surface water abstraction points within 2km of the site. The closest is located approximately 1739m to the South West of the centre of the site, and is licensed to M W Ward for the general agriculture/direct spray irrigation purposes.

Reference to the Environment Agency website indicates that the site is not located within a Total Catchment groundwater protection zone. The nearest groundwater source protection zone (total catchment) lies approximately 1.4km to the west of the centre of the site at the closest point.

Hydrology
The nearest surface water body is the River XX, which at its closest point to the site, lies approximately 1.6km to both the north west and north east of the centre of the site (as it meanders around XX village). The River XX generally flows in a southerly direction. The River XX has been given a River Quality Target (RQT) of 3 near the site. The stretch of the River XX between XX Mill and The XX has been compliant to the RQT3 since 1995.

In addition the Environment Agency website reports that both the site and River XX are within a Catchment Abstraction Management Strategy (CAMS).

18

Monitoring and Sampling Techniques for Land

Extracts from a Site Report – Historical Condition

An AEA technician visited the site on 4th June XX and noted that the overall XX Business Park is predominantly built up with hardstanding areas with isolated patches of grass as fringes to buildings. The site building 16 itself was a shell, with walls and floor in disrepair. In general, the hardstanding areas were in disrepair and should not be viewed as being resistant to any material spillages until works have been completed to bring the building up to the required standard.

The issues and areas identified in the previsit site assessment included:

- *Areas where the historical use of solvents and oils occurred, widespread use of solvents over 40 years;*
- *Bulk diesel and oil storage tanks and electrical substations.*

During the site reconnaissance observations were also made of the following areas (if either currently or historically present at the site):

- *Underground and above ground storage tanks (USTs and ASTs),*
- *Electrical substations/transformers,*
- *Chemical storage areas and/or transfer lines, operational areas where hazardous materials used,*
- *Sumps, oil interceptors and trenches, burning grounds.*

It should be noted that observations were not limited to just these areas, but also to areas identified as having the potential to affect the land quality at the site during the site visit.

In addition site staff reported that three USTs each storing 500 gallons of diesel, and two ASTs each storing 1,000 litres of oil were historically located on the part of the subject site now occupied by the XX IDC. The historic location of these tanks could not be confirmed by site staff, although they reported that the tanks would have been removed during the redevelopment of the site for the XX IDC.

19

Monitoring and Sampling Techniques for Land

Extracts from a Site Report - Emission Routes from the Proposed Operation

Site Operation / Plan Reference	Substance	Relevant Activity	Potential for pollution from the activity	Pollution Prevention Measures	Nature of primary containment	Testing & Inspection of primary containment	Nature of secondary containment
1 Fuel In	Wood waste	Delivery from XX Ltd to fuel storage silo	Failure of containment leading to increased organic matter in surface water run-off	Yes	Heavy Duty Vehicle	Inspected daily as part of the maintenance procedures	Covering placed over each heavy duty vehicle load
2 Walking Floor	Wood waste	Feeding of fuel into combustion chambers	Failure of containment leading to increased organic matter in surface water	Yes	Automatic screw conveyor	Inspected on a daily basis as part of the daily routine and during working observations	Covered area surrounding the conveyor, concrete hardstanding
3 Burner 1 and auxiliary Burner 2 (8MW)	Wood waste (with addition of diesel)	Combustion of fuel at 850°C	Failure of containment leading to spillage to land and internal drainage	Yes	Burner	Inspected on a daily basis as part of the maintenance procedure	Burners situated on concrete hardstanding
4 Hoppers	Grate ash	Collection of grate ash from burners 1 and 2 above	Failure of containment leading to spillage to land and collection in drainage channels	Yes	Covered bins that are wetted and sealed	Inspected on a daily basis as part of the maintenance procedure	Situated on concrete hardstanding
5 Waste ash skip	Grate ash	Collection and storage of grate ash from hoppers under burners 1 and 2, and fly ash from incinerator exhaust gases, hydrated lime from the APCR	Failure of containment leading to spillage to land, including during replacement with new skip	Yes	Covered bins that are wetted and sealed	Inspected on a daily basis as part of the maintenance procedure	Situated on concrete hardstanding

20

Monitoring and Sampling Techniques for Land

Extracts from a Site Report - Assessment of Land Pollution Potential

Potential Source	Pathway	Receptor
Chemicals used and stored on the site (numerous see Table 2)	Spillage during filling, replacement or from poor storage container conditions	Soils below the site Perched water in made ground Plant workers
Diesel	Spillage during filling/use, failure of containment	Soils below the site Perched water in made ground Plant workers
Waters at high temperatures should there be a failure of containment	Spillage from boilers or condensers	Surface waters Perched water in made ground Plant workers
Overground conveyor systems with waste biomass	Failure to contain the biomass leading to potential increase organic matter in surface water run off	Perched water in made ground
Contamination on land	Migration in surface water runoff Migration to soils at depth Migration to perched water Migration to groundwater	Soils below the site Perched water in made ground

21

Monitoring and Sampling Techniques for Land

Extracts from a Site Report - Preventative Measures

Source and migration pathway	Receptor	Preventative measures	Risk
Chemical use or storage spill to land	Soil Surface water Groundwater Plant workers	Automatic leak detection Controlled process (pressure, levels, valves) Bunding where appropriate New kerbed hardstanding to be put in the building Drainage (contained and controlled) to sewer connection	LOW
Diesel	Soil Surface water Groundwater Plant workers	Bunded storage tank New kerbed hardstanding to be put in the building Drainage (contained and controlled) to sewer connection	LOW
Waters at high temperature	Surface waters Groundwater Plant workers	Appropriate bunding around boilers and condensers Daily inspections	LOW
Overground conveyor systems with waste biomass	Surface water Groundwater	Daily inspection of process areas Controlled management of clearance procedures and daily cleaning to ensure reduced biomass content in surface water	LOW

22

Sampling, Analysis and Reporting

23

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting

Where testing is required what can you expect to see before sampling is carried out:

- Sampling objectives;
- Justification of targeted or non-targeted sampling – ”Mercury” or “metals suit”;
- Locations and depths to be sampled – plans and cross sections of bore holes;
- Media to be sampled - gases, soils, water, vegetation, etc;
- Sampling protocols - solids/liquids, sample volumes, collection method;
- Sample storage, preservation and transport;
- Sample treatment - filtering, grinding, sieving, drying etc;
- Analytical methods to be applied – spectrometry, etc;
- Reporting arrangements / time period;
- To be undertaken to MCERTS or other standard?
- **Discuss the proposed sampling campaign with your contaminated land team.**

24

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting

Intrusive Investigation 1 –
Waste from a hand dug pit

25

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting

Intrusive Investigation 2 –
Window sampling rig

26

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting

Intrusive Investigation 3 – Excavated core samples from window sampling

27

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting

Intrusive Investigation 4 – Cable percussion rig

28

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting - Analytical Test Methodology

- Guidance on quality assurance for soil analysis is given in EA's "**MCERTs Standard for Laboratories Undertaking Chemical Testing of Soil"** This requires that chemical testing of soil, where results are to be submitted for regulatory purposes, require laboratories to be accredited to ISO/IEC 17025 for this MCERTS performance standard.
- The MCERTS performance standard for the chemical testing of soil covers:
  - performance targets;
  - the selection and validation of methods;
  - sampling pre-treatment and preparation;
  - participation in proficiency testing schemes;
  - the reporting of results and information.
- Guidance on test methods for a wide range of pollutants, see GOV.UK

29

Monitoring and Sampling Techniques for Land

Sampling, Analysis and Reporting - Contents of a Land Contamination Test Report

- Details of methods of intrusive investigation - the number of sampling points, their locations including a scaled plan and the reasoning behind these decisions.
- Sample storage - maintenance and copies of the sample 'chain of custody'.
- Field measurements - equipment used and calibration details.
- Details of the laboratory used and analysis for which it has accreditation - MCERTS Accreditation.
- The limit of detection used by the laboratory should be an order of magnitude lower than the assessment criteria against which the results are to be compared.
- As well as the usual summary table of results, the raw data should be included in the appendix of the report (makes for a very long report!).

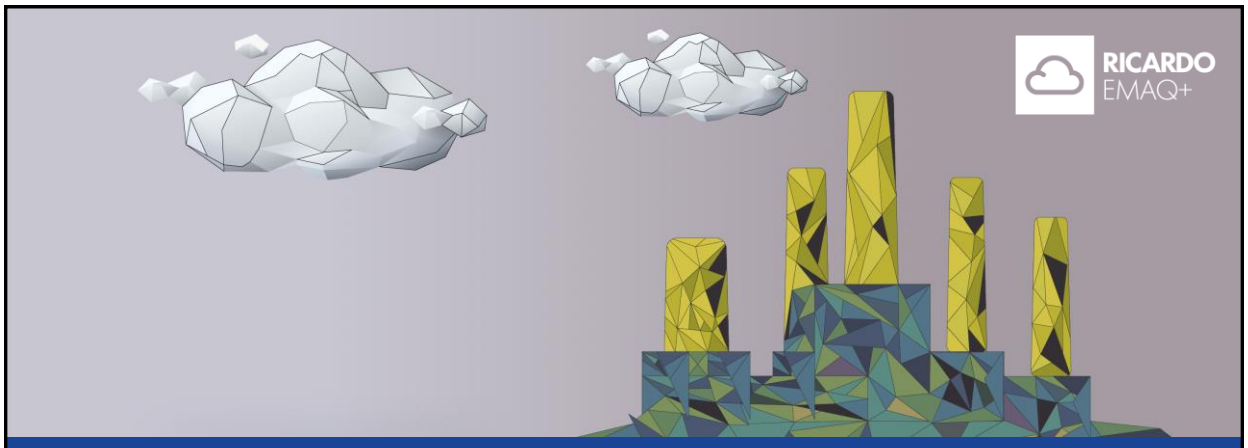
30

Monitoring and Sampling Techniques for Land – End of Session 3

Any Questions? Please email EMAQ+ to receive a response emaq@ricardo.com

Thank You

31



Essentials of PPC 4

Session 4: Energy Efficiency, Resource Efficiency and Waste Minimisation

1

Contents

Introduction

Energy efficiency:

- Overview;
- Operator requirements, BAT;
- Example – Energy efficiency permit conditions for a part A(2) activity;
- Example – Energy Plan;
- Energy efficiency compliance monitoring.

Resource use and waste minimisation:

- Overview;
- Operator requirements;
- Example – Resource efficiency: alternative materials;
- Example – Resource efficiency: compliance monitoring.

2

Energy Efficiency, Resource Efficiency and Waste Minimisation

Introduction

- Resource efficiency is all about managing raw materials, energy and water **in order to minimise waste and thereby reduce cost and environmental impact.**
- **Resource efficiency saves money** and make a business more competitive, particularly with growing supply chain pressure to demonstrate reduced environmental impact:
  - 2% of annual profit lost through inefficient management of energy, water and waste;
  - 4% of turnover is spent on waste *[CBI stats].*

3

Energy Efficiency - Overview

4

Energy Efficiency, Resource Efficiency and Waste Minimisation

Energy Efficiency - Overview

- All industrial, commercial, transport and domestic activities consume energy, and release greater or lesser amounts (normally as heat) to the environment.
- For industrial activities, the direct release of heat pollution may be substantial. It can affect the local environment and contribute more widely to **raising global temperatures**.

  For example, the release of hot flue gases from permitted activities associated with combustion, (such as glass making, foundries, minerals drying, etc), can release significant amounts of both direct and radiant heat to the environment. Also, the release of hot cooling waters into streams and rivers can have significant effects on aquatic life.
- However, the main concern associated with energy use arises from climate impacts from the combustion of fossil fuels regulated in Part A(2) permitted activities by the requirements of Climate Change Agreements (See Essentials of PPC 3 webinar).

5

Energy Efficiency - Operator Requirements

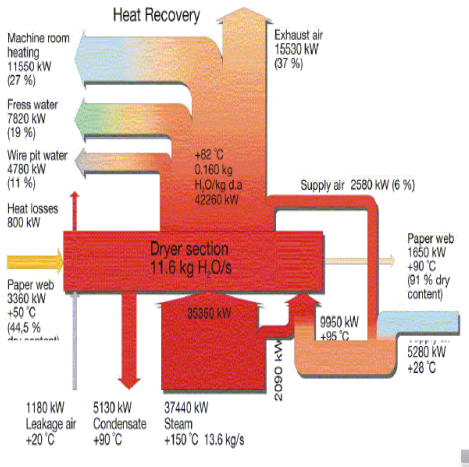
6

Energy Efficiency, Resource Efficiency and Waste Minimisation

Operator Requirements

As part of BAT compliance an operator is expected to do the following:

- Produce an annual report on energy consumption for the permitted activity;
- Monitor energy flows and target areas for reduction and update annually. Sankey diagrams and energy balances would be useful aids;
- Ensure all plant is operated and maintained to minimise the use of and loss of energy;
- Ensure that all appropriate containment methods (e.g. insulation, seals and self closing doors) are employed and maintained to minimise energy loss;
- Adhere to the specific energy efficiency requirements in the permit for the activity.



