A GUIDANCE NOTE ON THE BEST PRACTICABLE MEANS

FOR

ORGANIC CHEMICAL WORKS

(BATCH MANUFACTURE OF ORGANIC CHEMICALS IN MULTIPURPOSE PLANT)

BPM 25/1

Environmental Protection Department
Air Management Group

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1.0 INTRODUCTION

1.1 This note is issued by the Environmental Protection Department as one of a series to provide guidance for the control of specified processes in Part IV of the Air Pollution Control Ordinance (the Ordinance). It is a guide in the assessment of an application for a licence under the Ordinance.

1.2 It should be understood that this note sets out the minimum requirement for the applicant to provide and maintain the best practicable means for the prevention of the 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, including this note.

1.3 This note covers the batch manufacturing of organic chemicals in a multipurpose plant, which comes within the specified process "Organic Chemical Works" described in Schedule 1 to the Ordinance as:

"Works, not being a chemical process described in any other specified process, of the following kinds in which–

(a) the installed capacity exceeds 100 tonnes per annum (expressed as the total organic chemical products), and in which–

(i) any organic chemicals, including organic intermediate products, pesticides, fertilisers, and specialty chemicals, are manufactured in any organic chemical process; or

(ii) any organic solvent or mixture of solvents is recovered by any thermal process; or

(b) any organic liquids, including liquid fuel, are stored in tanks having an installed capacity exceeding 100 m^3."

2.0 CONTROL OF EMISSION OF AIR POLLUTANTS

2.1 Emission of air pollutants shall be minimised and controlled to prevent:

(a) harm to the environment, or adverse effects to human health;

(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 on; and

(d) imposing undue constraint on the existing and future development or land use.

2.2 Stack or Vent Emission of Air Pollutants

2.2.1 Emissions to the atmosphere should be colourless, free from persisting trailing mist or fume, and free from droplets.

2.2.2 Smoke emission from a combustion process should be less than Ringelmann Shade 1.

2.2.3 Emission from a non-combustion process should not exceed the concentration limits as given in Annex 1.

2.2.4 Dispersion

(a) Chimneys include vents, structures and openings 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 in determining the adequacy of its height.

(b) A chimney should be at least 3 metres above the roof of any building to which it attaches, and the roof of any adjacent or attached buildings.

(c) Releases to air from chimneys should be directed vertically upwards and not restricted or deflected by the use of, for example, plates or caps. This include the use of properly designed flame arresters where they are required for operational safety reasons.

(d) Chimneys should normally be designed for an efflux velocity of not less than 15 m/s at full load condition. If the chimney is coned to obtain the minimum velocity, care is needed to avoid generating excessive positive pressure zones within the chimney unless the chimney wall is impervious or lined. The cones should be well maintained.

(e) Chimney flues and ductwork leading to the chimney should be adequately insulated by materials free of asbestos to minimise the cooling of waste gases and prevent liquid condensation on internal surfaces, and the design should allow for the regular internal cleaning of the chimney flues and ductwork. Where a wet method of arrestment is used to treat process gases, the mean velocity should not exceed 9 m/s within the barrel of the stack with the design of the flue such that the final velocity exceeds 15 m/s.

(f) Wherever practicable, hot releases should take place from the minimum number of vents in order to obtain maximum advantage from thermal buoyancy, and multiplicity of discharge points should be avoided.

(g) Emissions from chimneys should be hot enough to avoid visible plume formation in the vicinity of the chimney. This is to prevent the condensation or absorption of environmentally harmful substances by the condensing water vapour. Exhaust gas from a wet scrubber can be heated by the use of waste process heat to raise the exit temperature of the exhaust gases and prevent immediate condensation on exit from the chimney. This procedure also assists the thermal buoyancy of the plume.

Unless there is no available waste heat and the emission contains no significant environmentally harmful substances, this guideline should be followed for all situations.

2.3 Fugitive Emission of Air Pollutants

2.3.1 All storage tanks should be fitted with level indication, and alarms where appropriate, as an aid to avoiding spillage.

2.3.2 Tanks should be designed to give adequate security against leakage and have facilities for detecting any leaks that do occur.

2.3.3 Good operational practices should be developed to prevent or minimise fugitive emissions from the sources such as those listed below; and capture techniques should be used as far as practicable to collect the fugitive emissions which do occur for treatment:

(a) Losses through open hatchways on reactors and pre-blend tanks which occur during charging and operation,

(b) Losses from evaporation of organic compounds at stations where filters are drained or washed, and

(c) Drum loading stations.

