

Process Guidance Note  
NIPG 6/36 (Version 2)

# Tobacco Processes

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ENVIRONMENT (NI) ORDER 2002  
POLLUTION PREVENTION AND CONTROL REGULATIONS (NI) 2003  
INDUSTRIAL POLLUTION CONTROL (NI) ORDER 1997  
IPC (PRESCRIBED PROCESSES AND SUBSTANCES) REGULATIONS (1998)

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GUIDANCE FOR PROCESSES PRESCRIBED FOR  
AIR POLLUTION CONTROL  
AND  
AIR POLLUTION PREVENTION AND CONTROL  
BY DISTRICT COUNCILS



Department of the  
**Environment**

[www.doeni.gov.uk](http://www.doeni.gov.uk)

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Environment  
Agency

# Contents

<b>1 Introduction</b> .....	<b>1</b>
<b>2 Timetable for compliance and reviews</b> .....	<b>3</b>
Existing processes or activities .....	3
New processes or activities .....	4
Substantially changed processes or activities .....	4
Permit reviews .....	4
<b>3 Process description</b> .....	<b>5</b>
<b>4 Potential releases</b> .....	<b>8</b>
<b>5 Emission limits, monitoring and other provisions</b> .....	<b>9</b>
<b>6 Control techniques</b> .....	<b>17</b>
Techniques to control emissions from contained sources .....	18
Techniques to control fugitive emissions .....	21
Air quality .....	22
Management .....	22
<b>7 Summary of changes</b> .....	<b>25</b>
<b>8 Definitions and further information</b> .....	<b>27</b>
Health and safety .....	28
EMS additional information .....	28
References .....	29
Web addresses .....	29
<b>Appendix 1: Extract from Pollution Prevention and Control Regulations (NI) 2003</b> .....	<b>30</b>
<b>Appendix 2: Method for sampling of emissions from biological (earth, peat and heather) filters using gas detection tubes</b> .....	<b>33</b>
<b>Appendix 3: Guidance on the Preparation of an Odour Response Procedure</b> .....	<b>34</b>
<b>Appendix 4: Guidance on the Application of BS EN 13725 (Dilution Olfactometry) to the Assessment of Odours from Tobacco Processing</b> .....	<b>36</b>

## List of Tables

<b>Table 1:</b> Compliance timetable .....	<b>3</b>
<b>Table 2:</b> Emission limits, monitoring and other provisions .....	<b>9</b>
<b>Table 3:</b> Summary of control techniques .....	<b>17</b>
<b>Table 4:</b> Summary of changes .....	<b>25</b>
<b>Table 5:</b> Examples of issues to consider relating to odour release .....	<b>35</b>

# List of Figures

Figure 3.1: A typical tobacco process .....7

# 1 Introduction

- 1.1 This Note is issued by the Department of the Environment to give guidance on the conditions appropriate for the control of emissions into the air from tobacco processes/installations.<sup>1</sup> It supersedes guidance note NIPG 6/36 Version 1 that issued in March 1998.
- 1.2 This is one of a series of notes giving guidance on Best Available Techniques (BAT) and Best Available Techniques Not Entailing Excessive Cost (BATNEEC)<sup>2</sup>. The notes are all aimed at providing a strong framework for consistent and transparent regulation of installations.
- 1.3 This note is for use under both Local Air Pollution Control (LAPC) established by the Industrial Pollution Control (NI) Order 1997, and Local Air Pollution Prevention and Control (LAPPC) established by the Environment (NI) Order 2002<sup>3</sup>. It constitutes statutory guidance to regulators under regulation 38 of The Pollution Prevention and Control Regulations (NI) 2003. To the extent it provides guidance on techniques, it also constitutes statutory guidance to regulators under section 7(11) of the 1997 Order, and in any event regulators are expected to have regard to it. The note will be treated as one of the material considerations when determining any appeals against a decision under either the 1997 or 2002 Order.
- 1.4 The note also (where appropriate) gives details of any mandatory requirements affecting air emissions which are in force at the time of publication, such as those contained in Directions from the Department.
- 1.5 All processes are subject to BAT/ BATNEEC. In general terms, what is BAT/ BATNEEC for one process in a sector is likely to be BAT/ BATNEEC for a comparable process; but in each case it is, in practice, for regulators (subject to appeal) to decide what is BAT/ BATNEEC for the individual process and the regulator should take into account variable factors (such as configuration, size and other individual characteristics of the process) and the locality (such as proximity of particularly sensitive receptors<sup>4</sup>). Ultimately, therefore, what constitutes BAT/ BATNEEC is site specific but this guidance note comprises guidance for the generality of processes in the sector and careful regard should be had to it, in order to maximise consistency of permits as appropriate.

## Site specific BAT/ BATNEEC

## Who is affected

- 1.6 This guidance is for:
  - regulators: who must have regard to the guidance when determining applications and reviewing extant authorisations and permits
  - operators: who are best advised also to have regard to it when making applications, and in the subsequent operation of their process
  - members of the public: who may be interested to know what the Government considers (in accordance with the legislation) amounts to appropriate conditions for controlling air emissions for the generality of processes in this particular industry sector

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1. the term “process(es)” is used in the remainder of the note to mean both “processes” under the Industrial Pollution Control (NI) Order and “installations” and “activities” under the Environment (NI) Order 2002
2. BATNEEC is the formulation used in the Industrial Pollution Control (NI) Order and BAT is used in the Environment (NI) Order 2002. For the purposes of this guidance note, the two concepts are regarded as having essentially the same effect.
3. In accordance with Part 2 of Schedule 3 to the PPC (NI) Regulations, SR 2003/46: tobacco manufacturing processes transfer from regulation under the 1997 Order to the 2002 Order from 1 April 2006.
4. Guidance on the relationship between BAT/BATNEEC and air quality objectives is contained in the General Guidance Manual on policy and procedures for Part C installations.

- 1.7 The guidance is based on the state of knowledge and understanding at the time of writing of:
- tobacco processes
  - their potential impact on the environment and
  - what constitutes BAT/ BATNEEC for preventing and reducing air emissions
- 1.8 The note may be amended from time to time in order to keep abreast with developments in BAT including improvements in techniques and new understanding of environmental impacts and risks. Such changes may be issued in a complete revision of this document, or in separate additional guidance notes which address specific issues. (It may not always be possible to issue amending guidance quickly enough to keep in absolute step with rapid changes, which is another circumstance where paragraph 1.5 above might apply.)
- 1.9 Steps will be taken to ensure that those who need to know about changes are informed. Operators (and their advisers) are, however, strongly advised to check with the regulator whether there have been any changes before relying on this note for the purposes of making an application under the 1997 or 2002 Orders or making any other decisions where BAT/ BATNEEC may be a consideration.