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Energy Efficiency – Example; Energy Efficiency Permit Conditions for a Part A(2) Activity

8

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Efficiency Permit Conditions for a Part A(2) Activity SG4 Ferrous Foundry

Condition	Compliance checks for regulator
A. All raw materials to be used in the electric furnaces shall be kept covered so as **to prevent water ingress** into the material, for 24 hrs prior to use, as far as is practicable.	A. Physically check where material is stored – this storage requirement is designed to reduce energy expenditure on driving off moisture unnecessarily.
B. The operator shall ensure that the appropriate measures have been implemented to ensure the required quality of metal is produced in the most **energy efficient manner.** Special attention shall be given to **melt temperature control**, i.e. avoidance of superheating metal. The operator shall be required to take temperature readings from every ladle of metal to ensure that **temperature control is optimised.** The optimum temperatures for casting metal are between 1450 to 1500 degrees Celsius (but can vary between process and product). The operator shall **record any temperature readings noted to be outside this range**. All such information shall be retained by the operator and kept with the log book. Thereafter, the operator shall ensure, as far as is reasonably practicable, that the optimum temperature for melting of iron is maintained whilst the electric furnaces are operational.	B. Site operating procedures detailing the heating profile for key materials processed on site? Is the procedure reasonable? Is it being applied? Do records show that the procedure is in use? Continuous monitoring of temperature available for inspection?

9

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Efficiency Permit Conditions for a Part A(2) Activity

Condition	Compliance checks for regulator
C. Where gas-fired heating systems are used for core or mould making or other activities within the installation, particular attention shall be paid to **good cleaning and maintenance of burner systems.**	C. Site operating procedures detailing how and when cleaning and maintenance is carried out? Do Log book records show when this was carried out?
D. The operator shall ensure that all plant listed in permit is **operated and maintained to optimise the use and minimise the loss of energy.**	D. Does the site have operating maintenance procedures? Do records show that these have been complied with?
E. The operator shall produce an **annual report** on the energy consumption of the installation. The report shall monitor energy usage for the installation and **identify target areas for reduction** and shall be updated annually.	E. This information is probably required by the CCA, but if not, should address the data required in condition F.

10

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Efficiency Permit Conditions for a Part A(2) Activity

Condition	Compliance checks for regulator
F. The operator shall calculate the following indicators of **energy efficiency performance** expressed as a ratio: • Prime energy v good tonnes produced (SEC). • Electricity v good tonnes produced. • Natural gas v good tonnes produced. All such information shall be retained by the operator and kept with the log book. Where any of the above parameters are not specifically monitored, arrangements shall be made to undertake monitoring of the use of the energy source within 8 weeks of issue of this permit.	F. Most companies will have a CCA and this additional requirement will be easy to calculate. This provides a ratio of energy used to production and is therefore reproducible year on year as a measure of performance. Have regard to baseline energy use data, this may be high for some industries such as metal melting, energy efficiency improves with volume of production.

11

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Efficiency Permit Conditions for a Part A(2) Activity

Condition	Compliance checks for regulator
G. In respect of energy efficiency, the operator shall meet the requirements of either: (i) Climate Change Agreement (CCA), or (ii) Direct Participation Agreement (DPA); in addition to the requirements of conditions A to F (above). Where neither (i) nor (ii) above are complied with the operator shall notify the regulator immediately.	G. Legal requirement for some A2 sectors (notably metal melting sectors) to have either CCA or DPA. Normally only require to see certificate of conformance to demonstrate compliance (CCA are checked by other agencies). However, it is key to demonstrating BAT that the baseline energy requirements from the guidance as interpreted into the permit as compliance conditions are being actively and consistently complied with.

12

Energy Efficiency – Example; Energy Plan

13

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Plan

The site: The Iron Foundry Co Ltd is an iron foundry with a typical output of 6,500 tonnes of ductile iron castings annually.

The company is participating in the UK Target 2010 CCA, and is therefore committed to a program of continuous improvement. This will be achieved via the implementation of an energy management plan to meet CCA SEC Target of 5810 kWh(P)/te by 2010.

Targets would be agreed for 2 year milestones out to 2010, with reductions on Base Year SEC of about 3% every 2 years.

Energy Consumption MY1 (2002)			
Energy source	Delivered kwh	Primary kwh	% primary
Electricity Gas Oil	15,549,233 3,468,785 586,560	40,428,006 3,468,785 586,560	91% 8% 1%
Total	19,604,578	44,483,351	100%

Adjusted for fuel input equivalent at the power station (Delivered x 2.60)

Specific Energy Consumption for the site		
MY1 Production 8,254 te	SEC (kWhP/Te)	CCL Target
MY1 (Sept 01-Sept02)	5,389	5,810

SEC = Primary Energy Used /Te of product

14

Energy Efficiency, Resource Efficiency and Waste Minimisation

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Example – Energy Plan

The following table provides data on the output of casting in the Base Year (1999), together with the energy usage, to provide an average specific energy consumption for the base year (BY). To meet the CCA 2010 Target, a reduction in SEC of about 16% will be required.

Specific energy consumption					
Output of good casting	Electricity usage (delivered)	Gas usage	Fuel oil usage	Total primary energy usage	SEC
tonnes	kWh	kWh	kWh	kWh	kWh(P)/te
6685.1	16,364,219	3,666,069	28,032	46,241,070	6,917
A typical SEC for this type of foundry in BY was about 6,100 kWh(P)/te					

Clearly, to meet the full CCA target by MY1(2002), instead of MY5 (2010), then a major energy improvement plan would have been required!

15

Energy Efficiency, Resource Efficiency and Waste Minimisation

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Example – Energy Plan

The energy saving opportunities identified during BY study.

Changes to operating practices within the foundry would result in energy savings along the lines of:

Process/system changes	% reduction in energy
Installation of new furnaces	13.3%
Modification to heat treatment cycles	0.22%
Modification of charge make-up	0.50%
Drawing air from outside the building	0.02%
Leak reduction programme	0.04%
Improvements in yield (2%)	0.73%
Changes to motors and drives	0.56%
Lighting changes	0.06%
Total energy reduction by 2010	15.43%

16

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Plan

Process	Metered energy (1999)	
	kWh	% of total electrical energy
Melting furnaces	8,913,356	54.5
Auto-pour furnace	1,032,389	6.3
Heat treatment furnaces -Excel Top Hat furnaces -Salem batch furnace	 414780 236005	 2.5 1.4
Total	10,596,530	64.8
	Estimated energy	
	Estimated energy	% of total electrical energy
Compressed air	628,789	3.8
Lighting	263,953	1.6
Total	892,731	
Grand total	11,489,271	70.2
Total electrical energy usage	16,364,219	~30% not accounted for*

*The large unaccounted fraction would suggest that; (i) the estimated items are gross underestimates; or (ii) not all areas have been accounted for. There could also be some metering errors.

17

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Plan

Energy Saving Opportunities: Foundry

1. Low cost /no cost opportunities:
   - Reduction in melting energy consumption by more efficient working;
   - Modification of heat treatment cycles and associated reduction through metal charge make-up;
   - Compressed air leak reduction and installation of ducting to draw air from outside the building;
   - Improvement to yield;
   - Introduction of a formal Energy Management system.

18

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Plan

Energy Saving Opportunities: Foundry

2. Medium Term opportunities:

- Provision of appropriate sub-metering;
- Appropriate changes to motors and drives;
- Reduction in gas consumption through improved ladle and space heating.

3. Long Term opportunities involving changes to plant and Process:

- Extension to the cooling track;
- Replacement pipework and air dryers to improve compressor efficiency;
- Replace furnaces with new, more efficient models.

19

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Plan

Energy Saving Opportunities: Foundry

Example appraisal of energy saving options – compressed air supply:

- Site uses a large compressor (Atlas Copco GA110) which operates 24/7 for 47 wks/yr and is supplemented by a CompAir RA60 operating for 13 hr/day, 5½ day/wk, 47 wks/yr. Compressors provide air for moulding and core machines and air for the Fischer Converter gas pre-heater.
- Foundry operates from 6.45am to 6pm and only has small air demand outside these hours for core machines which operate on a 3 shift system.

20

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Energy Plan

Current position					
Compressor	Rating	Operational hours	kWh on-load	kWh off-load	Total kWh
GA110 RA60	110 kwh 37.3kwh	7896 3360	512,450 25,065	71,222 20,052	583,672 45,117
Total energy consumption: 628,789 kWh (3.1% of total energy consumption)					

Revised position GA110: 12hrs/day (6am-6pm) 5½ day/wk, 47 wks/yr RA60: 24hrs/day (6am-6pm) 7 day/wk, 47 wks/yr					
Compressor	Rating	Operational hours	kWh on-load	kWh off-load	Total kWh
GA110 RA60	110 kwh 37.3kwh	3102 7896	99,396 206,164	47,770 17,671	147,166 223,835
Total energy consumption: 371,001 kWh (1.85% of total energy consumption)					

21

Energy Efficiency – Compliance Monitoring

22

Energy Efficiency, Resource Efficiency and Waste Minimisation

Energy Efficiency Compliance Monitoring

What should you expect to see:

- Up-date of energy usage data on an annual basis;
- Revised SEC based on most recent energy usage;
- Annual up-date on the implementation of site improvements;
- Whether further improvements have been identified;
- Conclusion on whether the operator is on track to meet its obligations under the CCA;
- Demonstration of compliance with conditions of the permit probably involving:
  - Energy audit;
  - Energy optimisation plan (or similar, i.e. how to implement energy planning, monitoring, reduction etc.);
  - KPI's based on overall energy use/tonne good product or other metrics to enable comparative performance management;
  - Energy monitoring for key plant/key locations;
  - Temperature monitoring of heated materials linked to alarms i.e. melt temperatures, etc.

23

Energy Efficiency, Resource Efficiency and Waste Minimisation

Resource Efficiency and Waste Minimisation – Overview

24

Energy Efficiency, Resource Efficiency and Waste Minimisation

Resource Efficiency and Waste Minimisation - Overview

- The IED requires that waste production is avoided; 'where waste is generated it is recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment.'
- Permit applications should describe measures for the prevention and recovery of waste.
- Waste minimisation seeks to avoid inefficient use of raw materials and other substances at a permitted activity.
- A variety of techniques can be classified under the term waste minimisation, including:
  - Basic housekeeping, measurements and audits and the application of clean technologies.

25

Energy Efficiency, Resource Efficiency and Waste Minimisation

Resource Efficiency and Waste Minimisation - Overview

- A consequence of waste minimisation will be the reduction of:
  - Gaseous emissions (solvents, fumes, dust, odour, etc);
  - Liquid (waste water);
  - Solid emissions (direct and indirect process wastes);
  - Heat from production;
  - Transport emissions associated with delivery of raw materials and disposal of waste.
- The operator will also be able to reduce expenditure due to the successful implementation of waste minimisation measures, thereby making the business more viable to operate.

26

Energy Efficiency, Resource Efficiency and Waste Minimisation

Resource Efficiency and Waste Minimisation – Operator Requirements

27

Energy Efficiency, Resource Efficiency and Waste Minimisation

Operators are required to:

Example Conditions on Resource Usage for a SG3 Ferrous Foundry

Condition	Compliance Checks for Regulator
The operator shall:	
•***Maintain an inventory covering the principal types of raw materials used,*** to be submitted to the regulator annually based on consumption of raw materials for the previous year.	Basic information required of all operators, useful for establishing baseline performance, and determining substantial changes
•***Review alternatives for the principal types of raw materials used with regard to their environmental impact.*** Notably this shall include, iron, sand and solvent use. Review of iron shall be undertaken by considering alternate melting and casting techniques, whilst review of solvent and sand usage shall be undertaken by consideration of alternate core and mould technologies. Such reviews shall be submitted to the regulator every four years.	Ensures an ongoing drive to minimise waste by ensuring that the types of raw materials are considered in terms of likely waste generation, e.g. greensand moulding technology is less harmful but produces far more waste than shell moulding. Shell moulding is more environmentally harmful but reduces waste, and reduces casting rejects.
•***Maintain records to demonstrate that quality control procedures are used to minimise any potential environmental impact of raw materials.*** Notably this shall include ensuring that scrap iron is free from contamination, and other raw materials are supplied and stored in a manner such that contamination cannot occur.	Positively demonstrating visual checks on incoming raw materials

28

Energy Efficiency, Resource Efficiency and Waste Minimisation

Operators are required to:

Example Conditions on Resource Usage

Condition	Compliance Checks for Regulator
The operator shall (cont): •***Undertake to complete any long term studies needed into the less polluting options and make any material substitutions identified within the review period.*** Such studies will be identified as and when required by the regulator and requested in writing. All information required by this condition shall be submitted to the regulator annually, or where such information is requested every four years from the date of issue of the permit as may be required for long term studies. All such information shall be retained by the operator and kept with the log book.	Where new technology arises, requirement to consider the options, and, where cost is an issue for not implementing, supply cost-benefit-analysis data to justify position.

29

Energy Efficiency, Resource Efficiency and Waste Minimisation

Operators are required to:

Example Conditions on Resource Usage

Condition	Compliance Checks for Regulator
The operator shall calculate the following indicators of waste minimisation performance expressed as a ratio: a) tonnes of iron material melted v tonnes of good product b) tonnes of returned iron v tonnes of good product c) tonnes of sand consumed v tonnes good product d) tonnes of towns water consumed in the operations v tonnes of good product. Additionally, the operator shall calculate the amount of water recycled expressed as a percentage of total water usage in the operations. e) tonnes paint solvent used v mass of solids in lay down weight of coatings. f) tonnes of waste sand v tonnes of good product All such information shall be retained by the operator and kept with the log book. Where any of the above parameters are not specifically monitored, arrangements shall be made to undertake monitoring of the use of the material within 8 weeks of issue of this permit.	This condition provides a ratio of raw material and waste linked to production and is therefore reproducible year on year as a measure of performance. Have regard to baseline energy use data, this may be high for some industries such as metal melting, energy efficiency improves with volume of production.

