



**A GUIDANCE NOTE ON THE  
BEST PRACTICABLE MEANS  
FOR  
SPECIFIED PROCESS –  
CEMENT WORKS  
(MANUFACTURE OF CEMENT  
AND ASSOCIATED PROCESSES)**

**BPM 3/4 (2020)**

**Environmental Protection Department**

Environmental Compliance Division /  
Air Policy Group

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## 1. INTRODUCTION

- 1.1 This Note is one of a series issued by the Environmental Protection Department (EPD) to guide the air pollution management of specified processes (SP), to which Part IV of the Air Pollution Control Ordinance (the Ordinance) applies, and the assessment of an application for an SP licence. It covers the specified process and associated processes for the manufacture of cement, which are described as follows in Schedule 1 to the Ordinance-

“Works in which the total silo capacity exceeds 50 tonnes and in which cement is handled or in which argillaceous and calcareous materials are used in the production of cement clinker, and works in which cement clinker is ground.”

### Best Practicable Means (BPM)

- 1.2 Under section 12 of the Ordinance, the owner of any premises used for the conduct of an SP shall use the **best practicable means** (BPM) for preventing the emission of noxious or offensive emissions from their plants, preventing the discharge of such emissions into the atmosphere and rendering such emissions where discharged harmless and inoffensive. This Note sets out the minimum requirements for the provision and maintenance of the BPM for an individual plant. However, an applicant for an SP licence should recognize that fulfilment of the requirements in this Note does not necessarily lead to the granting of the licence because the decision will also take into account the circumstances of an individual application. In addition, the Authority may impose specific requirements in the licence, if granted, on top of the requirements set out in this Note. The terms and conditions in the SP licence should be the statutory requirements for the environmental management of the SP.

(Note: “best practicable means”, where used with respect to the emission from a premises of an air pollutant, has reference not only to the provision and the efficient maintenance of appliances adequate for preventing such emission, but also to the manner in which such appliances are used and to the proper supervision by the owner of the premises of any operation in which such an air pollutant is evolved.)

- 1.3 If an SP licence holder seeks to renew the licence of his existing SP that fails to meet the latest version of this Note at the time of the licence renewal application, the licence holder should provide full justifications for the failure and, if it is technically and economically feasible to upgrade the emission performance of the plant concerned, propose for the Authority’s consideration a practicable upgrade plan with reasonable implementation timeframe.
- 1.4 This Note supersedes the previous document “A Guidance Note on the Best Practicable Means for Cement Works (Manufacture of Cement and Associated Processes) BPM 3/4 (2013)” issued in May 2013.

## 2. EMISSION LIMITS

- 2.1 All emissions to air, other than steam or water vapour, shall be colourless, free from

persistent mist or fume, and free from droplets.

2.2 Emissions from non-fugitive fixed emission points in the specified and associated processes as covered by this Note shall not:

- (a) exceed the concentration limits set out in Annex I.
- (b) appear to be as dark as or darker than Shade 1 on the Ringelmann Chart when compared in the appropriate manner with the Ringelmann Chart or an approved device.

### **3. TYPE OF FUEL USE**

3.1 All fuels to be used shall comply with the Air Pollution Control (Fuel Restriction) Regulations (“Fuel Regulations”) in force. Clean energy sources and fuels with proven benefits to the environment (such as electricity and gaseous fuel) shall be used whenever possible in the relevant specified process and associated operations. The use of alternative fuels, which are fuels other than those specified in the Fuel Regulations (e.g. non-fossil fuels such as biofuels and waste-derived fuels), shall be approved by the Authority, subject to the result of commissioning trials.

### **4. CONTROL OF EMISSIONS**

4.1 Emission of air pollutants shall be minimized to prevent:

- (a) harm to the environment, adverse effects to human health, or creation of any nuisance situation (e.g. objectionable odour noticeable outside the premises where the process is carried out);
- (b) hindrance to the attainment or maintenance of the relevant air quality objectives; and
- (c) undue constraint on the existing and future development or land use.

4.2 To satisfy the emission limits set out in Section 2 of this Note, prevention or reduction of emissions at source should be made. Where the emission cannot be prevented or reduced at source to a sufficient extent to meet these requirements, air pollution control equipment shall be provided to meet the emission limits.