**Consultation**

- 1.10 This note has been produced in consultation with relevant trade bodies and representatives of regulators including members of the Industrial Pollution Liaison Committee and the NI Industrial Pollution Liaison Group

**Publication**

- 1.11 This and other published guidance in this series are available, free of charge, via the Department at [www.doeni.gov.uk/epd](http://www.doeni.gov.uk/epd).
- 1.12 General guidance explaining policy and setting out LA-PPC policy and procedures is contained in the Department's "General Guidance Manual on Policy and Procedures for Part C Installations" available from [www.doeni.gov.uk/epd](http://www.doeni.gov.uk/epd) and referred to in this document as the "General Guidance Manual". This is designed for operators and members of the public as well as district council regulators
- 1.13 In addition to the General Guidance Manual referred to above, explanation or clarification of certain terms used in this sector guidance note can be found in a general guidance note issued under the Industrial Pollution Control (NI) Order 1997: "Interpretation of terms used in process guidance notes" that issued in March 1998 (NIGG4). Where there is any conflict between NIGG4 and the guidance issued in this note or in the General Guidance Manual, the latter two documents should prevail, as should any subsequent guidance issued in relation to LAPPC.

## 2 Timetable for compliance and reviews

### Existing processes or activities

2.1 The previous guidance advised that upgrading to that standard should usually have been completed by 1 January 2003. Requirements still outstanding from any existing upgrading programme should be completed.

### Upgrading for this note

2.2 The new provisions of this note and the dates by which compliance with these provisions is expected are listed in the table below, together with the paragraph number where the provision is to be found. Compliance with the new provisions should normally be achieved by the dates shown. Authorisations/permits should be varied as necessary, having regard to the changes and the timetable.

**Table 1: Compliance timetable**

Provision	Relevant Paragraph / Row in this note	Compliance Date
Daily inspection of odour arrestment and air handling plant.	<b>5.7</b>	Within 3 months of the publication of this note.
Provision for an Odour Response Procedure.	<b>6.18</b>	Within 3 months of the publication of this note.
Inclusion of provisions to limit the sulphur content of fuel where a thermal system is used for odour arrestment.	<b>Table 2</b> , Rows 3 and 4	Within 6 months of the publication of this note.
Testing of odour arrestment efficiency and inclusion of BS EN method.	<b>5.15</b>	Within 12 months of the publication of this note.
Where fitted testing of VOC arrestment efficiency and inclusion of EN method.	<b>5.15</b>	Within 12 months of the publication of this note.
Emission limit for particulate matter reduced to 20 mg/m <sup>3</sup> .	<b>Table 2</b> , Row 6	Within 12 months of the publication of this note.
Fitting of mist eliminators to scrubbing equipment, where required.	<b>6.13</b>	Within 12 months of the publication of this note.
Inclusion of a standard for odour arrestment efficiency.	<b>Table 2</b> , Row 2	Within 12 months of the publication of this note. *
Where fitted, inclusion of continuous monitoring for odour arrestment plant.	<b>5.10</b>	Within 12 months of the publication of this note.
Inclusion of continuous monitoring provisions for VOC recovery plant.	<b>5.12</b>	Within 12 months of the publication of this note.
Any other provisions.	-	To be complied with as soon as practicable, which in most cases should be within 12 months of the publication of this note.
* In the case of existing processes where odour arrestment equipment has been installed to meet the requirements of the previous guidance notes, the regulator should consider establishing a date for full compliance allowing for the use of the existing equipment until the end of its reasonable operational life provided that emissions from the equipment do not result in offensive odours beyond the process boundary.		

2.3 Replacement plant should normally be designed to meet the appropriate standards specified for new installations or activities.

### Relaxation of conditions

2.4 Where provisions in the preceding guidance note have been deleted or relaxed, authorisations should be varied as necessary as soon as reasonably practicable. **Section 7** provides a summary of all changes.

### New processes or activities

- 2.5 For new processes or activities, the authorisation/permit should have regard to the full standards of this guidance from the first day of operation.

### **Substantially changed processes or activities**

- 2.6 For substantially changed processes or activities, the authorisation/permit should normally have regard to the full standards of this guidance with respect to the parts of the process that have been substantially changed and any part of the process affected by the change, from the first day of operation.

### **Permit reviews**

#### **Reviewing permits**

- 2.7 Under LAPC the requirement is to review conditions in authorisations at least every four years. (Article 6(6) Industrial Pollution Control (NI) Order 1997)
- 2.8 Under LAPPC the legislation requires permits to be reviewed periodically but does not specify a frequency. It is considered for this sector that a frequency of once every six years ought normally to be sufficient for the purposes of Regulation 15(1) of Pollution Prevention and Control Regulations (NI) 2003.

More frequent review may be necessary in individual cases for the reasons given in Regulation 15(2). Further guidance on permit reviews is contained in the General Guidance Manual available on [www.doeni.gov.uk/epd](http://www.doeni.gov.uk/epd). Regulators should use any opportunities to determine the variations to authorisations/permits necessitated by paragraph 2.2 above in conjunction with these reviews.

- 2.9 Under both LAPC and LAPPC, conditions should be reviewed where complaint is attributable to the operation of the process and is, in the opinion of the regulator, justified.

### 3 Process description

#### Regulations

- 3.1 Tobacco processes are prescribed for:
- **Local air pollution control, LAPC**, under section 6.9 of Schedule 1 to the IPC (Prescribed Processes and Substances) Regulations 1998, SR 28
  - **Local pollution prevention and control, LAPPC**, under section 6.8 of Schedule 1 of the Pollution Prevention and Control Regulations (NI) 2003 SR 46

In the event that any of the following definitions apply, such processes are prescribed for Chief Inspector integrated pollution prevention and control, IPPC, in accordance with the Pollution Prevention and Control Regulations (NI) 2003:

Processes which may result in the release into water of any substance listed in paragraph 13 of Part 2 of Schedule 1 of the Pollution Prevention and Control Regulations (NI) 2003 in a quantity which, in any period of 12 months, is greater than the background quantity by more than the amount specified in relation to the substance in that paragraph.

- 3.2 Regulation 9 (1) requires that no person should operate an installation after the prescribed date except under and to the extent authorised by a permit granted by the regulator. The date for section 6.8 Part C processes in Northern Ireland is 1st April 2006. (See Schedule 3 Part 2 paragraph 9 (3) regarding applications being deemed to have been made for existing Part C processes).
- 3.3 In respect of the interface with Part A, it is not envisaged that any tobacco processing would fall under IPPC control by virtue of the definition in Section 6.8 Part (A) (f) (that is involve the release of a substance in paragraph 13 of Part 2 of Schedule 1 of the Regulations to water).
- 3.4 This note addresses processes in which tobacco leaf (lamina) and stem is prepared for use in the manufacture for sale of cigarettes, cigars, pipe tobacco, hand rolling tobacco, other smoking materials and snuff.