30

Energy Efficiency, Resource Efficiency and Waste Minimisation

Operators are required to:

Example Raw Material Inventory

Type	Item	2007	2008	Waste %age
Ferrous Scrap	Heavy Duty Scrap	997670 Kgs	1499590 Kgs	0.2%
	DDQ Steel Punchings	1721708 Kgs	1639130 Kgs	0.01%
Pig Iron and Ferro-Alloys	SG Pig Iron	251900 Kgs	388380 Kgs	0.3%
	Ferro Silicon Briquettes	24397 Kgs	9332 Kgs	0%
	Ferro Manganese Briquettes	14366 Kgs	14166 Kgs	0%
	Iron Sulphide	1000 Kgs	2000 Kgs	0%
	Ferro Silicon	37000 Kgs	39000 Kgs	0%
	Ferro Manganese	4000 Kgs	4720 Kgs	0%
	Copper Granules	7753 Kgs	9831 Kgs	0%
	3 – 9mm Premco (Recarb)	67280 Kgs	35000 Kgs	0%
	0.25 – 4mm Premco (Recarb)		30000 Kgs	0%
	Koag 5	5000 Kgs	6000 Kgs	0%
	Ferrux 740 (Slag Coagulnt Cupola)	1500 Kgs	2000 Kgs	0%
Limestone	Limestone	108580 Kgs	131960 Kgs	1.1%
Coal and Coke	Coke (Czechoslovakian)	499040 Kgs	643580 Kgs	1.2%
	Coke (Chinese)	12140 Kgs		-
Nodularisation Materials	Ferro Silicon Magnesium Alloys			
	Elmag 6113	20000 Kgs	30000 Kgs	0%
	Ertalloy IM6	9000 Kgs		
Slag (offsite recovery)		23792 Kgs	22662 Kgs	36%
Sand	Greensand	1444500 Kgs	1261995 Kgs	94%

31

Energy Efficiency, Resource Efficiency and Waste Minimisation

Resource Efficiency and Waste Minimisation – Example – Alternative Materials

32

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Resource Efficiency

Review of Alternative Materials

- Suppliers are reluctant to develop new technology/products for a reducing foundry market in this country when they can supply existing technology to the developing markets in the far east (China and India).
- The Airset catalysts have varied during the year to take into account weather influences on the process (Setting times).
- The company is also investigating resins and catalysts with a lower sulphur content
- Ferban 200 clay was substituted by a blended clay Ferban 70/30 to reduce clay additions but improve dry strength (improve strength when casting).
- Coal dust replacement is a direct replacement for previous materials, but with lower volatiles to meet volatile additions regulations.
- Shell moulding techniques replaced by air set cores for key lines, reduced use of raw materials and no fume or odour emissions.

33

Energy Efficiency, Resource Efficiency and Waste Minimisation

Resource Efficiency and Waste Minimisation – Example – Compliance Monitoring

34

Energy Efficiency, Resource Efficiency and Waste Minimisation

Example – Resource efficiency

Resource Efficiency Compliance Monitoring

- Up-date of resource usage on an annual basis.
- Specific resource usage consumption performance indicators.
- Revised indicators based on most recent resource usage.
- Annual up-date on the implementation of site improvements.
- Whether further improvements have been identified.
- Conclusion on whether the company is optimising its resource and energy usage.

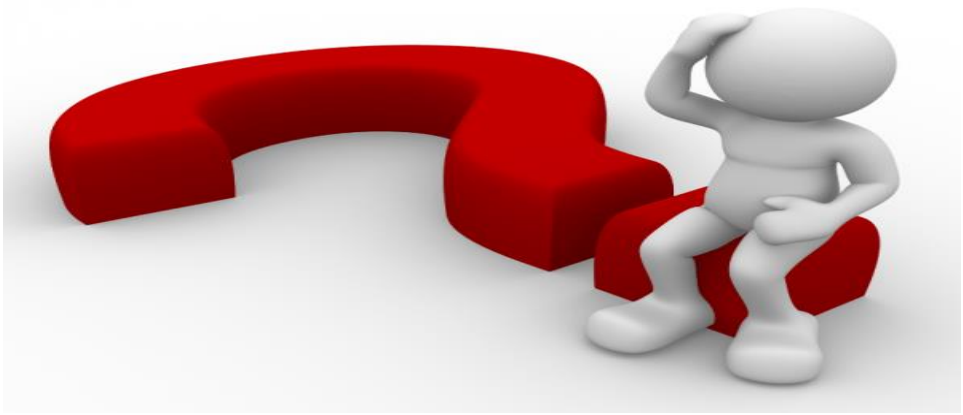
Similarly for waste minimisation but with a focus on installation's waste data..

35

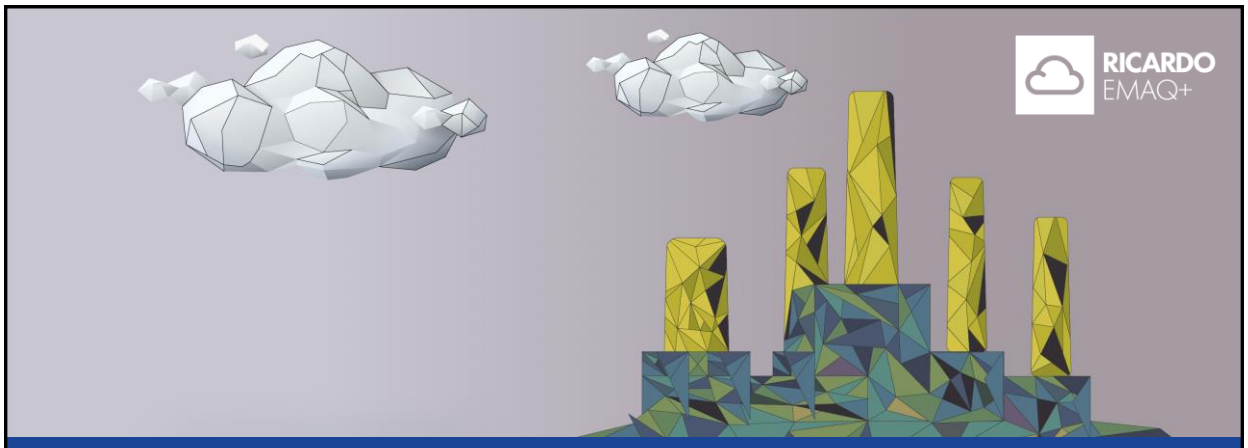
Energy Efficiency, Resource Efficiency and Waste Minimisation – End of Session 4

Any Questions? Please email EMAQ+ to receive a response emaq@ricardo.com

Thank You



36



Essentials of PPC 4

Session 5: Noise and Odour Monitoring and Compliance

1

Contents

Noise

- Guidance.
- Key stages of the investigation and management of Noise (includes vibration).
- Noise compliance monitoring.
- Noise complaints investigation.
- Noise abatement measures.

Odour

- Odour measurement, an illustrated example.
- Odour management plans.
- Key stages of the investigation and management of odour.
- Summary check list - odour compliance monitoring.

2

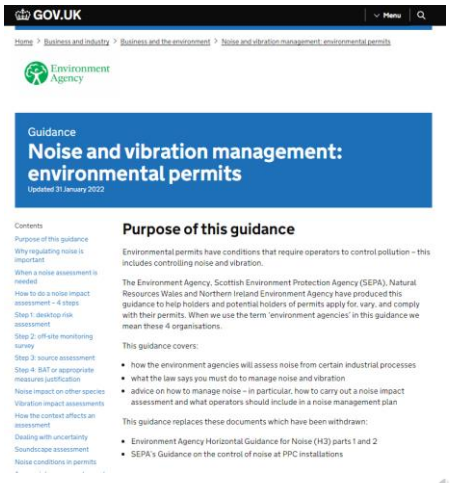
Noise - Guidance

3

Noise and Odour Monitoring and Compliance

Guidance

- Originally H3 “Horizontal Guidance for Noise” was used to inform noise control at Part A(2) activities, it was separated into 2 parts, both now withdrawn / superseded.
- H3, Part 2 - Noise Assessment and Control – now superseded by online guidance :Noise and vibration management: Environmental permits https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits.
- Noise and vibration management: Environmental permits updated on 31/01/22.



4

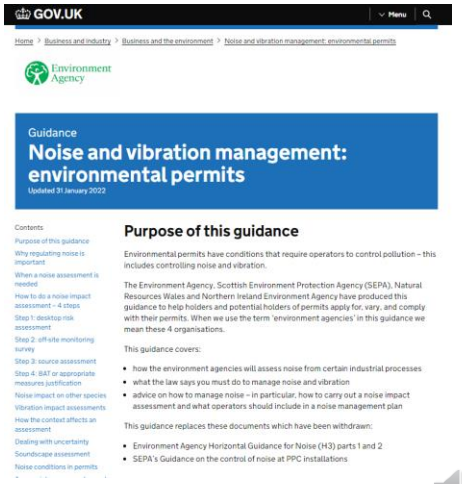
Noise and Odour Monitoring and Compliance

Guidance : Noise and Vibration Management: Environmental Permits

NOT written for Local Authorities, but relevant guidance for LA-IPPC / Part A(2) permits.

- How the environment agencies will assess noise from certain industrial activities;
- What the law says an operator must do to manage noise and vibration;
- Advice on how to manage noise – in particular, how to carry out a noise impact assessment and what operators should include in a noise management plan.

It references noise impact assessments guidance - see next slide.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Menu

Home > Business and industry > Business and the environment > Noise and vibration management: environmental permits

Environment Agency

Guidance

Noise and vibration management: environmental permits

Updated 31 January 2022

Contents

Purpose of this guidance

Why regulating noise is important

When a noise assessment is needed

How to do a noise impact assessment – 4 steps

Step 1: desktop risk assessment

Step 2: off-site monitoring survey

Step 3: source assessment

Step 4: BAT or appropriate measures justification

Noise impact on other species

Vibration impact assessments

How the context affects an assessment

Dealing with uncertainty

Soundscape assessment

Noise conditions in permits

Purpose of this guidance

Environmental permits have conditions that require operators to control pollution – this includes controlling noise and vibration.

The Environment Agency, Scottish Environment Protection Agency (SEPA), Natural Resources Wales and Northern Ireland Environment Agency have produced this guidance to help holders and potential holders of permits apply for, vary, and comply with their permits. When we use the term 'environment agencies' in this guidance we mean these 4 organisations.

This guidance covers:

- how the environment agencies will assess noise from certain industrial processes
- what the law says you must do to manage noise and vibration
- advice on how to manage noise – in particular, how to carry out a noise impact assessment and what operators should include in a noise management plan

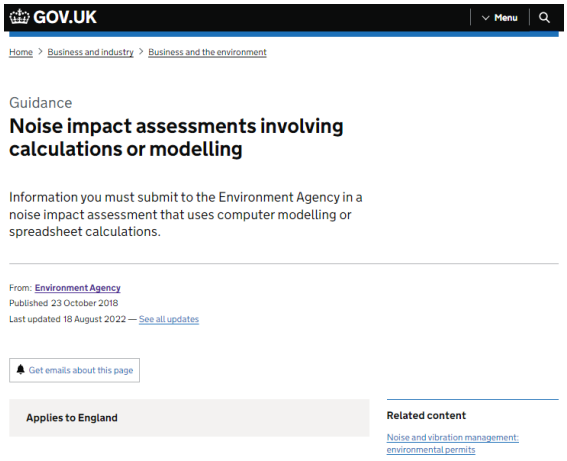
This guidance replaces these documents which have been withdrawn:

- Environment Agency Horizontal Guidance for Noise (H3) parts 1 and 2
- SEPA's Guidance on the control of noise at PPC installations

5

Noise and Odour Monitoring and Compliance

Guidance: Additional Specific Noise Guidance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Menu

Home > Business and industry > Business and the environment

Guidance

Noise impact assessments involving calculations or modelling

Information you must submit to the Environment Agency in a noise impact assessment that uses computer modelling or spreadsheet calculations.

From: Environment Agency

Published 23 October 2018

Last updated 18 August 2022 — See all updates

Get emails about this page

Applies to England

Related content

Noise and vibration management: environmental permits

- Noise impact Assessment – information requirements.
- Requires data submission where models are used.
- Full calculations.
- Locations.
- Mitigation data.
- Terrain data (MODELS).
- BS4142 context evaluation.
- https://www.gov.uk/guidance/noise-impact-assessments-involving-calculations-or-modelling

6

Key Stages of the Investigation and Management of Noise

7

Noise and Odour Monitoring and Compliance

Key Stages of the Investigation and Management of Noise (includes vibration)

Inventory of sources	Potential impact	Control measures	BAT for activity	Managing the activity
•Where it the noise coming from? •Single of several sources? •Single or several sites?	•What is the level of impact? •What standards apply?	•What mitigation measures are in place? •What management measures are in place?	•What is BAT for the activity? • review guidance •Are additional controls required?	ELV's Monitoring / surveys procedures Training Continual Improvement Reviews.