4.3 As process selection has direct bearing on the air emissions and energy use, the applicant should make reference to overseas best practices of the trade in working out an appropriate design. The adoption of energy-efficient design such as a dry process with multistage preheating and precalcination should take precedence of a wet process, whenever practicable.

4.4 Properly designed operation process shall be installed and implemented to prevent or minimize the formation and release of air pollutants including, but not be limited to, particulates, and oxides of nitrogen and sulphur. Relevant emissions shall be adequately collected by local exhaust and vented to suitable abatement plant for

treatment to meet the emission limits set out in Section 2 of this Note, before being discharged to the atmosphere.

#### Clinker and cement production

- 4.5 Exhaust gases from the main processing equipment (kiln, clinker cooler, mill, drier, etc.) shall be vented to suitable gas cleaning equipment for treatment to meet the emission limits set out in Section 2 of this Note.
- 4.6 Process heating for clinker and cement production shall be of suitable design incorporating the latest combustion engineering technologies to ensure efficient use of energy and to prevent air pollution. Optimization of the clinker burning process by advanced automatic control system to enhance production and reduce air emissions should be implemented as far as practicable.
- 4.7 Dust emissions from ancillary processing equipment (crushing, screening, blending, packing, loading, etc.) shall be properly contained and vented to suitable equipment to meet the emission limits set out in Section 2 of this Note.

#### Design of Chimney

- 4.8 Chimney includes vent, structure and opening of any kind from or through which air pollutants may be emitted. The applicant will need to demonstrate that the proposed chimney will provide sufficient dispersion of air pollutants.
- 4.9 The design of chimney is to be determined by mathematical or physical dispersion modelling techniques acceptable to the Authority. The aim is to ensure the objectives listed in paragraph 4.1 are observed and followed through.
- 4.10 Unless otherwise agreed by the Authority, the design of chimney shall at least satisfy the following conditions:

(a) Chimney height

- (i) For combustion process, the final chimney height shall be agreed with the Authority and in any case, it shall be at least 3 metres above the roof top of the building to which it is attached or 8 metres above ground level, whichever is greater. In addition, suitable adjustment shall be made to take into account of local meteorology, topography and background emissions.
- (ii) For non-combustion process, the same guideline shall be observed as far as practicable and in any case, it shall be at least 3 metres above the roof top of the building to which it is attached.

(b) Efflux velocity

The efflux velocity of the chimney shall not be less than 15 m/s at full load condition. Where a wet method of arrestment is used, the linear velocity within the chimney shall not exceed 9 m/s to avoid entrainment of droplets from chimney surface into the gas stream.

(c) Exit temperature

For combustion process, the flue gas exit temperature shall not be less than the acid dew point.

(d) Mode of discharge

(i) Emissions from chimney shall be directed vertically upwards and not restricted or deflected by the use of, for example, plates, caps or cowls.

(ii) Where practicable, hot emissions should take place from a minimum number of chimneys and multiplicity of discharge points should be avoided in order to obtain maximum thermal buoyancy.

(iii) Chimney for release of hot emissions shall, wherever possible, be insulated. The insulation materials shall be free of asbestos.

## **5. OPERATION AND MAINTENANCE**

5.1 BPM requirements include proper operation and maintenance of equipment, its supervision when in use and the training and supervision of qualified staff. Specific operation and maintenance requirements may be specified by the Authority for individual equipment.

5.2 All control and monitoring equipment shall be operational and functioning properly when the plant or other associated processes are in normal operation.

5.3 Operating staff shall be properly trained in their duties relating to control of the process and emissions to air. Particular emphasis shall be given to training for start-up, shut-down and abnormal conditions.

5.4 Malfunctioning and breakdown of any process or air pollution control equipment, which would cause exceedance of the emission limits or breaches of other air pollution control requirements, shall be reported to the Authority without delay. Moreover, the relevant process shall be stopped as soon as practicable until the problem is rectified and normal operation of the process and the control equipment can be restored.