#### Process or activity

- 3.5 In the context of this note, "process" or "activity" comprises the whole process from receipt of raw materials via production of intermediates to dispatch of finished products, including the treating, handling and storage of all materials and wastes relating to the process.
- 3.6 Whilst there are commercial variations in tobacco processes, particularly in respect of the different products such as cigarettes, cigars, pipe tobacco, hand rolling tobacco, other smoking materials and snuff, the basic process steps are summarised below and shown in Figure 1. Some products do not require all of the processing steps identified.
- 3.7 The process can be divided into two distinct phases:-
- Primary processing where tobacco leaf (lamina) and stem is prepared to the stage at which it is ready for inclusion in the finished cigarette or cigar, or for packing for sale as pipe tobacco, snuff or hand rolling tobacco
  - Secondary processing includes forming the cigarettes or cigars and packing.

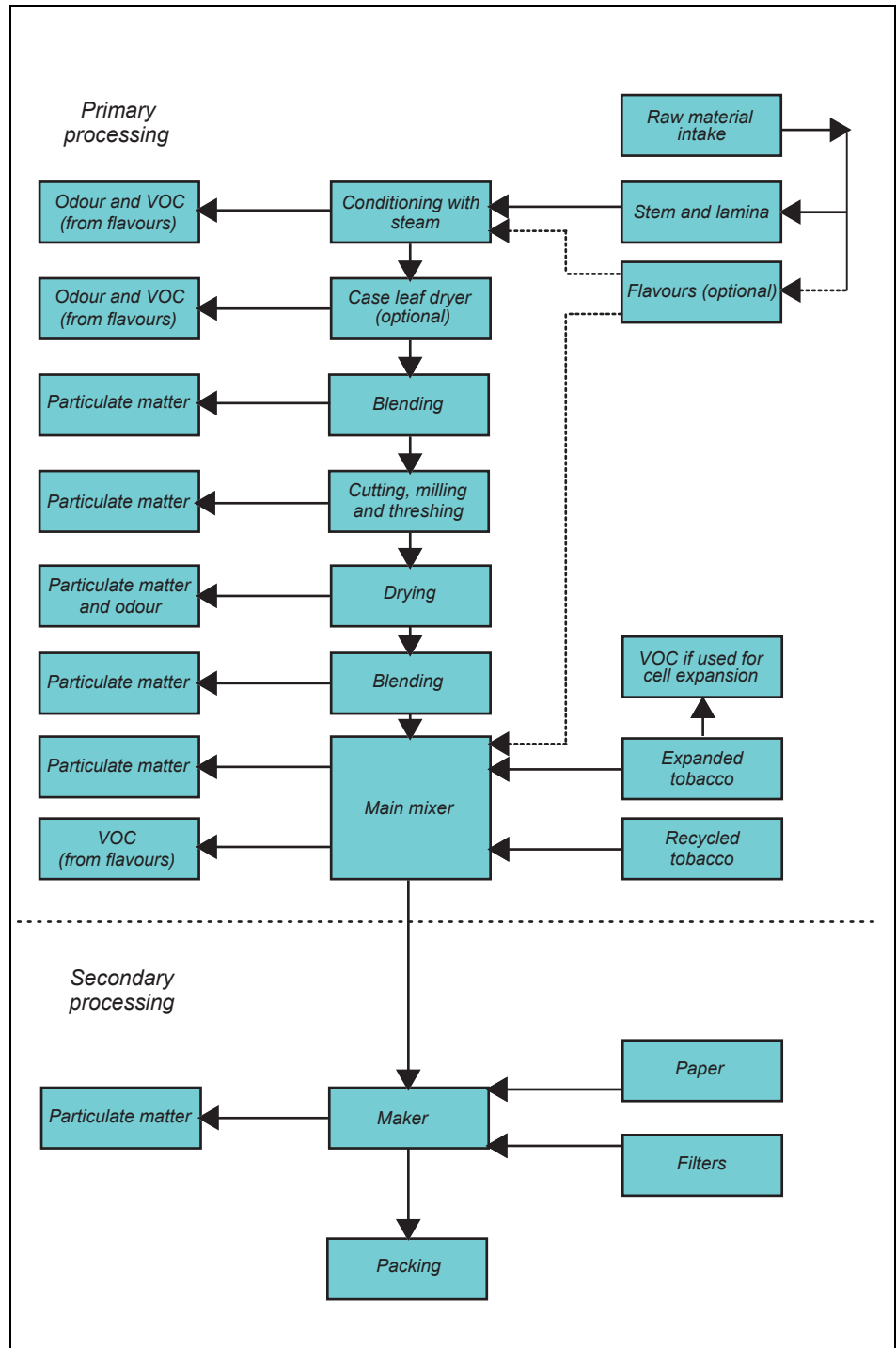
Some factories at which smoking and other tobacco materials are produced undertake both primary and secondary processing. Others undertake either one or the other alone, either sending the tobacco which has been subjected to primary processing elsewhere for secondary processing, or receiving primary processed tobacco from elsewhere for secondary processing.

- 3.8 It is unlikely that factories undertaking only secondary processing will have any noticeable environmental impact due to air emissions: the potential for dust emissions tends to be minor and emissions of odorous gases and vapours are normally negligible. Regulators may consider that where secondary processing alone is undertaken, the potential for emissions to air of prescribed substances or

odour would be trivial and hence would not require a permit or authorisation. However, this would not preclude the inclusion of conditions relating to dust emissions from secondary processing in an authorisation for a process where primary and secondary processing are both undertaken at the same processing site.

- 3.9 The preliminary processing of tobacco involves curing the leaf (either by air, heat or sunlight) followed by threshing to separate the lamina and the stem. This process is carried in the country of origin and hence has not been considered further. In the case of tobacco for cigar manufacture the hard leaves are not threshed before primary processing.
- 3.10 The tobacco is first subject to a conditioning process using steam to ensure that the tobacco is sufficiently pliable to allow the subsequent processing steps to be completed without damage to the material. In some circumstances additional materials may be added at this stage for flavouring the tobacco. If flavourings are added at this point (called casings) they are subject to a subsequent flash drying operation to ensure that the casing is incorporated within the tobacco but avoiding too much drying of the tobacco.
- 3.11 The conditioned tobacco is then blended to ensure a uniform quality before it is shredded by high-speed rotary knives to the desired thickness. The shredded tobacco (rag) is then subject to hot air drying and cooling before final mixing. The mixing process may include the addition of flavours, recycled tobacco from in-line wastage and dust handling equipment and possibly tobacco which has been subject to a cell expansion process to make the texture less dense.
- 3.12 The cell expansion operation may be undertaken at the manufacturing site or material may be processed elsewhere. The process involves expanding the cells in the tobacco by the use of a substance (for example carbon dioxide or VOCs) which can change state by pressure or temperature variation.
- 3.13 The subsequent process operations are the secondary processing steps. These include forming the cigar or cigarette which is undertaken mechanically. In the case of cigarettes the tobacco is wrapped within a paper and a filter is added. In cigar making the binder and wrapper may be formed from tobacco leaf. The secondary process also involves recovery of tobacco which has become an in-line waste during the process operations due to spillage, collection in dust control systems and damaged or unsatisfactory finished product.
- 3.14 In the case of other tobacco products, the secondary process is largely a packaging operation.