8

Noise and Odour Monitoring and Compliance

Key Stages of the Investigation and Management of Noise – Basic Approach

IQQI	
Identify	What sources? Where are they?
Quantify	Determine levels, Characterise noise (frequency, event noise, impact, etc), Durations?
Qualify	Understand activity and need for the process / action Determine sensitive receptors (not just residential) Topography, context
Impact	Standards? Other regulatory controls

9

Noise and Odour Monitoring and Compliance

Key Stages of the Investigation and Management of Noise – Noise Inventory

- Delivery to and dispatch from the permitted activity site, including vehicle reversing alarms.
- Transport of materials on the permitted activity site — including non-vehicular means of transfer such as pumping, blowing, conveyors, etc.
- Waste–recycling facilities and waste–storage areas and removal of wastes from the permitted activity site for off-site disposal.
- Raw materials and finished product stockyards and associated handling and stock–management activities.
- Noise from the operation of the production plant and machinery directly employed in production at the permitted activity site.
- High–level alarms or other audible warning devices (external).
- Public address systems/ tannoy systems, associated with management of the permitted activity.
- Overhead cranes.
- Cooling towers, extraction/ventilation fans, compressors.
- Noise from maintenance activities, often carried out at night and weekends when production allows.
- Emergency equipment — generators, flares, dump stacks.
- Construction, commissioning or modification work to the permitted activity and associated buildings.
- Etc, etc, etc……

10

Noise Compliance Monitoring

11

Noise and Odour Monitoring and Compliance

Noise Compliance Monitoring

Process Checks

- During production subjective monitoring at key on site locations [once per shift].
- Record observation, if abnormal/excessive noise detected, the noise identification/description, amplitude and weather conditions are recorded in a noise monitoring log.
- Evaluation of effectiveness of abatement provided; i.e. are acoustic enclosures closed, shrouding in place, etc.

Formal Noise Test

- *BS4142: 2014 Method for rating industrial noise affecting mixed residential and industrial areas* – this describes a method for assessing industrial and background noise levels outside residential buildings and for assessing whether the industrial noise is likely to give rise to complaints from the occupiers of residential buildings and therefore potentially be a "nuisance"
- Need permit conditions to require monitoring, assessment, notification, mitigation and recording.

12

Noise and Odour Monitoring and Compliance

Noise Compliance Monitoring

The BS4142: 2014 assessment methodology involves the following procedure:

- measure the background (LA90,T) sound level, in the absence of the noise source, at the noise sensitive receptors (if possible);
- measure the sound levels attributable to the noise source of concern at the sensitive receptor as an LAeq,T (using the procedures set out in the standard);
- correct the noise levels for duration and acoustic features (including ambient correction where necessary) as outlined in the standard, to produce the rating level (LAar,T). (The correction for tonal, impulsive or any distinctive character in the noise source is a maximum of +18dB);
- assess the potential impact by subtracting the measured background noise level from the rating level;
- Provide CONTEXT.

13

Noise and Odour Monitoring and Compliance

Noise Compliance Monitoring

The BS4142: 2014 assessment methodology points to note

- Ensure measurements minimise uncertainty e.g. type 1 instrument with calibration certificate and avoid adverse weather, strong winds, reflections etc.
- Calibrate SLM before measurements and record readings and conformance check after.
- Select the correct measurement period for the specific, residual and background levels, justify if you are varying that period.
- Measure at least 3.5m from reflecting surfaces and 1.2 – 1.5m above ground levels.
- Ensure all the information is reported.
- Describe the nature and characteristics of the specific noise source.
- Describe the main sources of the ambient and background sound.
- Correct the measured specific noise source for effects of the ambient sound.
- Correct the measured level for the duration or “on-time”.
- Consider the corrections for acoustic features are they justified?

14

Noise Complaints Investigation

15

Noise and Odour Monitoring and Compliance

Noise complaints investigation

- Are complaints received? are people disturbed / annoyed?
- Has the operator demonstrated BAT or is there scope for further improvement?
  For Part A2 installations – refer BAT conclusions or Sector Guidance
- Are all significant emission sources controlled?
  Need to understand sources – have they been identified and controls identified
- Have effective abatement measures been employed?
  Are they consistent with BAT Conclusions, sector guidance
- Do records show that the plant and equipment and abatement measures are being operated correctly?
  In accordance with permit condition and documented working procedures
- Is the equipment serviced and maintained in accordance with manufacturer's instructions / written procedures required by permit conditions?
  In accordance with permit condition and documented working procedures

16

Noise and Odour Monitoring and Compliance

Noise complaints investigation

- Are adequate records being kept and made available to the regulator?
  For example in accordance with permit condition
- Are complaints subject to comprehensive investigation?
  Do they have a complaints procedure within the noise management plan or EMS
- Are complaint outcomes recorded and notified to the complainant and the regulator?
  Good communication and should be a Part A2 permit condition
- Is the operator using due diligence to manage the operation of the permitted activity and emissions from the activity?
  For example as part of an EMS
- If further action is required, do permit conditions cater for that requirement?
  For example through a requirement for noise management plan. If not then consider Notice or further steps.

17

Noise and Odour Monitoring and Compliance

Noise Complaints Investigation - Form

Noise complaint report form	Date:	Ref. No.
Name and address of complainant		
Tel no. of complainant		
Time and date of complaint		
Date, time and duration of offending noise		
Weather conditions (e.g., dry, rain, fog, snow)		
Wind strength and direction (e.g.,light, steady, strong, gusting)		
Complainant's description of noise (e.g., hiss, hum, rumble, continuous, intermittent)		
Has complainant any other comments about the offending noise?		
Any other previous known complaints relating to installation (all aspects, not just noise)		
Any other relevant information		
Potential noise sources that could give rise to the complaint		
Operating conditions at the time offending noise occurred (e.g., flow rate, pressure at inlet and pressure at outlet)		
Action taken:		
Final outcome:		
Form completed by		Signed

18

Noise Abatement Measures

19

Noise and Odour Monitoring and Compliance

Noise Abatement Measures

May include some of the following generic noise control equipment:

- acoustic enclosures;
- acoustic louvers;
- noise barriers;
- acoustic panelling;
- acoustic lagging;
- Silencers, e.g. in line on ducting / exhaust stacks;
- steam and air diffusers;
- vibration isolation mounts;
- vibration damping;
- impact deadening.

Etc, etc, etc……

20

Odour – Odour Measurement, an illustrated Example

21

Noise and Odour Monitoring and Compliance

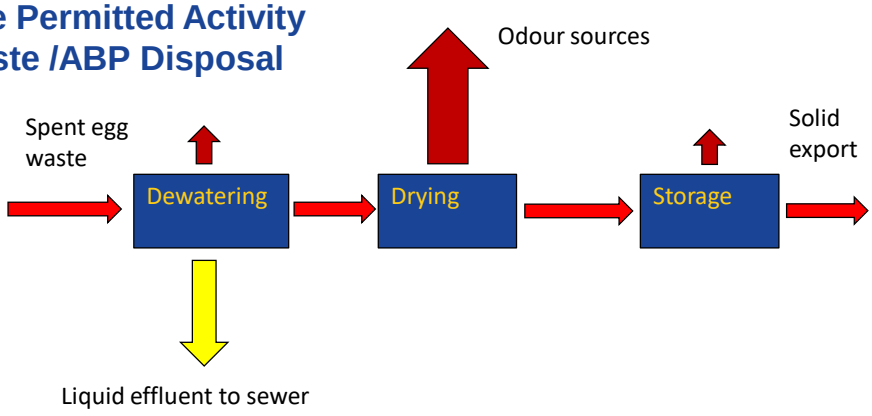
Example Permitted Activity
Odour Management Plan – The Key Pathways

Odour source	Receptor	Pathway	Risk management / BAT for odour control	Probability of exposure	Consequence	What is the overall risk?
Dryer emission stack	Industrial and residential in the vicinity of the site	Air	Good management Control using an odour abatement plant – initially based on caustic/ hypochlorite scrubber	Low	Odour annoyance without adequate abatement	Not significant with effective controls in place
Excursion through doors louvers etc	Impact within site boundary	Air	Good process management Good housekeeping	Low	Small impact within site boundary	Not significant
Tanks, skips and skip handling area	Impact within site boundary	Air	Good process management Good housekeeping	Low	Small impact within site boundary	Not significant

22

Noise and Odour Monitoring and Compliance

Example Permitted Activity
Egg Waste /ABP Disposal



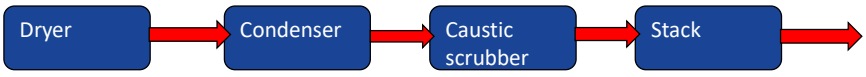
23

Noise and Odour Monitoring and Compliance

Odour Management Plan – Emission Quantification

Olfactometry BS EN 13725:2019 – Determination of odour concentration measurement by dynamic olfactometry, example data from original abatement system.

Test	Exit –condenser (ou_E/s)	Make up air contribution (ou_E/s)	Exit caustic scrubber (ou_E/s)	Removal efficiency (%)
1	839,380	6967	66,361	92
2	1,243,142		295,700	76
3	1,641,974		247,126	85



24

Noise and Odour Monitoring and Compliance

Odour Measurement

Steps in olfactometry test [BSEN 13725:2019].

1. Odour sampling equipment in action – surface source.

2. Odour panel in action:
- Determination of detection threshold;
- BSEN requires;
  - Instrument calibration,
  - panellist calibration.

25

Noise and Odour Monitoring and Compliance

Odour Measurement

Knowing what substances are in the emission can be useful to assess whether BAT is being applied:
- pollutant analysis if applicable, using GC/MS, colorimetric tubes, etc;
- Example data from original abatement system.

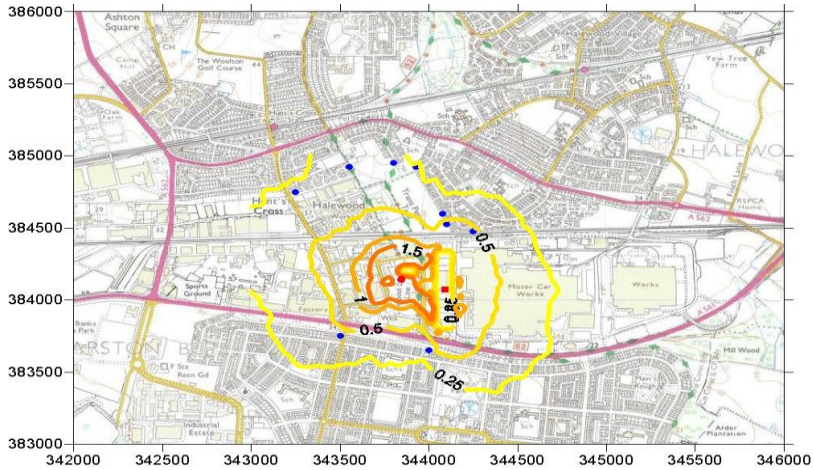
Analysis of GCMS	Inlet (#88447)	Outlet (#88449)	Odour threshold value	Inlet	Outlet
	mg/m^3	mg/m^3	mg/m^3	$ou_E/m3$	ou_E/m^3
Methyl mercaptan	1.10	0.00	0.0021	524	0
Trimethylamine	56.00	3.10	0.0059	9,492	525
Ethanol	18.00	1.40	55	0	0
Isopropanol	1.30	0.19	26	0	0
1-Propanol	5.30	0.40	6	1	0
2-Methyl propanal	3.20	0.35	0.12	27	3
3-Methylbutanal	5.60	0.37	0.0081	691	46
1-Butanol	1.70	0.14	1.5	1	0
2-Methylbutanal	5.40	0.39	0.00054	10,000	722
Dimethyl disulphide	0.67	0.12	0.048	14	3
2-Nonanone	1.50	0.00	0.23	7	0
Nonanal	1.10	0.09	0.013	85	7

26

Noise and Odour Monitoring and Compliance

Odour Measurement – Impact Assessment

Using dispersion modelling can be a useful way to predict impact concentrations beyond the site boundary.



Example shown – A single stack source based on 60,000 ou_E/s

Ordnance Survey (2023). Halewood [Map]. OS VectorMap® Local. https://digimap.edina.ac.uk/roam/map/os

27

Noise and Odour Monitoring and Compliance

Odour Measurement - Exposure Criterion

Set appropriate targets e.g. compare predictions against Environment Agency guidelines. Link to H4 Odour Management Guidance here

Relative offensiveness of odour	Indicative criterion of significant pollution[note 2]
More offensive odours: Activities involving putrescible wastes Processes involving animal or fish remains Brickworks Creamery Fat & Grease Processing Waste water treatment Oil refining Livestock feed Factory	1.5 OU_E/m^3 (1.0 OUE $/m^3$)[note 3]
Odours which do not obviously fall within a high or low category: Intensive Livestock rearing Fat Frying (food processing) Sugar Beet Processing	3 OU_E/m^3 (2.5 OUE $/m^3$)[note 3]
Less offensive odours (but not inoffensive): Chocolate Manufacture Brewery Confectionary Fragrance and Flavourings Coffee Roasting Bakery	6 OU_E/m^3 (5.5 OUE $/m^3$)[note 3]

Note 1: Reference: EA H4 Guidance Appendix 6.
Note 2: Odour Units (OUE) as 98th percentile of hourly averages.
Note 3: Local adjustment for hypersensitive populations (odour generated a high level of complaint) – Reference: EA H4 Guidance Appendix 6.