## **6. FUGITIVE EMISSION CONTROL**

### Engineering design/technical requirements

6.1 The Authority will prescribe the requirements in consideration of the circumstances of an individual SP plant. As a general guidance, the loading, unloading, handling and storage of fuel, raw materials, products, wastes or by-products shall be carried out in a manner acceptable to the Authority so as to prevent the release of:

(a) visible dust emission;

- (b) emissions of organic vapours; and/or
  - (c) other noxious or offensive emissions.
- 6.2 Silos shall be fitted with suitable high-level alarm device to prevent overfilling and be operated within the manufacturer's specifications. As a typical design, such device will automatically detect the level of material in a silo and send an audible and visual signal, first to warn that the capacity is close to full and then, if no action is taken, to actually stop the silo from filling. The seating of pressure relief valves to all silos should be checked periodically.
- 6.3 Without prejudice to the generality of the above general requirements, the following control measures shall be implemented:

Materials handling

- 6.4 The loading, unloading, handling and storage of all materials shall be carried out in such a way to minimize the emission of dust to the air.
- 6.5 Stock of bulk cement, other cementitious materials, dry pulverised fuel ash, pulverised coal and other pulverised materials shall be stored in silos. Stock of clinker or other dusty materials shall be stored in either silos or closed sheds. Dust-laden air from silos and closed sheds shall be vented to suitable equipment to meet the emission limits set out in Section 2 of this Note.
- 6.6 Other materials which may generate airborne dust emissions, for example crushed rock, coarse aggregate, or coal shall be delivered, stored and handled so as to prevent or minimize dust emissions.
- 6.7 The packing of cement into bags and loading of cement into bulk tankers and barges shall be carried out using purpose-designed plant fitted with extraction for displaced air ducted to suitable arrestment plant, for example bag filters, to meet the emission limits set out in Section 2 of this Note.

Conveyors

- 6.8 Conveyance of cement, other cementitious materials, dry pulverised fuel ash, pulverised coal and other pulverised materials shall be by totally enclosed conveying system acceptable to the Authority. Dust-laden air from the conveying system shall be vented to suitable equipment to meet the emission limits set out in Section 2 of this Note.
- 6.9 Conveyance of clinker and other dusty materials inside buildings shall be carried out so as to prevent or minimize airborne dust emissions. Where conveyors are used, they should be provided with protection against wind-whipping, for example by fitting side boards. Conveyor discharges shall be arranged to minimize free fall at all times.
- 6.10 Conveyance of clinker and other dusty materials outside buildings shall be by fully covered or totally enclosed systems, unless otherwise agreed by the Authority. Transfer points shall be totally enclosed.

Cleaning of vehicles leaving the premises

- 6.11 All practicable measures shall be taken to prevent or minimize the dust emission caused by vehicle movement.
- 6.12 All traffic areas, including roads and areas with regular vehicle movement, within the premises shall be paved with a suitable roadway covering, adequately wetted, and kept clean constantly by a cleaning method acceptable to the Authority.
- 6.13 Vehicle cleaning facilities shall be provided and used at suitable locations acceptable to the Authority to prevent dust being carried off site by vehicles.

Housekeeping

- 6.14 A high standard of housekeeping shall be maintained and there shall be no visible emissions from the process buildings. All spillages or deposits of materials on ground, support structures or roofs shall be cleaned up promptly by a cleaning method acceptable to the Authority. Any dumping of materials at open area shall be prohibited unless otherwise agreed by the Authority.

**7. MONITORING REQUIREMENTS**

- 7.1 Necessary monitoring equipment and techniques shall be provided and used to demonstrate that the process is properly operated and the emissions can be minimized to meet the air pollution control requirements. The scope, manner and frequency of the monitoring shall be sufficient for this purpose and will be determined by the Authority. Monitoring results shall be recorded in such manner specified by the Authority. The record shall be retained at the premises for a minimum of two years, or other period specified by the Authority, from the date of recording and made available for examination as and when required by the Authority.
- 7.2 Without prejudice to the generality of paragraph 7.1 above, the following parameters of air emissions from the subject specified process and associated operations shall be monitored and recorded continuously or periodically:

(a) Continuous monitoring

In-stack levels of exhaust gas emissions from the kiln system for clinker production including, but are not limited to, the following air emissions:

- (i) particulates;
- (ii) oxides of nitrogen;
- (iii) sulphur dioxide;
- (iv) hydrogen chloride; and
- (v) total organic carbon.

(b) Periodic measurement

Periodic measurement of heavy metals and dioxins shall be made to confirm

compliance with the emission limits set out in Annex I. The testing frequency shall be determined by the Authority. All measurement results shall be recorded, processed and presented in a summary report as agreed by the Authority. The report shall be submitted to the Authority within reasonable time to be agreed with the Authority after the source sampling(s) as required is/are completed.