Figure 3.1: A typical tobacco process



## 4 Potential releases

### Pollutants and sources

- 4.1 The key emissions from these processes that constitute pollution for the purposes of the Industrial Pollution Control (NI) Order 1997 or the Pollution Prevention and Control Regulations 2003 and therefore warrant control are **particulate matter, VOCs** and those which may lead to **offensive odour** beyond the process boundary. The odorous emissions are a complex cocktail of chemical species.
- 4.2 Contained emissions of particulate matter are largely associated with emissions from the blending, milling and threshing, cutting, drying, material transfer and mixing operations in primary processing and from the maker, material transfer and in-line tobacco recycling operations in secondary processing. There is the potential for fugitive emissions of particulate matter which may arise from transfer of potentially dusty materials including discharge into hoppers and onto conveyors, and delivery to silos and equipment. Also material collected by bag filters may become re-entrained if it is not securely contained and carefully handled.
- 4.3 The emissions of VOCs may arise from two distinct operations. During primary processing, flavours may be added to the tobacco which are either themselves VOCs or which use VOCs as a carrier, diluent or solvent. These flavours are added in enclosed equipment and hence containment is relatively straightforward (some flavours may be added during the secondary processing operations but the potential releases are trivial). VOCs may also be used for cell expansion operations in a totally enclosed system and the VOC is recovered for re-use in the process.
- 4.4 The potential emission sources for odours are:
  - from the application of flavours
  - from the conditioning of the tobacco with steam
  - from the application of heat during drying and also potentially from cooling processes
  - from the storage and discharge of liquid waste and effluent from the odour arrestment equipment
  - from the odour arrestment equipment discharge (this may be a stack or vent or may be a biofilter with an area source at ground level)
  - fugitive emissions from building and process air due to lack of containment.
- 4.5 Where the odour arrestment equipment comprises a scrubber, emissions of materials which are added to the scrubber for improved performance (such as acids, hypochlorite, sodium hydroxide etc.) may be released with the plume if the scrubber and mist eliminator are not properly managed.
- 4.6 Where a thermal oxidiser or other combustion plant is used for the arrestment of odours, the emissions will be characteristic of the combustion releases from the fuel. These will include:-
  - sulphur dioxide from the burner, influenced by the sulphur content of the fuel.
  - oxides of nitrogen from the combustion equipment. The emission depends on the nitrogen content of the fuel, the amount of excess air, the flame temperature and the burner type.
  - carbon monoxide, which may be emitted if the combustion process is badly managed.
  - metals, volatile organic compounds, chlorides and fluorides may also be emitted where waste or recovered oil is used in the combustion equipment.

## 5 Emission limits, monitoring and other provisions

### Emission standard for odour

- 5.1 Subject to paragraph 5.2, it should be the aim that any location at or beyond the site boundary is free from offensive odour as perceived by the regulator. This shall be achieved by applying the process controls, management controls and arrestment provisions of this note.
- 5.2 The locality of a process site will influence the assessment of the potential for odour impact. In cases where the site has a low odour impact due to its remoteness from sensitive receptors and the escape of offensive odour beyond the site boundary would be unlikely to cause harm, the provision in this note to arrest odorous emissions may not be necessary to demonstrate BAT. In these circumstances it is expected that the operations should be optimised to minimise odour emissions and also that effective process management is applied (as outlined in paragraphs 6.14 to 6.18). Assessment of the potential for odour impact beyond the site boundary should take account of all predicted wind directions and weather conditions which are typical of the location in question.

Table 2: Emission limits, monitoring and other provisions

Row	Odour	Emission limit / provision	Type of monitoring	Monitoring frequency (subject to paragraph 5.18)
1	Odour emissions from contained and fugitive sources.	Aim that any location at or beyond the site boundary is free from offensive odour (subject to the provisions of paragraph 5.2).	Determination by process assessment (see paragraph 5.7)	Daily
2	Contained process releases.	Where installed, any odour arrestment equipment should have an odour removal efficiency of not less than 90%† subject to paragraph 5.4.	Determination by manual extractive sampling and analysis by dynamic olfactometry in accordance with BS EN13725.	On installation of new/replacement odour arrestment equipment and/or in the circumstances described in paragraph 5.15

† Where the inlet odour concentrations are very low and the 90% destruction efficiency is difficult to demonstrate due to measurement reproducibility and equipment efficiency at low concentrations, the final discharge to air should contain less than 500 odour units/m<sup>3</sup>.

Row	Sulphur dioxide	Maximum concentration of sulphur in fuel	Type of monitoring	Monitoring frequency (subject to paragraph 5.18)
3	All processes where oil-fired thermal oxidisers or combustion plant are used for odour control.	1% wt/wt	Statement of compliance	See paragraph 5.16
4	All processes where oil-fired thermal oxidisers or combustion plant are used for odour control and the fuel used is gas oil as defined in the Sulphur Content of Liquid Fuels Regulations (NI) 2002	0.2% wt/wt (before 1/01/2008) 0.1% wt/wt (from 1/01/2008)		

Row	Particulate matter	Emission limits / provisions	Type of monitoring	Monitoring frequency (subject to paragraph 5.18)
5	Emissions from drying and conditioning processes where emissions are vented to cyclones and the flow exceeds 100m <sup>3</sup> /min (except where the final discharge of the arrestment equipment is within buildings)	50mg/m <sup>3</sup> .	Indicative monitoring plus annual extractive monitoring in accordance with the main procedural requirements of BS EN 13284-1:2002	Continuous
6	Emissions from contained process sources (other than those covered by Row 5 above) where the flow exceeds 100m <sup>3</sup> /min (except where the final discharge of the arrestment equipment is within buildings)	20mg/m <sup>3</sup> .		

Row	VOCs	Emission limits / provisions (see also 5.12 and 6.8)	Type of monitoring	Monitoring frequency (subject to paragraph 5.18)
7	Emissions from cell expansion involving the use of VOCs.	The operator should record the solvent recovery efficiency of the cell expansion process, (see paragraph 6.8). Where the process is batch, a recovery efficiency of at least 95% should be achieved, for other process types the recovery efficiency should be at least 85%.		The recovery efficiencies given in Column 3 represent the average rolling efficiency based on one years operation.

### Existing odour arrestment equipment

- 5.3 In the case of existing processes where odour arrestment equipment has been installed to meet the requirements of the previous guidance notes, the regulator should consider permitting the use of the existing equipment until the end of its reasonable operational life provided that emissions from the equipment meet the provisions of paragraph 5.1. The regulator should still require that the available equipment is optimised for odour removal and should establish an odour arrestment efficiency based upon operating data. Where emissions from the odour arrestment equipment do not meet the provisions of paragraph 5.1, the equipment should be required to be upgraded to the specified efficiency in Table 2.
- ▶ In determining the 'reasonable operational life' of odour arrestment equipment, the operator would be expected to continue to maintain and repair the equipment to prolong its operational life. The regulator should consider the physical condition of the arrestment equipment (potential for leaks, unavailability of spares, increased

frequency of malfunction or failure) and the odour arrestment efficiency (the arrestment plant no longer capable of achieving the interim odour arrestment efficiency determined as above) as key indicators of plant reaching the end of its operational life.