2.3.4 The loading and unloading of transport containers, or transferring material from one vessel to another, should be carried out so as to minimise the emission of pollutants to air. Techniques available include sub-surface filling via filling pipes extended to the bottom of the container, the use of vapour balance lines that transfer the vapour from the container being filled to the one being emptied, or an enclosed system with extraction to suitable treatment plant.

2.3.5 Releases to air from process and cooling water systems and associated treatment plant should be minimised. Techniques include ensuring that initial contamination is minimised by provision of adequate phase separation facilities, that any intermediate stripping is efficient and enclosed drainage to treatment plant is used.

2.3.6 The aim should be to prevent organic and particulate matter emissions to air during plant cleaning, equipment decoking, catalyst regeneration, catalyst discharging and charging operations, and catalyst and sludge disposal. Techniques available include venting and steaming vessels to flare, discharge of vessel contents to enclosed vessels with suitable treatment.

2.3.7 Vent systems should be chosen to minimise breathing releases and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment.

2.3.8 Secondary emissions resulted from the collection and open treatment of wastewater containing volatile organic compounds should be minimised. Consideration should be given to pre-stripping of the wastewater or use of an enclosed treatment method. Vented vapours should be passed to the fuel gas system, treatment plant or flare.

2.4 Pressure Relief and Emergency Vent Emissions

2.4.1 Means for dealing with polluting emissions from pressure relief systems should be provided. Such means normally include phase separation where two phase flow is possible, and may include venting to scrubber systems; to flare; to vent; or to an enclosed dump tank. Procedures should be in place to reduce to a minimum the likely frequency of such emissions. It may be appropriate to have two relief devices in parallel set at different relief pressures. The lower set pressure can allow low emission rates capable of being scrubbed in emergency equipment, whilst the higher set pressure deals with the low probability high flow rate event that cannot be abated and must be released at a sufficient height to promote dispersion and prevent hazardous concentrations at ground level or in buildings and plant structures. Processes must be operated in such a way as to protect the environment as well as persons at work.

2.4.2 All practicable steps should be taken to prevent the occurrence of a runaway reaction. On the basis that in most cases, one reactant is added at a controlled rate to the full charge of the second reactant, important considerations include:

(a) Operating procedures which ensure that the reaction is properly initiated and under control before the main reactant addition stage, which is often on automatic control, commences.

(b) If initiation of the reaction is known to be a problem, impurities in the feed materials should be minimised.

(c) Limitation of the flow of the input reactant such that the heat of reaction evolved cannot exceed the capacity of the reactor cooling system.

2.4.3 Safety relief systems should generally be isolated from routine emission collection systems. In such cases, consideration should be given to the application of appropriate abatement techniques.

2.4.4 For emergency vent emissions which could have a significant environmental impact, total containment relief systems should be considered. This would require a vent receiver which does not discharge directly to atmosphere and is capable of receiving the complete process gaseous, liquid and solid inventory, taking account of all decomposition products, without itself being overpressurised.

2.4.5 Emergency relief systems which deal with pyrophoric materials may require a total containment vent receiver maintained under an inert atmosphere. For less significant pyrophoric emergency emissions it may be acceptable to allow discharge to atmosphere directly so long as:

(a) combustion is contained;

(b) combustion products are vented to a safe location; and

(c) emission of combustion products does not have a significant environmental impact.

3.0 MONITORING REQUIREMENTS

3.1 Parameters and sampling frequency will be determined by the Authority. The aim should be to demonstrate:

(a) the process is properly controlled; and

(b) compliance with the terms and conditions imposed to the licence.

3.2 As a general requirement, indication of the satisfactory of air pollution control equipment should be provided. For example where a wet scrubbing system is used to remove acid gases from the exhaust gas, both the flow of liquor, and its pH or strength should be monitored.

3.3 If it can be demonstrated to the satisfaction of the Authority that the emission of any air pollutant will be minimal, for example due to its absence from the feedstock or demonstrated through sampling, then monitoring and regular measurement may not be required for that pollutant.

3.4 A leak detection and repair/maintenance programme should be implemented to prevent diffuse emissions result from equipment leaks. A leak detection programme might include fixed point ambient air monitoring to determine areas where leaks are occurring or by conducting regular inspections throughout the plant using a portable volatile organic compounds detection device such as a flame ionisation detector, photoionisation detector, or infra-red detector.