28

Noise and Odour Monitoring and Compliance

Example Permitted Activity
Setting Appropriate Targets

Applying the criteria to our example …….

Based on 60,000 ou_E/s [Test 1] no additional abatement required.

However based on 295,700 ou_E/s [Test 2] additional odour abatement is required [=1-(100,000/295,700) = 66%].

	Nearest receptor	max
Target odour exposure criterion:	**1.5 ou_E/ m^3**	**1.5 ou_E/ m^3**
Current Discharge condition		
Stack = 26.5m, Velocity = 10m/s	100000 ou/s or 18100 ou_E/ m^3	29032 ou/s, or 5250ou_E/ m^3

29

Noise and Odour Monitoring and Compliance

Example Permitted Activity
What is BAT for an activity?

BAT will depend on the process, it is location and industry practice (BAT Conclusions and SG Notes).
A BAT review can justify selection of control measures.

In the example, the BAT review was based on the characteristics of the activity and targets that have been set, e.g. control must deal with:

- Emission contains: Amine, Oxygenated compounds (e.g. aldehydes, ketones etc), Reduced sulphur compounds (e.g. H_2S, mercaptans, organic sulphides);
- Variable emissions as the activity is a batch process;
- Must be able to reduce the odour concentration to less than 5,250 ou_E/ m^3;
- Air flow rate of 20,000 m^3/hr;
- New plant with defined process specific services (e.g. steam supply).

30

What techniques could be considered?

BAT assessment should considered a range of options appropriate to the process sector.

In the example, the BAT assessment considered:

- Improved process control;
- Thermal incineration as a stand alone process;
- Thermal incineration using steam raising boilers;
- Biofiltration;
- Carbon filtration as a stand alone process;
- Chemical scrubbing as a stand alone process;
- Combination of chemical scrubbing and carbon filtration;
- UV/Ozone as a stand alone process;
- Improved stack dispersion.

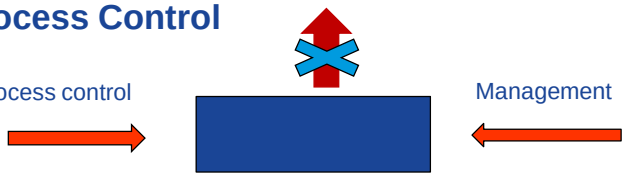
31

BAT Assessment measures

32

Noise and Odour Monitoring and Compliance

Example Permitted Activity
Improved Process Control

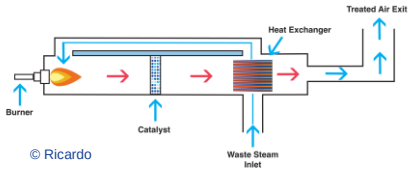


Strengths	Weaknesses
• Preferred option in most cases. • Prevent emission occurring in the first place. • Cost effective.	• Must have a good understanding of the process and the mechanism by which emission is released. • Need effective management through set procedures. • Need to follow those procedures. • May not necessarily deal with all odour.

33

Noise and Odour Monitoring and Compliance

Compliance Techniques
Thermal Incineration
(and Catalytic Converter)



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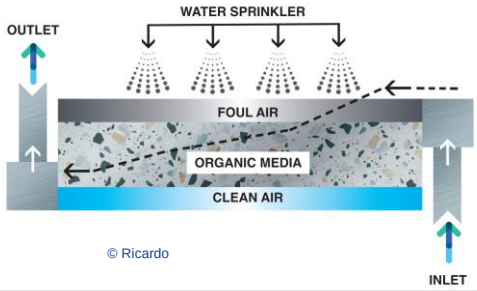
Strengths	Weaknesses
• Very high efficiency (>99%) can be achieved on a broad spectrum of odorants. • Performance is independent of incoming odour concentration. • Suitable for treating air flows with fluctuating concentrations. • Tolerance of wet and dusty gases. • Performance is usually predictable and uniform. • Operator attention can be low when automated controls are used. • Atmospheric dispersion is enhanced by plume rise of warm exhaust.	• May be costly, especially when volatile organic compounds (VOCs) occur at low concentrations. • The carbon foot print is increased as a result of the combustion of additional fuel. • There may be an increase in the emission of oxides of nitrogen due (i) to the combustion of nitrogen in the support air and (ii) to the combustion of nitrogen based odours. • Possibility of incomplete oxidation may be brought about by inadequate design or operational malfunction. • High risk of nuisance incidents in case of plant failure or maintenance although this can be mitigated if a suitable stand by-system is available. • High capital cost and operational cost.

34

Noise and Odour Monitoring and Compliance

Compliance Techniques
Biofiltration



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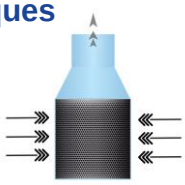
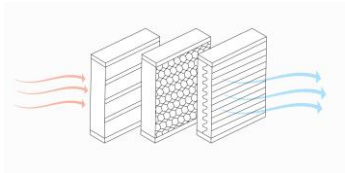
Strengths	Weaknesses
• Relatively low capital and operational cost option, even at high flow capacity. • No or low requirement of chemicals/consumables. • Relatively low medium replacement costs. • High odour abatement efficiency feasible.	• Biofilters require large area. • Take 1-2 weeks to start up when commissioning. • Need relatively continuous loading/nutrients. • Backpressure can cause increased energy costs when medium not changed in time. • Media replacement requires careful planning. • Not suitable for high concentrations or highly fluctuating feed streams without pre-treatment.

36

Noise and Odour Monitoring and Compliance

Compliance Techniques
Carbon filtration





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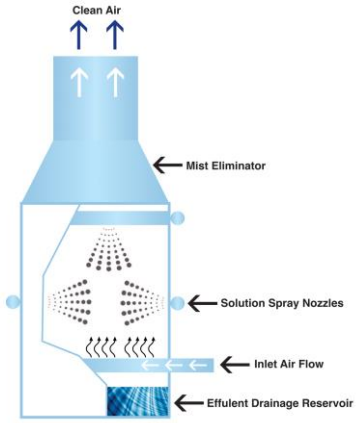
Strengths	Weaknesses
• Simple, consistent operation on many odours. • Effective for odours that are less soluble in water. • Simple operation. • Suitable to cope with variable emissions. • Immediately active, no lead time when switched on. • Suitable as a stand-by system or for peak-time. • Compact size, small footprint. • Relatively low operational health and safety risk: no storage of chemicals.	• High cost, especially at high concentrations of odorants and VOCs. • Life span may be reduced by adsorption of non-odorous VOCs. • Adsorbent is a costly consumable. • Causes a secondary solid waste for disposal. • High humidity will reduce effectiveness of adsorption.

37

Noise and Odour Monitoring and Compliance

Compliance Techniques
Chemical Scrubbing

Strengths	Weaknesses
• Can achieve high removal efficiency in multistage. • Instant response to variations in loading. • Can treat large gas flows. • Small footprint, compact. • Can adapt relatively quickly to fluctuating concentrations. • Subject to design can achieve satisfactory abatement efficiency for variety of odorants.	• High usage of chemicals, hence operation needs careful optimisation. • Relatively complex process equipment. • Relatively intensive and chemical process skills needed to operate effectively. • Possibility of scaling of media. • Generates a saline waste stream. • Residual emissions of chemical odours which needs careful control.



38

Noise and Odour Monitoring and Compliance

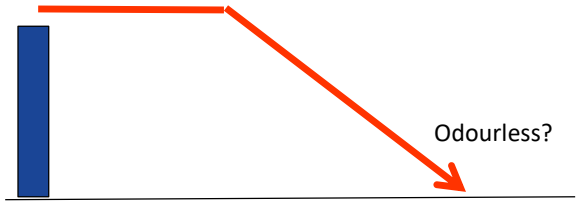
Compliance Techniques
UV/Ozone

Strengths	Weaknesses
• No adsorption required. • Straightforward installation. • On-off system, suitable for intermittent use. • No chemicals involved.	• Appears to be effective for H_2S reduction, but less so for odorants with larger molecules. • Reaction time within duct work is usually too short to achieve full oxidation of more complex odorants. • Requires proper maintenance to ensure adequate ozone/radical generation. • Control of ozone/radical relative to treatment needs can be problematic. • Emissions of unused ozone may pose a problem, as it is a toxic gas.

39

Noise and Odour Monitoring and Compliance

Compliance Techniques
Stack Dispersion



Strengths	Weaknesses
• Proven technology. • Supplement other abatement processes.	• Stacks may need to be v. tall to meet objective. • Odour is not removed, just diluted to below threshold. • Difficult to size because of nature of odour (human response based on very short exposure).

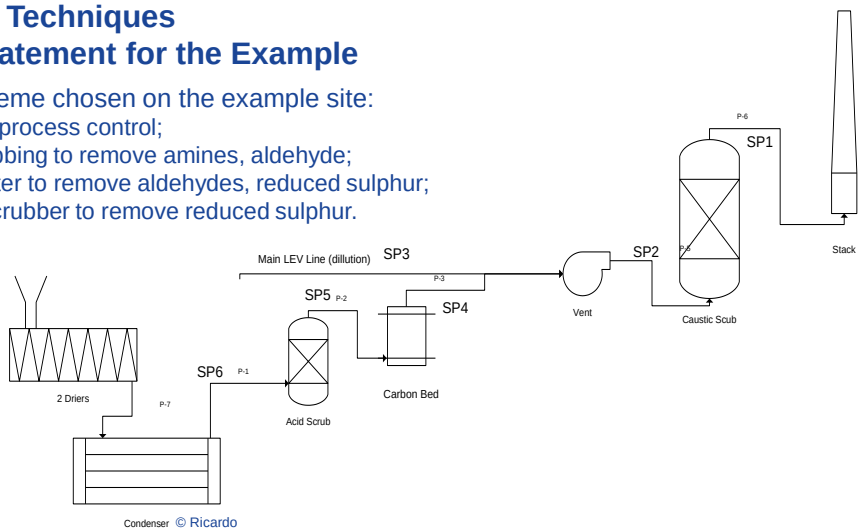
40

Noise and Odour Monitoring and Compliance

Compliance Techniques
Selected Abatement for the Example

Abatement scheme chosen on the example site:

- Improved process control;
- Acid scrubbing to remove amines, aldehyde;
- Carbon filter to remove aldehydes, reduced sulphur;
- Caustic scrubber to remove reduced sulphur.



41

Odour management plan

42

Noise and Odour Monitoring and Compliance

Odour Management Plan – What to Include?

The OMP should include:

- A directory of all sources of odour at the permitted activity site,
  A survey to identify operations and release points. Also consider other local sources outside installation.
- Detail any abatement techniques applied to each odour source,
  Informed by site survey, scrubber, carbon filter, biofilter
- Include a detailed site plan to show the location of the above,
  Locations and nature of release (vent, area, fugitive).

43

Noise and Odour Monitoring and Compliance

Odour Management Plan – What to Include?

The OMP should include:

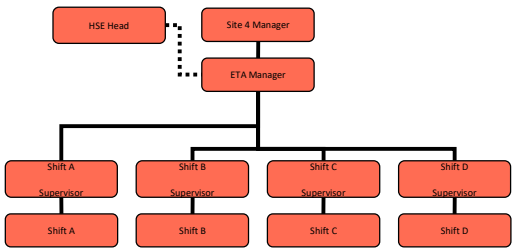
- Classify each odour / identify the chemicals involved,
  From process, an odour survey and potentially measurement/speciation of odour.
- An odour assessment / monitoring programme in place to measure odour units from each source which may cause an offensive odour over the site boundary,
  Olfactometry survey.
- Reports of the measured odour units to demonstrate permit condition compliance (offensive odour over the boundary or other condition),
  Monitoring and/or odour survey.
- Trends to be demonstrated, preferably graphically from the measurement data,
  Summary of monitoring, complaints and related data.

44

Noise and Odour Monitoring and Compliance

Odour Management Plan - Management Considerations

- The OMP needs to be produced by the site manager and signed off at Director level.
- Management structure.



- Structured OMP review - annual check and after process changes or odour events.
- Training – outline staff duties to deliver OMP.
- Complaints - Record all complaints of offensive odour over the boundary, the investigations undertaken and outcomes of the investigations.
- Notifications – Permit condition duty to inform the regulator of abnormal events.

45

Key Stages of the Investigation and Management of Odour

46

Noise and Odour Monitoring and Compliance

Key stages of the investigation and management of odour

Inventory of sources	Potential impact	Control measures	BAT for activity	Managing the activity
•Where it the odour coming from? •Single of several sources? •Single or several sites?	•What is the level of impact? •What standards apply?	•What mitigation measures are in place? •What management measures are in place?	•What is BAT for the activity? • Review guidance •Are additional controls required?	Targets Monitoring / surveys procedures Training Continual Improvement Reviews.

47

Noise and Odour Monitoring and Compliance

Key Stages of the Investigation and Management of Odour

Identify	What sources? Where are they?
Quantify	Determine levels, Characterise odour (Odour Units, hedonic tone, concentrations), Durations, Masking?
Qualify	Understand activity and need for the process / action Determine sensitive receptors (not just residential) Topography
Impact	Standards? Opinions Other regulatory controls

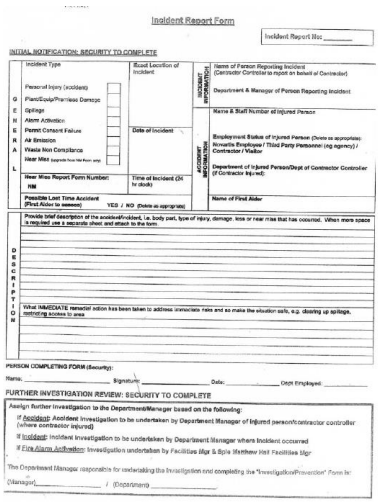
48

Noise and Odour Monitoring and Compliance

Complaints - Odour incident investigation

This requires ……..