### **New / replacement odour arrestment equipment**

- 5.4 It may be the case that operators can demonstrate that lower odour removal efficiencies than those in [Table 2](#) will meet the provisions of paragraph [5.1](#).
- ▶ Where it can be demonstrated that the provisions of paragraph [5.1](#) are being met new/replacement plant may be operated at odour removal efficiencies lower than the 90 % in [Table 2](#). To provide such demonstration, operators should determine using dispersion modelling or alternative appropriate techniques, what percentage efficiencies are required to meet the provisions of paragraph [5.1](#).

### **Monitoring, investigations and recording**

- 5.5 The need for and scope of testing, and the frequency and time of sampling depend on local circumstances, operational practice and the scale of operation. As part of proper supervision the operator will monitor emissions, make tests and inspections of the process and keep records, in particular:
- ▶ The operator should keep records of inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. The records should be:
    - kept on site
    - kept by the operator for at least two years; and
    - made available for the regulator to examine
  - ▶ Monitoring of emissions should be carried out according to the method specified in this section or by an equivalent method agreed by the regulator.
  - ▶ The reference conditions for limits in [Table 2](#) are 273K, 101.3 kPa, without correction for water vapour content.

### **Information required by the regulator**

- 5.6 The regulator needs to be informed of monitoring to be carried out and the results; the results should include process conditions at the time of monitoring.
- ▶ A summary of the data identifying the times, dates and duration of alarm events from indicative continuous monitoring of the performance of the particulate matter control system, VOC arrestment system and of the odour arrestment system in accordance with paragraphs [5.10](#), [5.11](#) and [5.12](#) should be submitted to the regulator at least every 6 months.
  - ▶ The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used.
  - ▶ The results of non-continuous emission testing should be forwarded to the regulator within 8 weeks of the completion of the sampling.
  - ▶ Adverse results from **any** monitoring activity (both continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained/received. The operator should:
    - identify the cause and take corrective action
    - record as much detail as possible regarding the cause and extent of the problem, and the action taken by the operator to rectify the situation
    - re-test to demonstrate compliance as soon as possible; and
    - notify the regulator

### Odorous emissions - monitoring installation performance

- ▶ The operator should hold either on site or available for inspection if required, a list of key arrestment plant and should have a written procedure for dealing with its failure, in order to minimise any adverse effects. (see paragraph 6.18)

5.7 The operator should monitor the performance of the installation to ensure that emissions that may result in a breach of the provisions of paragraph 5.1 are prevented or minimised. This assessment should include inspections of the process, buildings and equipment to check that emissions are being contained and treated to meet the standards of this note.

- ▶ In addition to the continuous indicative monitoring outlined in paragraph 5.10, where it is needed any odour arrestment equipment should be inspected at least once a day to verify correct operation and to identify any malfunctions. Depending upon the type of any arrestment plant used this inspection should include:
  - inspection of accessible air handling equipment and ductwork for leaks.
  - where a key component of the odour arrestment plant cannot be adequately accessed for inspection then arrangements to enable this should be made.
  - in the case of scrubbing equipment, thermal oxidisers and other combustion equipment, the inspection should include verification of the operation of the continuous monitoring equipment, any blockages and also identification of any leaks of either odorous air or liquid.
  - in the case of biofilters, the surface should be inspected to identify any cracking of the surface or voids in the bed, leaks around the edge of the filter or air handling equipment, review of the moisture content (considering both flooding and drying out) and looking for signs of compaction or uneven flow.
  - in the specific case of soil biofilters, the growth of plants and weeds should be inspected as any excessive flow or odour escape is often indicated by scorching of the earth or plant growth dying off.

### Indicative tests for odour arrestment plant

5.8 If offensive odours are detected beyond the process boundary or complaints are received but there is no obvious cause of odour release it may be necessary to check odour arrestment plant performance where it is being used. Depending upon the type of arrestment plant used, the following are examples of suitable indicative testing:

- ▶ In the case of thermal oxidisers or combustion equipment, the combustion efficiency is a good indication of performance. Emissions tested, in accordance with the first bullet of paragraph 5.10 below, should normally be below  $100\text{mg}/\text{m}^3$ , expressed as a 30 minute mean at 273K and 101.3kPa. If emissions exceed this indicative guide value it is likely that the odour destruction efficiency of the thermal oxidiser is reduced and it should be further investigated to identify reasons for the reduced performance.

### Continuous monitoring - general

5.9 Whilst there are no reliable continuous emission monitoring options for odours, where thermal oxidation or combustion equipment is used for odour control, continuous monitoring of carbon monoxide is an option (see paragraph 5.10). Where continuous monitoring (as described in 5.10, 5.11 and 5.12) is required it should be carried out as follows:

- ▶ The activation of alarms should be automatically recorded.
- ▶ All continuous monitors should be operated, maintained and calibrated (or referenced) in accordance with the manufacturers' instructions, which should be made available for inspection by the regulator. The relevant maintenance and calibration (or referencing) should be recorded
- ▶ All continuous monitoring readings should be on display to appropriately trained staff.
- ▶ Instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of arrestment plant failure or malfunction.

### Continuous monitoring - odour arrestment plant

- ▶ Purchasers of new or replacement monitoring equipment should specify the requirement for less than 5% downtime over any 3-month period, on ordering.

5.10 Where odour arrestment plant is used, continuous monitoring is required, depending upon the type of plant used, as follows:

- ▶ In the case of thermal oxidisers or combustion equipment, emissions should be continuously monitored and continuously recorded for carbon monoxide, or the operating temperature may be used as a surrogate measurement. The monitor should be fitted with an audible and visual alarm to activate if the operating temperature falls below 1123K (850°C) or if the carbon monoxide level exceeds the indicative guide in paragraph 5.8.
- ▶ In the case of scrubbing equipment, pH or Redox of the liquor and liquor flow should be continuously monitored. All liquid scrubbers should be fitted with an audible and visual alarm to activate if the liquor circulation fails or if the pH or Redox falls outside the operating range established during commissioning testing.
- ▶ If a bioscrubber is used, in addition to flow and pH or Redox monitoring, the pressure drop across the scrubber packing should be continuously monitored. The monitor should be fitted with an audible and visual alarm to activate if the pressure drop falls outside the operating range established during commissioning testing.
- ▶ If a biofilter is used the pressure drop across the biofilter should be continuously monitored. This can be achieved by measuring the delivery pressure on the main fan. The monitor should be fitted with an audible and visual alarm to activate if the pressure drop falls outside the operating range established during commissioning testing. If the process has more than one fan for different process areas and these fans are not operated when the areas are not in use (for example during the winter period when production levels are low) the value used for alarming may need to be variable depending upon the volume of air being treated and process conditions. In this case, where the alarm level is varied, the set point of the alarm should be recorded.
- ▶ The operating levels of the pH, Redox and pressure drop where monitored should be recorded daily.
- ▶ The cooling liquid flow of all direct or indirect condensers used for pre-treatment of emissions (including spray tower scrubbers) should be continuously monitored.