4.0 COMMISSIONING

4.1 Commissioning trials, to be witnessed by the Authority or his delegated representative whenever appropriate, should be conducted to demonstrate the performance and capability of the air pollution control measures. A report of the commissioning trial should be submitted to the Authority within 1 month after completion of the trial.

5.0 OPERATION AND MAINTENANCE

5.1 Best practicable means requirements include not only the provision of the appliances, but the proper operation and maintenance of equipment, its supervision when in use, and the training and supervision of properly qualified staff.

5.2 In general, equipment should be repaired as soon as practicable. Specific operation and maintenance requirements may be specified for individual equipment.

5.3 Malfunction, breakdown or failure of any process or air pollution control equipment that may result in abnormal emission of air pollutants should be reported to the Authority within 3 working days after the incident.

ANNEX 1 CONCENTRATION LIMITS FOR A STACK OR VENT EMISSION FROM A NON-COMBUSTION PROCESS

A.1 A stack or vent emission that is from a non-combustion process should not exceed the concentration limits tabulated in the following Table A.1.

Table A.1

Air Pollutant		Concentration Limit (mg/m^3)
Active ingredients in the pesticide and pharmaceutical industries		0.15
Total amines (expressed as dimethylamine)		10
Ammonia		15
Benzene		5
Bromine		10
Cadmium and its compound (expressed as cadmium)		0.1
Carbon disulphide		5
Carbon monoxide		100
Chlorine		10
1,2 Dichloroethane		5
Formaldehyde		5
Hydrogen bromide		5
Hydrogen chloride		10
Hydrogen cyanide		2
Hydrogen fluoride		5
Hydrogen iodide		5
Hydrogen sulphide		5
Iodine		10
Total particulate lead and its compounds (expressed as lead)		4
Total non-particulate lead compounds (expressed as lead)		20
Mercury and its compounds (expressed as mercury)		0.1
Nitrogen oxides (expressed as nitrogen dioxide)		300
Organic sulphides and mercaptans (expressed as methyl mercaptan)		2
Oxides of sulphur (expressed as sulphur dioxide)		300
Particulate matter		20
Total phenols, cresols and xylols (expressed as phenol)		10
Phosgene		1
Trimethylamine		2
Volatile organic compounds (excluding particulate matter)	Total Class A compounds	20
	Total Class B compounds (expressed as toluene)	80

Note: [a] The reference conditions for the concentration limits are: 0°C temperature, 101.325 kPa pressure, no correction for water vapour or oxygen content.

[b] Introduction of dilution air to achieve the concentration limits is not permitted.

[c] An 'active ingredient' is a material in a product, the properties of which are essential for the application for which the product is designed.

[d] Where the term 'expressed as' is used, then a correction should be carried out using the ratio of atomic or molecular weights of the substances as appropriate.

[e] The term 'volatile organic compounds' includes all organic compounds released to air in the gas phase.

[f] The concentration limits on volatile organic compounds apply where the following mass emission limits are exceeded:

Total Class A	100 g/hr;
Total Class B (expressed as toluene)	5 tonnes/year or 2 kg/hr, whichever is the lower.

Emissions below these mass emission limits may still require controls and the setting of appropriate emission limits.

[g] 'Class A compounds' are those organic compounds that may cause significant harm to the environment. They include Montreal Protocol substances and other harmful compounds such as: acetaldehyde, acrylic acid, benzyl chloride, carbon tetrachloride, chlorofluorocarbons, ethyl acrylate, halons, maleic anhydride, 1,1,1, trichloroethane, trichloroethylene, and trichlorotoluene.

[h] 'Class B compounds' are organic compounds of lower environmental impact than Class A compounds. Examples of this class include toluene, acetone and propylene.

[i] For mixed streams where `both Class A and Class B compounds exist, the concentration limit on volatile organic compounds is calculated by summing the product of the classes multiplied by their respective mass fractions.

A.2 The concentration limits for substances not specially listed in Table A.1 should be taken as being the same as substances they are closely equivalent to in terms of their effect on the environment.

A.3 The concentration limits tabulated in Table A.1 is generally not applicable to emissions from open processing plant where pollutants are released in a general air extraction system that is required to ensure employee health and safety. In such cases the total emissions to the environment from the process should be minimised by the application of best practicable means, which may involve enclosing process equipment and segregating emissions to render the pollutants more amenable to control.