Ambient monitoring

7.3 Ambient monitoring shall be conducted if required by the Authority, in such a manner and at such locations and frequency specified by the Authority.

<p>At site boundary and/or any other locations outside the premises acceptable to the Authority:</p>	<p>(i) Respirable suspended particulates (at least one 24-hour sample per 6 calendar days)</p> <p>(ii) Odour patrols along or beyond the site boundary when the plant is in operation [Odour patrols to be conducted by the plant environmental personnel or operator, who shall be free from any respiratory diseases at the time of patrolling, to detect any odour at least two times per day/shift (preferably one in the morning and one in the afternoon), or at frequency to be determined by the Authority.]</p>
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7.4 The following Boundary Ambient Standards set for triggering investigation by the licence holder.

<p>Respirable suspended particulates :</p>	<p>The prevailing 24-hour Air Quality Objective of respirable suspended particulates</p>
<p>Odour :</p>	<p>Objectionable odour noticeable at the site boundary and/or outside the premises</p>

7.5 Should any ambient monitoring result exceeds the Boundary Ambient Standards, the licence holder shall take action according to the Event and Action Plan at Annex III.

On-line monitoring

7.6 The continuous monitoring data referred to in paragraph 7.2(a) above shall be transmitted instantaneously to the Authority by telemetry system in such manner and format agreed with the Authority.

Miscellaneous requirements

7.7 Continuous measurement of process parameters such as kiln temperature profile,

oxygen content, etc. shall be made to demonstrate the process stability. Also, indication of satisfactory performance of air pollution control equipment shall be provided. For example, the pressure drop across dust filters should be recorded and kept on-site for inspection by the Authority.

- 7.8 The system of continuous emission monitoring including instrument specifications, quality control, operation and maintenance to be implemented by the licence holder shall meet the protocols set out in the General Requirements of Continuous Emission Monitoring (CEM) System issued by the Authority.
- 7.9 The licence holder shall publicise emission data at regular intervals as required by the Authority.

## 8. **COMMISSIONING**

- 8.1 Commissioning trials (to be witnessed by the Authority whenever appropriate) shall be conducted to demonstrate performance and capability of the air pollution control measures. Unless otherwise agreed by the Authority, the report of the commissioning trial shall be submitted to the Authority within 1 month after completion of the trial.

**ANNEX I CONCENTRATION LIMITS FOR EMISSION FROM CEMENT WORKS – MANUFACTURE OF CEMENT AND ASSOCIATED PROCESSES**

I.1 Air pollutant emission from the subject specified process and associated processes as covered in this Note shall not exceed the concentration limits specified below. All air pollutant concentrations are expressed at reference conditions of 0°C temperature, 101.325 kPa pressure, 10% oxygen and dry gas, unless specified otherwise.

(a) Kiln system for clinker production

(i) Daily Average Value

<b>Air Pollutant</b>	<b>Concentration Limit (mg/m<sup>3</sup>)</b>
Particulates	20
Nitrogen oxides expressed as nitrogen dioxide (NO <sub>2</sub> )	500
Sulphur dioxide (SO <sub>2</sub> )	200
Hydrogen chloride (HCl)	10
Total Organic Carbon	40

(ii) Average Value (over the sampling period of a minimum of 30 minutes and a maximum of 8 hours)

<b>Air Pollutant</b>	<b>Concentration Limit (mg/m<sup>3</sup>)</b>
Mercury and its compounds	0.05
Cadmium, Thallium and its compounds	Total 0.05
Arsenic, Antimony, Chromium, Cobalt, Copper, Lead, Manganese, Nickel and Vanadium and their compounds	Total 0.5

- (iii) Average Value (over the sampling period of a minimum of 6 hours and a maximum of 8 hours)

Air Pollutant	Concentration Limit
Polychlorinated dibenzodioxins and polychlorinated dibenzofurans <i>(see Annex II for the calculation of equivalent concentration)</i>	0.1 ng I-TEQ/m <sup>3</sup>

- (b) Silo system

Air Pollutant	Concentration Limit # <sup>Δ</sup> (mg/m <sup>3</sup> )
Particulates	10

- (c) Other processes

Air Pollutant	Concentration Limit # <sup>Δ</sup> (mg/m <sup>3</sup> )
Particulates	10

(Note # Concentration of air pollutant is expressed at reference conditions of 0°C temperature, 101.325 kPa pressure, without correction for water vapour content. Introduction of diluted air to achieve the emission concentration limit shall not be permitted.