- Prompt remedial action, investigating and reporting actual or potential non-compliance with operating procedures or emission limits.
- Investigation of incidents, (including any malfunction, breakdown or failure of plant, equipment or techniques, down time, any short term and long term remedial measures and near misses) and prompt implementation of appropriate actions.
- Detailed records are made of all such actions and investigations.


Incident Report Form

Incident Report No: _____

INITIAL NOTIFICATION: SECURITY TO COMPLETE

GENERAL

Incident Type

Personal Injury (accident)

Plant/Equip/Premises Damage

Spillage

Alarm Activation

Permit Consent Failure

Air Emission

Waste Non Compliance

Near Miss (separate from Near Miss Form, only)

Near Miss Report Form Number: NM

Possible Lost Time Accident (First Aider to assess) YES / NO (Delete as appropriate)

Road Location of Incident

Date of Incident

Time of Incident (24 hr clock)

ACCIDENT INFORMATION

Name of Person Reporting Incident (Contractor Controller to report on behalf of Contractor)

Department & Manager of Person Reporting Incident

Name & Staff Number of Injured Person

Employment Status of Injured Person (Delete as appropriate) Novartis Employee / Third Party Personnel (eg agency) / Contractor / Visitor

Department of Injured Person/Dept of Contractor Controller (if Contractor Employee)

Name of First Aider

DESCRIPTION

Provide brief description of the accident/incident, i.e. body part, type of injury, damage, loss or near miss that has occurred. (When more space is required use a separate sheet and attach to the form.

What IMMEDIATE remedial action has been taken to address immediate risks and so make the situation safe, e.g. clearing up spillage, restricting access to area

PERSON COMPLETING FORM (Security):

Name: _____ Signature: _____ Date: _____ Dept Employed: _____

FURTHER INVESTIGATION REVIEW: SECURITY TO COMPLETE

Assign further investigation to the Department/Manager based on the following:

If Accident: Accident Investigation to be undertaken by Department Manager of injured person/contractor controller (where contractor injured)

If Incident: Incident Investigation to be undertaken by Department Manager where incident occurred

If Fire Alarm Activation: Investigation undertaken by Facilities Mgr & Site Manager Ilot Facilities Mgr

The Department Manager responsible for undertaking the investigation and completing the "Investigation/Prevention" Form is:

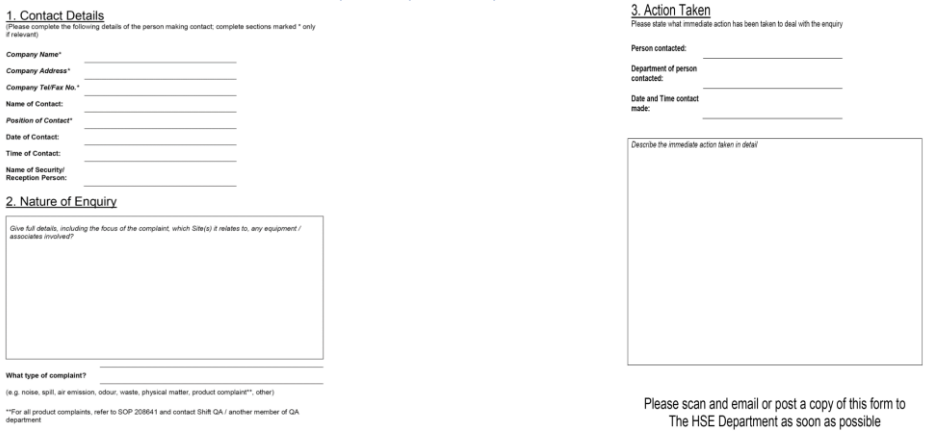
(Manager)_____ / (Department) _____

49

Noise and Odour Monitoring and Compliance

Complaint - Handling

- Recording mechanism for a complaint.
- Essential information to record: who, what, where, when!



1. Contact Details

(Please complete the following details of the person making contact; complete sections marked * only if relevant)

Company Name*

Company Address*

Company Tel/Fax No.*

Name of Contact:

Position of Contact*

Date of Contact:

Time of Contact:

Name of Security/ Reception Person:

2. Nature of Enquiry

Give full details, including the focus of the complaint, which Site(s) it relates to, any equipment / associates involved?

What type of complaint?

(e.g. noise, spill, air emission, odour, waste, physical matter, product complaint**, other)

**For all product complaints, refer to SOP 208641 and contact Shift QA / another member of QA department

3. Action Taken

Please state what immediate action has been taken to deal with the enquiry

Person contacted:

Department of person contacted:

Date and Time contact made:

Describe the immediate action taken in detail

Please scan and email or post a copy of this form to
The HSE Department as soon as possible

50

Summary Check List - Odour Compliance Monitoring

51

Noise and Odour Monitoring and Compliance

Summary Check List - Odour Compliance Monitoring

Simple Process Checks

- During production subjective odour monitoring at key off site locations [once per shift].
- Record observation, if odour is detected, the odour identification/description and strength are recorded in an odour monitoring log. The log also includes weather conditions (air pressure, wind speed and direction).
- During production subjective odour monitoring at odour control system (OCS) stack.

Formal Odour Test

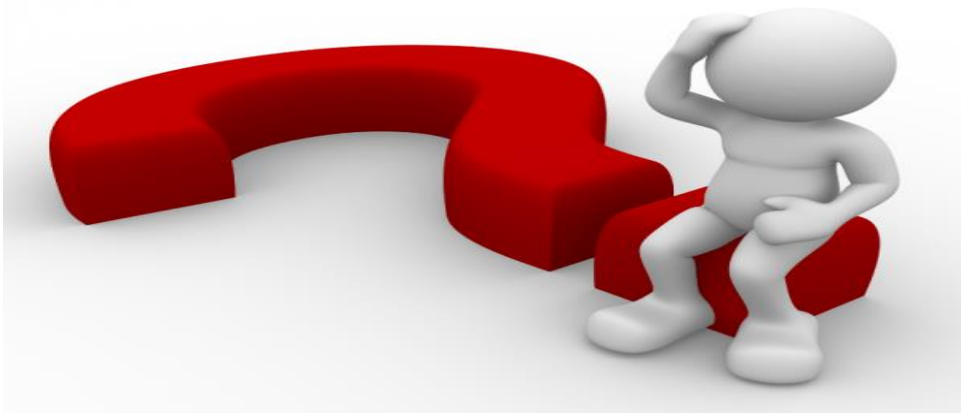
- BS EN 13725:2019 – Determination of odour concentration measurement by dynamic olfactometry.
- Collect 3 samples at each location.
- If necessary collect 3 samples at inlet to odour control plant to allow removal efficiency to be determined.
- Analyse samples within 30 hours of collection.

52

Noise and Odour Monitoring and Compliance – End of Session 5

Any Questions? Please email EMAQ+ to receive a response emaq@ricardo.com

Thank You



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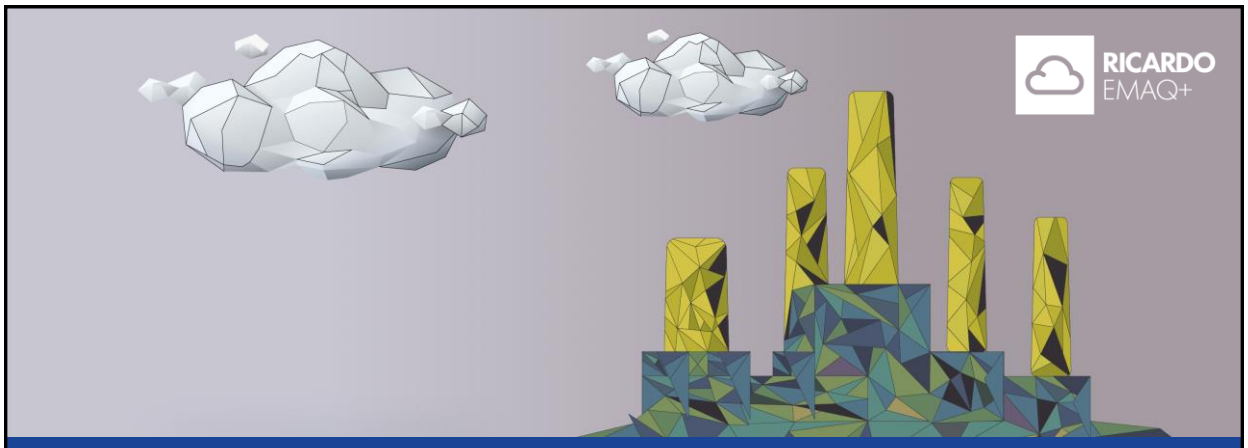

Essentials of PPC 4

Session 6: Demonstrating and Checking Compliance Case Study

1

Contents

- Permit monitoring conditions.
- Auditing emission monitoring :
  Accreditation and competence,
  Method implementation,
  Other check points
- Reporting.
- Data standardisation:
  Definitions,
  Requirements.
- Uncertainty and compliance for emission data.
- A report check list.

2

Demonstrating and Checking Compliance Case Study

Permit Monitoring Conditions

It is essential that the permit conditions regarding monitoring and reporting are comprehensive and clear. They normally include:

- The requirement for specific pollutants to be monitored, the permitted emission limit value, type of monitoring (continuous or periodic) the frequency of monitoring (if periodic), the accepted monitoring methodology (isokinetic / BS);

Pollutant	Emission Limit Value	Frequency and Type of Monitoring	Standard
Particulate matter	50mg/m^3	Non-continuous Isokinetic, every 12 months	BS EN 13284-1:2002 and/or BS ISO 9096:2003

- The standard conditions which monitored emission concentration limits shall be corrected to and reported as, i.e. 273.15K, 101.3kPa measured without correction for water vapour;
- The minimum time period and number of samples required and the activity is “operating normally”;
- Notification provided to the regulator in advance of monitoring date, arrangements and protocols;
- Report of monitoring to be received by the regulator within a stated time period after on site monitoring is complete;
- **Use the PG / SG / BAT Conclusions to ensure that ALL necessary monitoring requirements are conditioned in the permit.**

3

Auditing the Permitted Activity – Accreditation and Competence

4

Demonstrating and Checking Compliance Case Study

Summary of Monitoring Auditing Check Points

- Has a reasonable **sampling strategy** been formulated?
  MCERTS-accredited testhouses are required to produce a Site Specific Protocol (SSP) or measurement plan in advance of testing – this sets out aims of testing, details of test methods, applicable ELVs and other information and requirements.

  Has the SSP been approved by the operator. Has SSP been provided to the regulator in advance?

  Has the correct standard method been chosen to suit the phase, size and expected concentration of the target species?

5

Demonstrating and Checking Compliance Case Study

Emission Monitoring Auditing Check Points

- Is the sampling organisation accredited for the flue gas sampling being undertaken?
- Does team leader have a certificate of proficiency?
- Does the team have method documentation / Work Instructions (WIs)/ or protocols with them on site?
- Have they undertaken a risk assessment ?
- Are they familiar with test equipment ?

6

Demonstrating and Checking Compliance Case Study

Auditing the Permitted Activity - Accreditation

Is the contractor accredited for the testing being undertaken?

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
AMBIENT AIR PROCESS AIR	Sensory Tests Air quality - Determination of odour concentration by dynamic olfactometry	Documented In-House Procedures AEA/ENV/WI/45.07 based on EN 13725:2003	A
END			

Schedule of Accreditation
issued by
United Kingdom Accreditation Service
2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

4729
Accredited to ISO/IEC 17025:2005

Ricardo-AEA Limited (Trading as Ricardo Energy & Environment

Issue No:006 **Issue date:** 25 November 2016

Ricardo Energy & Environment The Gemini Building Fermi Avenue Harwell OX11 0QR	Contact: Dr Nigel Gibson Tel: +44 (0)1235 753609 E-Mail: nigel.gibson@ricardo-aea.com Website: www.ricardo-aea.com/cms/

Testing performed by the Organisation at the locations specified

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details		Activity	Location code
Address Ricardo Energy & Environment The Gemini Building Fermi Avenue Harwell OX11 0QR	**Local contact** Dr Nigel Gibson Tel: +44 (0)1235 753609 Email: nigel.gibson@ricardo-aea.com		
Address Ricardo Energy & Environment Ludbridge Mill East Hendred Wantage OX12 8LN	**Local contact** Dr N Gibson Tel: +44 (0)1235 753609 Email: nigel.gibson@ricardo-aea.com	Sensory Tests Air Quality	A

7

Demonstrating and Checking Compliance Case Study

Auditing the Permitted Activity - Competence

Does the team leader appear competent?