### Continuous monitoring - particulate arrestment plant

5.11 Continuous indicative monitoring can be used as a management tool. In conjunction with continuous recording it identifies any trends in emissions; for example, that emissions are gradually increasing, which may indicate a need for maintenance. It can also be used with or without continuous recording to trigger an alarm when there is a sudden increase in emissions; for example if arrestment plant fails. For a given concentration of particulate, the output level varies with the instrument. It should be noted that not all monitors provide a linear response to an increase in particulate matter. The monitor should be set up to provide a baseline output when the plant is known to be operating under the best possible conditions; i.e. such that emissions are fully compliant with the authorisation/permit. The instrument manufacturer should be able to set an output level which corresponds to around 75% of the emission limit, to trigger alarms. Thus the alarms are activated in response to this significant increase in particulate loading above the baseline, so that warning of the changed state is given before an unacceptable emission occurs. The regulator may wish to agree the alarm trigger level.

- ▶ Emissions from particulate arrestment plant (except where the final discharge of the arrestment plant is within buildings) where the exhaust airflow exceeds 100 m<sup>3</sup>/min should be continuously indicatively monitored for particulate matter. (By continuous indicative monitoring is meant monitoring to indicate the relative performance and/or process variation. Such monitoring does not provide data to demonstrate compliance with a numerical emission limit.)

### Continuous monitoring - VOC arrestment plant

- 5.12 Where cell expansion operations are carried out using VOC's, then the cooling liquid flow of all direct and indirect condensers used for solvent recovery should be continuously monitored.

### Visible emissions

- 5.13 Visible emissions should be limited and monitored as follows. Abnormal emissions require action as described in paragraph 5.14.
- ▶ Emissions from combustion processes used for arrestment of odour should be free from visible smoke.
  - ▶ All releases to air, other than condensed water vapour, should be free from persistent visible emissions.
  - ▶ All emissions to air should be free from droplets.

### Abnormal events

- 5.14 The regulator needs to be notified about certain events, whether or not there is related monitoring showing an adverse result, and the operator should respond to problems which may have an adverse effect on emissions to air.
- ▶ In the case of abnormal emissions, malfunction or breakdown leading to abnormal emissions the operator should:
    - investigate and undertake remedial action **immediately**
    - adjust the process or activity to minimise those emissions; and
    - promptly record the events and actions taken
  - ▶ The regulator should be informed without delay if there is an emission that is likely to have an effect on the local community.
  - ▶ It is recommended that a simple wind indicator be used to identify likely emission paths and areas of potential odour impact should normal emissions occur.

### Calibration and compliance monitoring

- 5.15 Calibration and compliance monitoring should meet the following provisions as appropriate depending upon the type of arrestment plant used:
- ▶ Testing of odour arrestment plant in accordance with **Table 2**, Row 2, should be carried out when the process is in normal operation.
  - ▶ Odour testing should take place on commissioning of new/replacement plant to demonstrate compliance with the requirements of **Table 2**, row 2. In addition, it may be necessary to carry out monitoring of emissions of odour at other times where the process is subject to justified complaint of offensive odour and the investigations carried out in accordance with paragraph 5.7, 5.8 and 5.10 cannot identify a cause for the odour.
  - ▶ No monitoring result should exceed the emission concentration limits specified in **Table 2**.
  - ▶ The destruction efficiency of any odour arrestment plant required to meet the provisions in **Table 2** should be tested in accordance with the main procedural requirements of BS.EN13725:2003. This testing should be carried out by dynamic olfactometry based upon manual extractive sampling undertaken simultaneously at the inlet and outlet of the odour arrestment plant. At least three samples should be taken from both the inlet and outlet. Where the odour arrestment plant comprises an open top biofilter, the guidance in Appendix 2 should assist in developing a sampling protocol.

- ▶ Non-continuous emissions monitoring of particulate should be carried out once a year according to the main procedural requirements of BS EN 13284-1:2002, with averages taken over operating periods excluding start-up and shutdown. Sampling equipment should be capable of collecting particulate matter of 0.1 microns diameter or less, with an efficiency of at least 75%. This provision is not necessary where the final discharge of the arrestment plant is within buildings or the volume of discharged air is less than 100m<sup>3</sup>/min or where emissions do not exceed the relevant emission limit in Rows 5 and 6 of **Table 2** without the use of arrestment plant.

5.16 Where oil-fired thermal oxidisers or combustion equipment is used for arrestment of odours, every delivery of liquid fuel should be confirmed by the fuel suppliers as being compliant with the Sulphur Contents of Liquid Fuels Regulations (NI) 2002, as required by **Table 2**. This confirmation should be available for audit. Where it is intended to use waste or recovered oil reference should be made to the Defra/WAG guidance on the Waste Incineration Directive in relation to any such use.

5.17 Exhaust flow rates should be consistent with efficient capture of emissions, good operating practice and meeting the requirements of the legislation relating to the workplace environment.

- ▶ The introduction of dilution air solely to achieve emission concentration limits prior to discharge should not be permitted.

### Varying monitoring frequency

5.18 Where non-continuous quantitative monitoring is required, the frequency may be varied. Where there is consistent compliance with emission limits, regulators may consider reducing the frequency. When determining "consistent compliance" factors to consider include:

- (a) the number of arrestment plant continuous indicative monitor alarms.
- (b) the number and frequency of complaints regarding offensive odour.
- (c) how the indicative surrogate performance monitoring of the odour arrestment plant reflects actual equipment performance, for example, the operating temperature and carbon monoxide emissions of a thermal oxidiser or combustion equipment are a good surrogate indicator compared to the pressure drop across a biofilter which is a less reliable surrogate indicator.
- (d) the variability of monitoring results, for example, results which range from 20 - 45 mg/m<sup>3</sup>, against an emission limit of 50 mg/m<sup>3</sup> might not qualify for a reduction in monitoring
- (e) the margin between the results and the emission limit, for example, results which range from 88 - 90% destruction when the limit is 90% destruction efficiency might not qualify for a reduction in monitoring.

- ▶ As the odour arrestment performance of a biofilter is very dependant upon operating conditions and biomass loading, it is not appropriate that reduced monitoring be applied where biofilters are used.
- ▶ Consistent compliance should be demonstrated using the results from at least three or more monitoring exercises carried out over a period of at least two years.
- ▶ Any significant process or arrestment plant changes which might have affected the destruction efficiency should be taken into account.
- ▶ Where emission limit values for particulate matter are consistently met without the use of arrestment plant, the annual monitoring provision should be dispensed with, subject to the caveats of this paragraph.

5.19 The frequency of testing should be increased, for example, as part of the commissioning of new or substantially changed processes, or where emission levels are near to or approach the emission concentration limits.

### Sampling provisions

5.20 Care is needed in the design and location of sampling systems in order to obtain representative samples for all release points.