<sup>Δ</sup> Measurement of air pollutant is by spot measurement using testing methods approved by the Authority)

## ANNEX II CALCULATION OF EQUIVALENT CONCENTRATION FOR DIOXINS

II.1 For the determination of total concentration of dioxins and furans, the mass concentrations of the following dibenzodioxins and dibenzofurans shall be multiplied by the following equivalence factors before summing:

	<b><u>Toxic Equivalence Factor</u></b>
2,3,7,8 - Tetrachlorodibenzodioxin (TCDD)	1
1,2,3,7,8 - Pentachlorodibenzodioxin (PeCDD)	0.5
1,2,3,4,7,8 - Hexachlorodibenzodioxin (HxCDD)	0.1
1,2,3,6,7,8 - Hexachlorodibenzodioxin (HxCDD)	0.1
1,2,3,7,8,9 - Hexachlorodibenzodioxin (HxCDD)	0.1
1,2,3,4,6,7,8 - Heptachlorodibenzodioxin (HpCDD)	0.01
Octachlorodibenzodioxin (OCDD)	0.001
2,3,7,8 - Tetrachlorodibenzofuran (TCDF)	0.1
2,3,4,7,8 - Pentachlorodibenzofuran (PeCDF)	0.5
1,2,3,7,8 - Pentachlorodibenzofuran (PeCDF)	0.05
1,2,3,4,7,8 - Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,6,7,8 - Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,7,8,9 - Hexachlorodibenzofuran (HxCDF)	0.1
2,3,4,6,7,8 - Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,4,6,7,8 - Heptachlorodibenzofuran (HpCDF)	0.01
1,2,3,4,7,8,9 - Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzofuran (OCDF)	0.001

### ANNEX III EVENT AND ACTION PLAN

<p>Parameter: Respirable Suspended Particulates (RSP) (24 hour average)  Monitoring frequency: At least one 24-hour sample per 6 calendar days  Action level: The prevailing 24-hour Air Quality Objective (AQO) of RSP</p>	
Plant Environmental Personnel	Licence Holder
<ol style="list-style-type: none"> <li>1. Identify the source, investigate the causes and propose remedial measures. (<i>Exceedance of action level may be caused by malfunction of sampler and its operation, high level of background concentration, failure of air pollution control equipment, mishandling of materials, etc.</i>)</li> <li>2. Discuss with the operator for remedial actions required.</li> <li>3. Carry out corrective actions.</li> <li>4. Check the effectiveness of actions.</li> <li>5. Repeat measurement and increase monitoring frequency if necessary.</li> </ol>	<ol style="list-style-type: none"> <li>1. Notify the Authority for events with concentration equal or above the prevailing 24-hour AQO of RSP.</li> <li>2. Rectify any unacceptable practice by Licence Holder.</li> <li>3. Amend working methods if appropriate.</li> <li>4. Report details of the findings (together with the daily inspection records in the past six days before the event) to the Authority.</li> </ol>
<p>Parameter: Objectionable Odour  Monitoring frequency and detecting method: To be determined by the Authority  Action level: Objectionable odour noticeable at the site boundary and/or any other locations outside the premises acceptable to the Authority</p>	
Plant Environmental Personnel	Licence Holder
<ol style="list-style-type: none"> <li>1. Identify the source, investigate the causes and propose remedial measures. (<i>Odour patrols along or beyond the site boundary should be made at least two times per day/shift by the plant environmental personnel when the plant is in operation. The time, location and result of these checks, along with weather conditions such as indicative wind direction and strength, should be recorded to help identify the source.</i>)</li> <li>2. Discuss with the operator for remedial actions required.</li> <li>3. Carry out corrective actions.</li> <li>4. Check the effectiveness of actions.</li> <li>5. Repeat odour patrols and increase patrol frequency if necessary.</li> </ol>	<ol style="list-style-type: none"> <li>1. Notify the Authority for events with emissions detected with objectionable odour.</li> <li>2. Rectify any unacceptable practice by Licence Holder.</li> <li>3. Amend working methods if appropriate.</li> <li>4. Report details of the findings to the Authority.</li> </ol>