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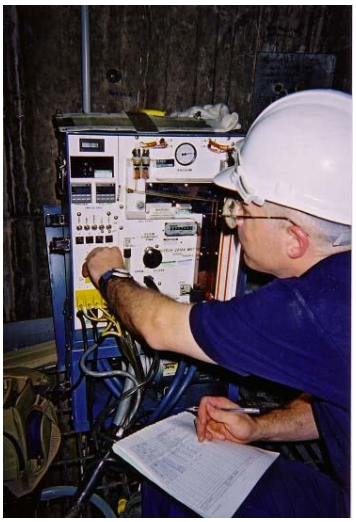

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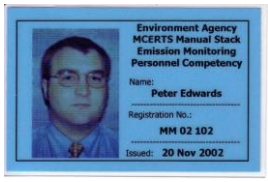
8

Demonstrating and Checking Compliance Case Study

Auditing the Permitted Activity - Accreditation

Does team leader have a certificate of proficiency?



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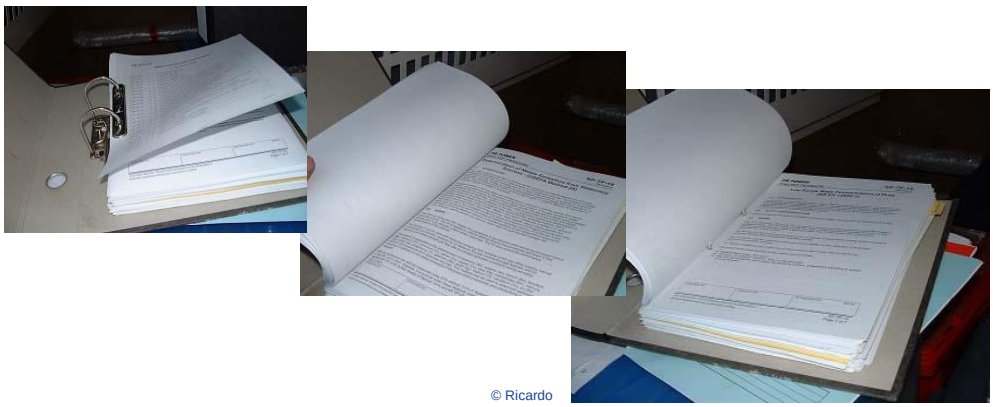
Demonstrating and Checking Compliance Case Study

Auditing the Permitted Activity - Accreditation

Does team have accredited method documentation, Working Instructions or protocols with them?



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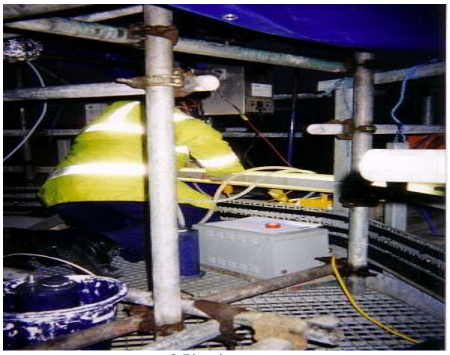
Demonstrating and Checking Compliance Case Study

Auditing the Permitted Activity - Competence

Have safe working practice issues been addressed?



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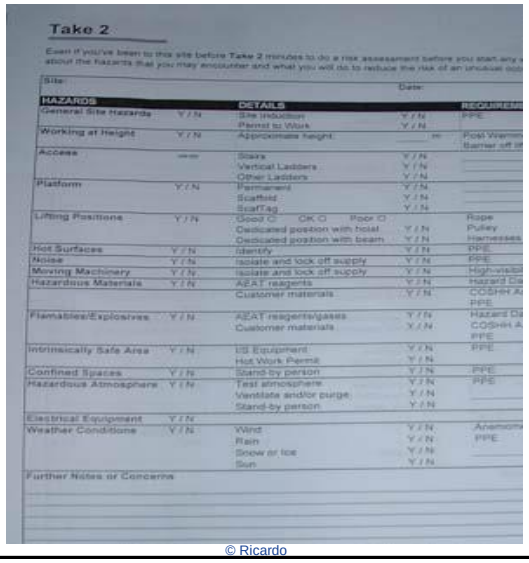

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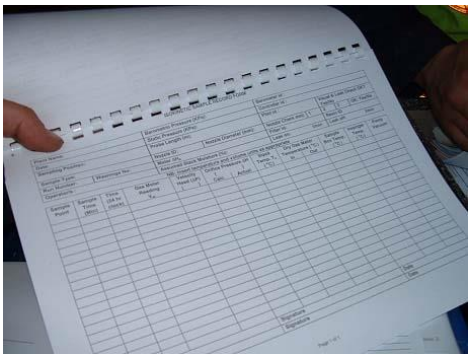
11

Demonstrating and Checking Compliance Case Study

Method Implementation - Competence

Are data being recorded in bound pro-forma notebooks, or just on loose leaf sheets?

Make visual checks and check records.



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12

Demonstrating and Checking Compliance Case Study

Auditing the Permitted Activity - Competence

Is the sampling/monitoring equipment hired?

- Does it have all the appropriate documentation with it?
- Does the operator know how to operate it correctly?

13

Method Implementation

14

Demonstrating and Checking Compliance Case Study

Method implementation auditing check points

- Are test gas standards being used for calibration of instrumental gas analysers?
- Are cylinder analysis certificates provided and still valid?
- Are meter calibration certificates provided and still valid?
- Is sampling being carried out to agreed methods?

15

Demonstrating and Checking Compliance Case Study

Method Implementation

Are test gas standards being used for calibration of instrumental gas analysers?

Are cylinder analysis certificates still valid?

Make visual checks and check records.

16

Demonstrating and Checking Compliance Case Study

Method Implementation

Are meters calibration and certificates still valid?

Check dates.



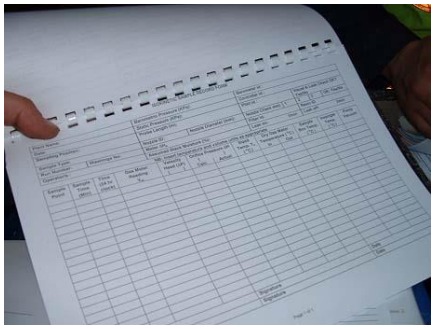

17

Demonstrating and Checking Compliance Case Study

Method Implementation

Is isokinetic / multi point sampling being carried out for particulate species?

Make visual checks and check records




18

Demonstrating and Checking Compliance Case Study

Other Check Points

- Is equipment clean and correctly assembled?
- Has equipment been leak checked?
- Has a preliminary velocity/temperature survey been carried out?
- Is the sampling position acceptable?
- Is any on-line equipment responding correctly when sampling, and does the logger match the monitor read out?
- Were sampler gas meter readings recorded before and after sampling?

19

Demonstrating and Checking Compliance Case Study

Method Implementation

Is equipment clean and correctly assembled?

20

Demonstrating and Checking Compliance Case Study

Method Implementation

Is equipment clean and correctly assembled?

Make visual checks on site.

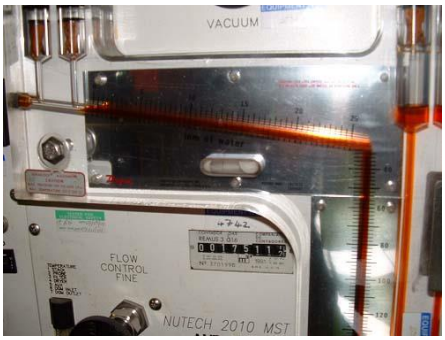
21

Demonstrating and Checking Compliance Case Study

Method Implementation

Is the inclined gauge manometer level and zeroed?

Make visual checks and check that it's been recorded.



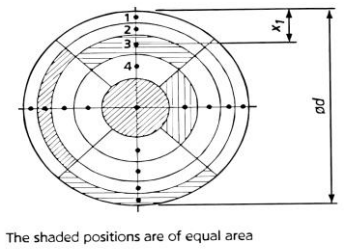
22

Demonstrating and Checking Compliance Case Study

Method Implementation

Has a preliminary velocity/temperature survey been carried out?

Make visual checks and check that it has been recorded.



The shaded positions are of equal area

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Image courtesy of Powergen

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Demonstrating and Checking Compliance Case Study

Method Implementation

During particle sampling, is the sampling nozzle facing upstream and is it parallel to the duct sides?

Make visual checks.

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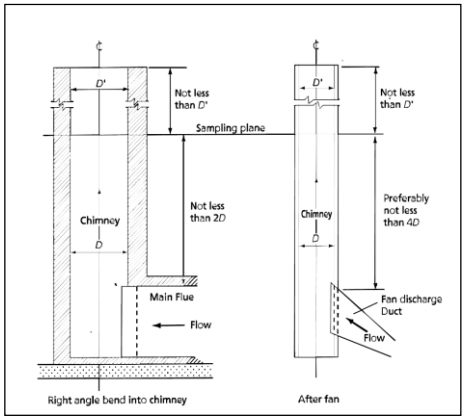
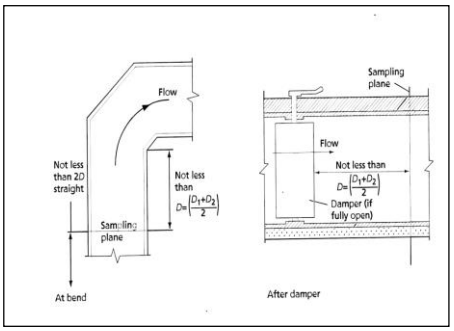
24

Demonstrating and Checking Compliance Case Study

Method Implementation

Is the sampling point far enough away from upstream and downstream obstructions/disturbances?





25

Demonstrating and Checking Compliance Case Study

Method Implementation

Is any on-line equipment responding correctly when sampling, and does the logger match the monitor read out?

Make visual checks and check records.

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26

Demonstrating and Checking Compliance Case Study

Method Implementation

Check requirements in the British Standard EN 15259 for position of stack monitoring ports and port specification. Also see, GOV.UK “Monitoring stack emissions: measurement locations.

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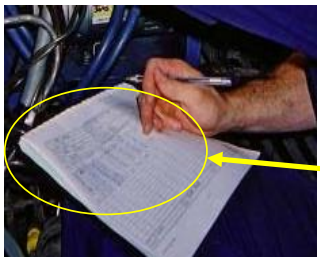
27

Demonstrating and Checking Compliance Case Study

Method Implementation

Were sampler gas meter readings recorded before and after sampling?

Check that pro-forma record sheets are correctly completed.



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28

Demonstrating and Checking Compliance Case Study

General Check Points

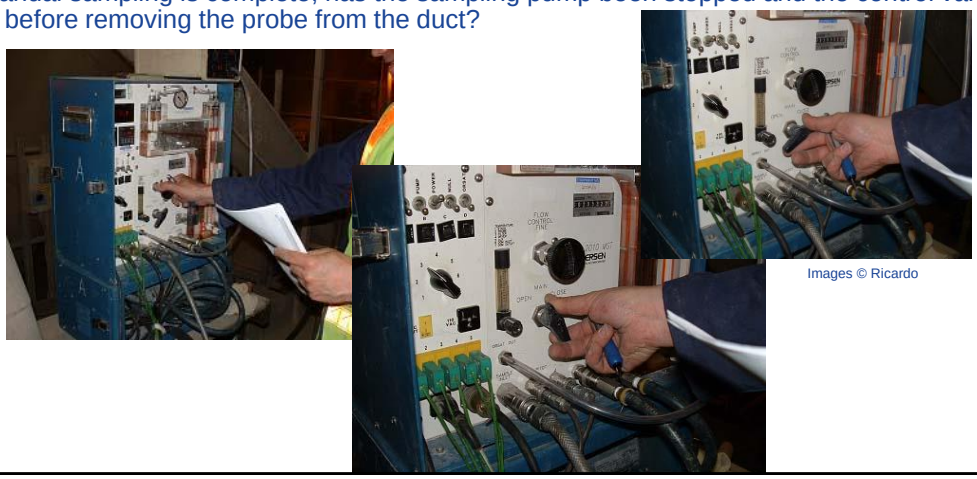
- After manual sampling is complete, has the sampling pump been stopped and the control valve closed, before removing the probe from the duct?
- For particulates, is multi-point sampling being undertaken isokinetically, and is the correct size, sharp sampling nozzle being used?
- Are minimum sampling time, mass and volume criteria being observed? (refer to permit conditions)
- For gases, is flowrate being held constant?
- For dioxins, is the system directly coupled?
- Are exposed samples being correctly recovered and recorded?

29

Demonstrating and Checking Compliance Case Study

Method Implementation

After manual sampling is complete, has the sampling pump been stopped and the control valve closed, before removing the probe from the duct?



30

Demonstrating and Checking Compliance Case Study

Method Implementation

For dioxins, is the system directly coupled?

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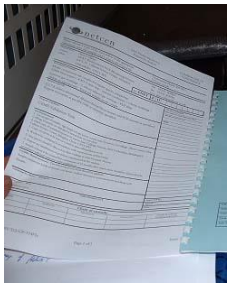
31

Demonstrating and Checking Compliance Case Study

Method Implementation

Are exposed samples being correctly recovered and recorded?



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32

The emission test report

33

Demonstrating and Checking Compliance Case Study

Report

The emission monitoring report should include ….

- Summary.
- Introduction.
- Methodology.
- Results.
- Conclusion.
- References.
- Detailed Calculations.

34

Demonstrating and Checking Compliance Case Study

Report

The Summary

- Summarises results (including uncertainty).
- Indicates compliance or non-compliance with permit conditions.

The Introduction

- Gives aims and objectives of the work, who the work was for, when and where it was undertaken.

The Methodology

- Gives plant description and conditions tested.
- States methods used and gives sampling conditions.