- ▶ The operator should ensure that adequate facilities for sampling are provided on stacks or ducts.
- ▶ Sampling points on new plant should be designed to comply with the British or equivalent standards. e.g. BS EN 13284-1, BS ISO 9096: 2003 or BS ISO 12141:2002 for sampling particulate matter in stacks.
- ▶ Where monitoring is not in accordance with the main procedural requirements of the relevant standard, deviations should be reported as well as an estimation of any error invoked.

## 6 Control techniques

- 6.1 The process is largely carried out in process equipment and hence good equipment design, materials handling and spillage prevention can greatly reduce the volumes of air necessary for odour containment by avoiding odour release into the building. However, the containment of potentially odorous emissions is the key to effective control. The effectiveness of containment and treatment measures should finally be judged by the perception of odours in the environment by the regulator. The operator should be advised of odours perceived by the regulator as soon as possible.
- 6.2 The following are examples of relevant odour control techniques:
- containment of odours within process buildings by good design and extract ventilation
  - good housekeeping and raw material handling practices
  - containment of odours within process equipment by maintaining material handling and storage facilities leakproof and spillproof as far as possible
  - control and minimisation of odours from residual materials, effluent and waste
  - containment of strong odour sources and treatment in odour arrestment plant where necessary to minimise odorous emissions to meet the provisions of Table 2 Row 1.
- 6.3 The following table provides a summary of the best available techniques that can be used to control the process in order to meet the emission limits and provisions in [Section 5](#). Provided that it is demonstrated to the satisfaction of the regulator that an equivalent level of control will be achieved, then other techniques may be used.

### Summary of best available techniques

**Table 3: Summary of control techniques**

Release source	Substance	Control techniques
Raw material and waste storage and handling	Odour	Keep material dry Good house keeping and raw material handling practices
Conditioning and drying processes	Odour	Within process equipment under negative pressure and vented to odour arrestment plant as necessary to meet the provisions of Table 2 Row 1 Appropriate construction <ul style="list-style-type: none"> <li>impervious and easy to clean surfaces</li> </ul>
Extracted process air	Odour	Containment of odours within process buildings by good design and extract ventilation Where necessary vent to suitable arrestment plant <ul style="list-style-type: none"> <li>biofilters</li> <li>thermal oxidisers/combustion plant</li> <li>scrubbers</li> <li>located to take account of sensitive receptors</li> </ul>
Waste gas from process buildings and odour arrestment plant	Odour	Final dispersion to ensure no offensive odour at sensitive receptors

**Table 3: Summary of control techniques**

Release source	Substance	Control techniques
Waste gas from odour arrestment plant	Sulphur oxides	Limit sulphur in fuel
Waste gas from odour arrestment plant	Carbon monoxide	Good combustion
Waste gases from cell expansion operations	Volatile organic compounds	Avoid the use of the VOCs Arrestment by recovery using adsorption and condensation preferred
Waste gases from flavour addition and associated drying operations	Volatile organic compounds	Minimise or avoid the use of VOCs in the flavour Arrestment by thermal treatment, biofiltration or recovery using adsorption and condensation
Raw material storage and handling	Particulate matter	Potentially dusty materials should be stored in buildings or appropriate containers
Cutting, blending, mixing, forming and pneumatic material transfer	Particulate matter	Process control Spillage management Dust arrestment <ul style="list-style-type: none"> <li>• bag filters</li> <li>• cartridge filters</li> </ul>

### Techniques to control emissions from contained sources

#### Odour control

- 6.4 Emissions from the process operations covered by this note comprise odours of mixed chemical species. The main principles for preventing odour emissions are:
- containment of the odours in the process equipment
  - raw material handling operations (as detailed below); and
  - final treatment by arrestment of odour emissions where necessary to meet the provisions of Table 2 Row 1

Where containment is used to prevent odours this is achieved by either carrying out operations with potential releases within enclosed equipment under slight negative pressure, or, as in the case of fugitive emissions, by controlling by building extract ventilation.

- ▶ Ventilation should be provided to maintain an adequate negative pressure within the process equipment (including tanks and vessels for holding condensate) to contain process releases within the equipment during process operation. The required ventilation rate will depend upon many factors (such as environmental conditions, process conditions, raw material quality, effectiveness of process containment). Containment of emissions within the process equipment should prevent fugitive releases.
- ▶ Ventilation equipment should be vented to odour arrestment plant as necessary to meet the provisions of [Table 2](#), Row 1.
- ▶ Suitable odour arrestment plant should be provided and operated at all times where necessary to meet the provisions of [Section 5](#) of this note (further information is available at Ref. h). Examples of the type of arrestment plant which are suitable include biofilters, high efficiency biological scrubbers, thermal incinerators and

other forms of combustion plant. In the case of tobacco processes, adsorption equipment is not anticipated to offer adequate odour removal due to the types of chemical species in the odour and the risk of odour breakthrough and re-entrainment.

- ▶ The presence of water vapour in the emissions from processes can adversely affect the operation of the odour arrestment plant. The water vapour will usually condense and this can lead to corrosion of materials of construction. Also in the case of scrubbing equipment, the condensation of significant volumes of water vapour will result in continuous liquid overflow and dilution of the scrubbing liquor. In circumstances where odorous emissions are saturated and wet scrubbing systems are used, the emissions may need to be condensed (for example by the use of a spray tower or quench scrubber) prior to odour treatment of the non-condensable gases.

6.5 Where odour arrestment plant is required it needs to be optimised to meet the odour destruction efficiency provisions of **Table 2**. Depending upon the type of arrestment plant used, this optimisation will include the following:

- ▶ In the case of thermal oxidisers or combustion equipment the operating temperature of the system will need to be maintained above 1123K (850°C). In the case of boilers, care is needed in their use for odour arrestment as the operating temperature and residence time may not have been designed for odour arrestment and there is the potential for quenching in the boiler. In addition, it may be necessary to establish a minimum firing rate for the boiler to ensure that the boiler conditions are always optimised for odour removal. The measurement of odour arrestment efficiency of the boiler can be used to demonstrate the correct operating parameters of the boiler.
- ▶ In the case of scrubbing equipment, it is likely that multi-stage scrubbing will be necessary to meet the odour destruction efficiency provisions of **Table 2**. In order to optimise the performance of the scrubber, it is important to ensure that it is well designed (adequate gas/liquid contact), well maintained, that the odours are sufficiently reactive with the scrubbing liquor to remove the odour and also that the reaction products do not themselves produce a volatile odour. In addition, additives to the liquor need to be automatically dosed with control by pH/Redox (over-dosing can lead to secondary odours from the scrubber associated with the chemical reagent).
- ▶ Mist eliminators should be fitted where droplet emissions occur and, in relation to new or replacement scrubbing plant, where there is a potential for such occurrence.
- ▶ If a bioscrubber is used, it is important to ensure that it is well designed (adequate gas/liquid contact), well maintained and that potential odours from scrubbing liquor are well managed. The scrubber will require regular inspection to identify possible blockage by biomass. In addition it is probable that the pH of the liquor will need to be controlled as the microbial activity of the biomass will be adversely affected by high alkalinity (which is a potential problem with emissions from certain tobacco processes).
- ▶ Biofiltration can be undertaken using packaged, enclosed biofilters or open biomass (such as peat/heather). If a peat and heather biofilter is used, it is essential to control the pH of the biomass as the microbial activity will be adversely affected by high alkalinity (which is a potential problem with the high levels of ammonia). In this case it may be necessary to pre-treat the emissions for example by water scrubbing (this will also have the beneficial effect of humidifying the air). In order to optimise the performance of the biofilter, the biomass must be maintained below 30°C,

must be kept moist, must have a gas flow at all times and leakage through edges and fissures must be avoided. Biofilters will require regular treatment to overcome consolidation - this may be regular surface turning or deconsolidation by digging-out the bed.

