



**A GUIDANCE NOTE ON THE
BEST PRACTICABLE MEANS**

FOR

CEMENT WORKS

**(MANUFACTURE OF CEMENT
AND ASSOCIATED PROCESSES)**

BPM 3/4 (2013)

Environmental Protection Department
Air Policy Group

May 2013

1. INTRODUCTION

- 1.1 This Note is one of a series issued by the Environmental Protection Department to provide guidance on air pollution management for processes specified under Part IV of the Air Pollution Control Ordinance (the Ordinance). It also serves as a guide for the assessment of an application for Specified Process licence under the Ordinance.
- 1.2 It should be understood that this Note sets out the basic requirements for the applicant to provide and maintain the best practicable means for the prevention of emission of air pollutants. The applicant should recognize that whether a licence is granted or refused, and on what conditions, will depend on all the circumstances of an individual application besides the requirements set out in this Note. The Authority may devise specific requirements for individual facility carrying out the specified process.
- 1.3 This Note covers the specified process and associated processes for the manufacture of cement, described as "Cement Works" in Schedule 1 to the Ordinance, using conventional fuels for clinker and cement production. Cement Works are 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.
- 1.4 Upgrading of control on the existing plants to meet the requirements should, however, be made whenever they can be achieved technically and economically. Discussion would be arranged by the Authority to agree on the details when the need arises.

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 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. FUEL RESTRICTION

- 3.1 All fuels to be used shall comply with the Air Pollution Control (Fuel Restriction) Regulations in force.

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;
- (b) threatening the attainment or maintenance of the relevant air quality objectives;
- (c) giving rise to an objectionable odour noticeable outside the premises where the process is carried out; and
- (d) imposing 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 is the choice. 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.

4.3 Energy sources and fuels with proven benefits to air pollution reduction shall be used whenever possible in the relevant specified process and associated operations.

4.4 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.

4.5 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

4.6 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.

4.7 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 presents opportunities to enhance production and reduce air emissions.

4.8 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.

Dispersion

- 4.9 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.
- 4.10 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.
- 4.11 In any case, 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.

Materials handling

- 4.12 Handling and storage of fuel, raw materials, products, wastes or by-products shall be carried out in such a manner to prevent the release of:
- (a) visible dust emissions;
 - (b) emissions of organic vapours; and/or
 - (c) other noxious or offensive emissions.
- 4.13 The receipt, handling and storage of all materials shall be carried out in such a way to minimize the emission of dust to the air.
- 4.14 Stock of clinker, bulk cement, other cementitious materials, dry pulverised fuel ash, pulverised coal and other pulverised materials shall be stored in silos. Stock of other dusty materials shall be stored in silos or covered storage. Dust-laden air from silos and covered storage shall be vented to suitable equipment to meet the emission limits set out in Section 2 of this Note.
- 4.15 Conveyance of cement, other cementitious materials, dry pulverised fuel ash, pulverised coal and other pulverised materials shall be by ducts or pneumatic pipelines. 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.
- 4.16 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.
- 4.17 Conveyance of clinker and other dusty materials outside buildings shall be by fully covered or totally enclosed systems. Transfer points shall be totally enclosed.
- 4.18 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.
- 4.19 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.

5. OPERATION AND MAINTENANCE

- 5.1 Best Practicable Means 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 need to be specified 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 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 In case of 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, the incident shall be reported to the Authority without delay. Moreover, the relevant facilities shall be closed down as soon as practicable until the problem is resolved and normal operation can be restored.

6. FUGITIVE EMISSION CONTROL

6.1 Boundary ambient standards

- (a) The 24-hour ambient levels of suspended particulates shall not exceed the relevant Hong Kong Air Quality Objectives (AQOs).
- (b) Odour level shall be no more than 2 odour units.

(Note: An odour unit is the measuring unit of odour level and is analogous to pollution concentration. It shall be determined by dynamic olfactometry in accordance with BS EN 13725 or other similar methods acceptable to the Authority. In this context, the odour level is defined as the ratio of the volume which the sample would occupy when diluted with air to the odour threshold, to the volume of the sample. In other words, one odour unit is the concentration of odorant which just induces an odour sensation.)

Engineering design/technical requirements

- 6.2 To be agreed with the Authority. 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:
- (a) visible dust emission; and/or
- (b) other noxious or offensive emissions.
- 6.3 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.
- 6.4 Without prejudice to the generality of the above general requirements, the following control measures shall be implemented:

Vehicles

- (a) all practicable measures shall be taken to prevent or minimize dust emission caused by vehicle movement;
- (b) 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 means of sweeping machines or other facilities;
- (c) 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

- (d) a high standard of housekeeping shall be maintained. 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 in open area shall be prohibited; and
- (e) there shall be no visible emissions from the process buildings.

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, after the date of last entry 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

- (i) 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.
- (ii) Ambient monitoring shall be made for suspended particulates, if required by the Authority, in such a manner and at such locations and frequency specified by the Authority.

On-line monitoring

- 7.3 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

- 7.4 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 filters should be displayed.
- 7.5 The system of continuous emission monitoring including instrument specifications, quality control, operation and maintenance to be implemented by the licensee shall meet the protocols set out in the General Requirements of Continuous Emission Monitoring (CEM) System issued by the Authority.
- 7.6 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 the 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, 101.3 kPa pressure, 10% oxygen and dry gas, unless specified otherwise.

(a) Kiln system for clinker production

(i) Daily Average Value

Air Pollutant	Concentration Limit (mg/m³)
Particulates	20
Nitrogen oxides expressed as nitrogen dioxide (NO ₂)	500
Sulphur dioxide (SO ₂)	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)

Air Pollutant	Concentration Limit (mg/m³)
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 (see Annex II for the calculation of equivalent concentration)	0.1 ng I-TEQ/m ³

- (b) Silo system

Daily Average Value

Air Pollutant	Concentration Limit ^{#Δ} (mg/m ³)
Particulates	10

- (c) Other processes

Daily Average Value

Air Pollutant	Concentration Limit ^{#Δ} (mg/m ³)
Particulates	10

(Note [#] Concentration of air pollutant is expressed at reference conditions of 0°C temperature, 101.3 kPa pressure, without correction for water vapour content. Introduction of diluted air to achieve the emission concentration limit shall not be permitted.

^Δ 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:

		<u>Toxic Equivalence Factor</u>
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