35

Demonstrating and Checking Compliance Case Study

Report

The Results

- Summary of results given here in tables (details in the Appendices).

The Discussion

- Summarises uncertainties of the measurements, e.g accuracy / precision of methods.
- Mentions factors which may affect validity of results.

The Conclusions

- States compliance or non-compliance for each pollutant.

36

Demonstrating and Checking Compliance Case Study

Report

The Appendices

- Detailed results, diagrams, plant information etc.
- Supporting sampling information for each test.
- Supporting analytical reports and calculations.
- Spread sheets (to be transparent and auditable).
- Details of any correction factors employed.

37

Data Standardisation: Definitions

38

Demonstrating and Checking Compliance Case Study

Data Standardisation: Definitions

Pollutant Gas Concentration:

- mass/volume (mg/m^3);

or

- volume/volume (ppm).

Note …..

- Pollutant concentrations often measured in ppm.
- Pollutant concentrations may need to be reported in $mg.m^{-3}$ (STP).

39

Demonstrating and Checking Compliance Case Study

Data Standardisation: Definitions

Ideal Gas Law

$PV = nRT$

Clapeyron after Boyle, Charles and Gay-Lussac

40

Demonstrating and Checking Compliance Case Study

Data Standardisation: Definitions

Conversion ppm to mg/m^3 .

Volume of one mole of gas at STP.

PV = nRT so V=nRT/P.

n = 1 mole.

R = $8.2 \times 10^{-5} m^3.atm.mol^{-3}.K^{-1}$.

T = 273 K (Standard Temperature).

P = 1 atm (Standard Pressure).

V = 0.0224 m^3 or 22.4 litres or at STP, 1 m^3 contains 1/0.0224 moles.

41

Demonstrating and Checking Compliance Case Study

Data Standardisation: Definitions

Conversion of 1 ppm to mg/m^3

By definition the mass of one mole is equal to its molecular mass (M) in grams.

One ppm at STP ($10^{-6}/0.0224$ mol/m^3) would have a mass of:

M x $10^{-6}/0.0224$ $g.m^{-3}$

∴ At STP, 1 ppm = M x $10^{-6}/0.0224$ $g.m^{-3}$

∴ At STP, 1 ppm = M/22.4 $mg.m^{-3}$

Pollutant	Formula wt	PPM	mg/m³ (STP)
SO_2	64	1	2.86
NO	30	1	1.34
NO_2	46	1	2.05
CO	28	1	1.25

42

Data Standardisation: Conversions

43

Demonstrating and Checking Compliance Case Study

Data Standardisation: Requirements

Converting from $mg.m^{-3}$ to $mg.m^{-3}$ (STP)

May need to take into account:

- Temperature;
- Pressure;
- Moisture;
- Oxygen.

Example condition ….. The concentrations of the substances listed in condition (2.4) shall be expressed at reference conditions, 273K, 101.3kPa, without correction for water vapour content and the results of the monitoring shall be expressed in milligrams per cubic metre ($mg.m^{-3}$).

44

Demonstrating and Checking Compliance Case Study

Data Standardisation: Requirements

Correcting for Temperature

$$C_r = C_m \times \frac{T_m}{273}$$

C_r = Concentration at Reference Conditions

C_m= Measured Concentration

T_m = Measured Temperature in ^oK

45

Demonstrating and Checking Compliance Case Study

Data Standardisation: Requirements

Correcting for Pressure

$$C_r = C_m \times \frac{P_{Ref}}{P_m}$$

C_r = Concentration at Reference Conditions

C_m= Measured Concentration

P_m = Measured Pressure

P_{ref}= Reference Pressure

46

Demonstrating and Checking Compliance Case Study

Data Standardisation: Requirements

Correcting for Moisture

$$\%H_2O = 100 \times \frac{\text{moles } H_2O}{\text{moles } H_2O + \text{moles dry gas}}$$

$$C_{dry} = C_{wet} \times \frac{100}{100 - \%H_2O}$$

47

Demonstrating and Checking Compliance Case Study

Data Standardisation: Requirements

Correcting for Oxygen

$$Cr = \frac{C_{m,dry}\,(20.9 - O_{2\ ref\ dry})}{(20.9 - O_{2\ meas\ dry})}$$

48

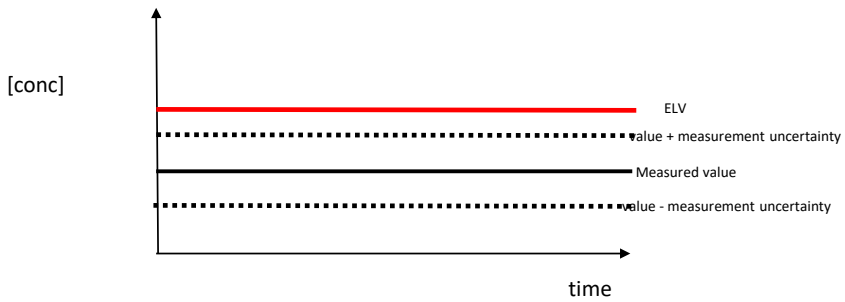
Uncertainty and compliance for emission data

49

Demonstrating and Checking Compliance Case Study

Demonstrating and Checking Compliance – Emission Data

Situation 1 – measured value is well below ELV, you can be confident that the site complies with the ELV

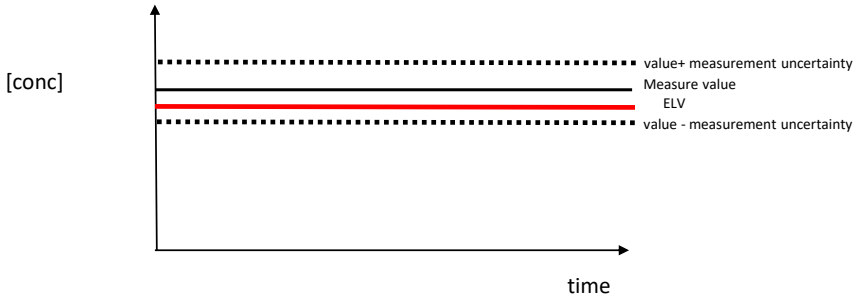


50

Demonstrating and Checking Compliance Case Study

Demonstrating and Checking Compliance – Emission Data

Situation 2 – measured value is above the ELV. Can you be confident that the site does not comply with the ELV?



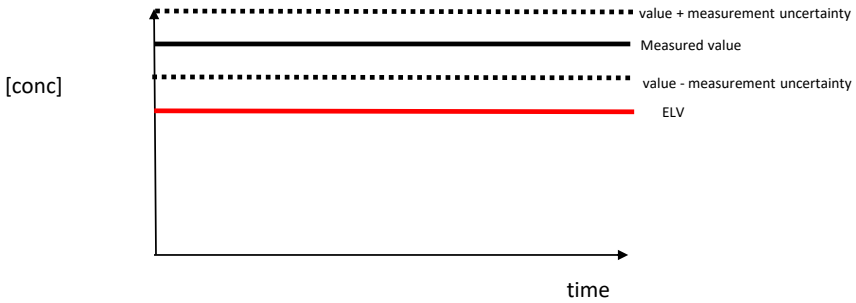
- In this situation you may ask the operator to investigate the reason for the exceeding the ELV.
- Require them to repeat the test?

51

Demonstrating and Checking Compliance Case Study

Demonstrating and Checking Compliance – Emission Data

Situation 3 – measured value is well above the ELV, you can be confident that the site does not comply with the ELV.



- The operator must investigate the reason for the exceeding the ELV.
- Require them to repeat the test.
- Consider formal enforcement ?

52

Demonstrating and Checking Compliance Case Study

Demonstrating and Checking Compliance – Emission Data

In summary the key steps are ……

1. Set conditions that demonstrate compliance with BAT – role of regulator.
2. Carryout monitoring using appropriate methods to show that BAT has been achieved – role of operator.
3. Present a report that provides evidence to show that BAT is being complied with – role of operator.
4. Review the evidence provided to ensure that BAT is in fact complied with – role of regulator.

53

A Useful Report Check List

54

Demonstrating and Checking Compliance Case Study

A Useful Report Check List

Copy is available on the EMAQ web site.

No	Criteria or question to be satisfied	Acceptability			Comment
		Full	Part	No	
1.0	**SUMMARY**				
1.1	Is there a summary?				
1.2	Does this confirm compliance?				
1.3	Does it highlight any non-compliances?				
2.0	**INTRODUCTION**				
2.1	Is there an introduction?				
2.2	Does it clearly identify the process and operator?				
2.3	Does it identify who carried out the monitoring work?				
2.4	Does it identify when the work was carried out?				
2.5	Is the purpose of the work clearly stated? I.e. demonstrating compliance				
2.6	Is the appropriate PG note referenced?				
2.7	Is the number of emission points to be tested clearly stated?				
2.8	Are these clearly identified?				
2.9	Are the species to be monitored clearly stated?				
2.10	Does it identify who carried out the analysis?				
3.0	**EXPERIMENTAL**				
3.1	Is there an experimental or methodology section?				
3.2	Does this give a description of the process(es) tested?				
3.3	Is abatement described?				
3.4	Is condensing stack condition assessed e.g. wet scrubbing?				
3.5	Are all the sampling positions clearly described?				
3.6	Are sampling and analysis methods described or referenced?				
3.7	Were standard methods used?				
3.8	Were any deviations being proposed?				
3.9	Are deviations clearly described and justified?				
3.10	Are any "in-house" methods used fully described?				
3.11	Are all methods acceptable for use?				
3.12	Does the contractor have a quality system?				
3.13	Are they accredited for flue gas sampling (eg UKAS)?				
3.14	Does their accreditation cover all sampled species?				
3.15	Are they accredited for analysis?				
3.16	Do the sampling team members have proficiency credentials?				
3.17	Is the process design and authorised throughput/production load stated?				
3.18	Is a description of the feed material or fuels given?				
3.19	Was all the monitoring work carried out correctly?				

55

Demonstrating and Checking Compliance Case Study

A Useful Report Check List

Copy is available on the EMAQ web site.

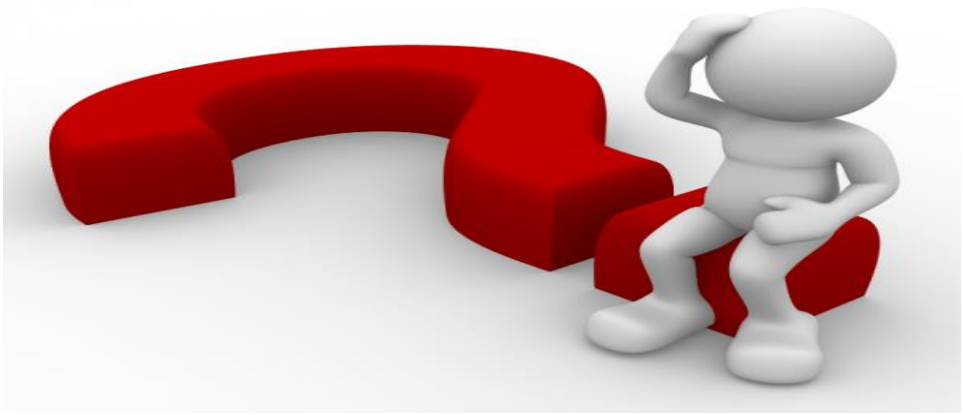
4.0	**RESULTS**				
4.1	Is there a results section?				
No	**Criteria or question to be satisfied**	**Acceptability**			**Comment**
		Full	**Part**	**No**	
4.2	Are the actual process throughputs/loads stated?				
4.3	Are these close enough to design to constitute a valid test?				
4.4	Are gas flow rates, temperatures and gas conditions at sampling points clearly summarised?				
4.5	Is a visual assessment of the plume included?				
4.6	Are pollutant concentrations and emission rates clearly summarised?				
4.7	Are test dates and times stated?				
4.8	Are measurement uncertainties given for each pollutant?				
4.9	Are results referenced to the correct conditions?				
5.0	**DISCUSSION**				
5.1	Is there a discussion section?				
5.2	Are there any issues raised that might affect the validity of the results?				
5.3	Were the BS 3405 positional requirements met?				
5.4	Was a velocity/temperature profile undertaken?				
5.5	Did this comply with minimum requirements				
5.6	If particle phase tested, were main requirements of BS 3405 met?				
5.7	Were there other issues that should have been raised?				
5.8	Are results compared with authorisation limits?				
5.9	Are implications for compliance/non-compliance stated?				
6.0	**APPENDICES**				
6.1	Is there an appendices section?				
6.2	Are there any diagrams of plant layout and sampling positions?				
6.3	Are the diagrams acceptable?				
6.4	Do they raise any new questions on suitability of sampling position, or sampling strategy followed				
6.5	Is plant operator data given?				
6.6	Is detailed temperature/flow profile given?				
6.7	Is this compliant with BS 3405?				
6.8	Are the key sampling parameters and readings summarised?				
6.9	Are calculations given in full?				
6.10	Have any spreadsheets been used?				
6.11	Are these transparent and auditable?				
6.12	Are spreadsheet inputs, calculations and outputs presented in full?				
6.13	Are uncertainties stated?				
6.14	Have standard approaches been followed?				
6.15	Is average moisture content given?				
6.16	Any evidence of condensing conditions in stack?				

56

Demonstrating and Checking Compliance Case Study – End of Session 6

Any Questions? Please Email EMAQ to receive a response emaq@ricardo.com .

Thank You



57