- ▶ The required residence time for the biofilters will depend upon many design conditions and will have to be sufficient to meet the provisions of **Table 2**, Rows 2 and 3. However the recommended residence time for peat and heather filters is a minimum of 60 seconds for lower intensity odours.

6.6 The use of odour masking agents and counteractants should not be permitted (other than as a scrubber liquor additive).

## Particulate matter

6.7 The main principles for preventing emissions of particulate matter are containment and, where necessary, arrestment .

- ▶ Emissions of particulate matter from blenders, cutters, mixers, makers and pneumatic material transfer systems should be contained, extracted and arrested if necessary to meet the visible emission provisions or the limits described in **Table 2** for particulate matter. In the case of emissions which are both odorous and contain particulate matter, it may be necessary to treat the releases from the particulate matter arrestment plant to remove the odour before final dispersion of residual odour.
- ▶ The methods of removal of collected particulate matter from arrestment plant should be undertaken carefully to avoid re-entrainment of dust. The discharge from particulate matter arrestment plant should be to screw auger, enclosed containers or enclosed conveyors. The potential for blockage of the rotary valve, discharge point or hopper should be continuously monitored (for example by the use of a rotation sensor on the rotary seal or a level indicator in the hopper). These indicative monitors should be fitted with an audible and/or visual alarm to activate when blockages occur. Alternatively the operator may elect to interlock the monitor to isolate the process equipment in case of potential blockage.

## Volatile Organic Compounds

6.8 Operations using VOCs should be undertaken in enclosed or covered vessels to minimise emissions.

- ▶ Where possible, flavour addition should be carried out using solvents of low volatility, and extracted to general abatement equipment.
- ▶ Cell expansion should be carried out in a fully enclosed system to the provisions of **Table 2** Row 7. Demonstration of the efficiency will usually involve the preparation of a Solvent Mass Balance. This should detail the total mass of organic solvent returned to the day tank/bulk tank and the mass of solvent delivered to the process. This should be measured for each batch operation or at an agreed frequency for semi-continuous processes. In calculating the solvent mass balance, the efficiency measure should not include any losses due to emergency vent activation - in this case the loss should not be included but the activation of the emergency vent should be recorded in accordance with paragraph **5.6**.
- ▶ Recovered solvents should not be burned unless the combustion unit is designed for the purpose and meets the requirements of the Waste Incineration Directive (EC/2000/76).
- ▶ VOCs with the risk phrase R45 (may cause cancer), R46 (may cause heritable genetic damage), R49 (may cause cancer by inhalation), R60 (may impair fertility) or R61 (may cause harm to the unborn child) should not be used in flavours or for cell expansion.

- ▶ CFCs or HCFCs should not be used for cell expansion

### Techniques to control fugitive emissions

#### Materials handling

- 6.9 Adequate provision should be made for the containment of liquid and solid spillages.
- ▶ All spillages should be cleared as soon as possible.
  - ▶ Dry sweeping of dusty spillages should not be permitted in circumstances where it may lead to the deposition of dust outside the site boundary.
  - ▶ All dusty, or potentially dusty materials should be stored in covered containers, sealed bags or purpose built silos.
  - ▶ The storage of raw materials should be permitted inside processing buildings provided that adequate steps are taken to prevent entrainment of particulate matter outside the building, for example by the use of plastic strip curtains on building access points.
  - ▶ Where necessary, in order to minimise emissions of dust, extraction should be provided from transfer points to arrestment plant - for example, a bag filter.
  - ▶ All tanks for liquid material storage should be fitted with level indicators or high level alarms to warn of potential overfilling (it may be acceptable to rely upon regular dipping of the tanks associated with a documented material transfer protocol). All such tanks should be vented to odour arrestment equipment where necessary to meet the provisions of [Table 2](#), Row 1.

#### Air quality

#### Ambient air quality management

- 6.10 In areas where air quality standards or objectives are being breached or are in serious risk of breach and it is clear from the detailed review and assessment work under Local Air Quality Management that the Part C process itself is a significant contributor to the problem, it may be necessary to impose tighter emission limits. If the emission limit that is in danger of being exceeded is not an EC Directive requirement, then industry is not expected to go beyond BATNEEC/BAT to meet it. Decisions should be taken in the context of a district council's Local Air Quality Management action plan. For example, where a Part C process is only responsible to a very small extent for an air quality problem, the council should not unduly penalise the operator of the process by requiring disproportionate emissions reductions. More guidance on this is provided in the revised Local Air Quality Management Technical Guidance, LAQM. TG (03) and in the Environment (NI) Order 2002 Local Air Quality Management Policy Guidance. Both of these documents are available from the Environment and Heritage Service website [www.ehsni.gov.uk](http://www.ehsni.gov.uk).

**Dispersion and dilution**

- 6.11 Pollutants that are emitted via a stack require sufficient dispersion and dilution in the atmosphere to ensure that they ground at concentrations that are harmless. This is the basis upon which stack heights are calculated using HMIP Technical Guidance Note D1 (D1). The stack height so obtained is adjusted to take into account local meteorological data, local topography, nearby emissions and the influence of plant structure. It is necessary that the assessment also take into account the relevant air quality standards that apply for the emitted pollutants.

Revised stack height calculations should not be required unless it is considered necessary because of a breach or serious risk of breach of an EC Directive limit value and because it is clear from the detailed review and assessment work that the Part B process itself is a significant contributor to the problem.

The calculation procedure of D1 is usually used to calculate the required stack height but alternative dispersion models may be used in agreement with the regulator. D1 relies upon the unimpeded vertical emission of the pollutant. A cap or other restriction over the stack impedes the vertical emission and hinders dispersion. For this reason where dispersion is required such flow impeding devices should not be used. A cone may sometimes be useful to increase the exit velocity and achieve greater dispersion.

An operator may choose to meet tighter emission limits in order to reduce the required stack height.

**Stacks, vents and process exhausts**

- 6.12 Liquid condensation on internal surfaces of stacks and exhaust ducts might lead to corrosion and ductwork failure or to droplet emission. Adequate insulation will minimise the cooling of waste gases and prevent liquid condensation by keeping the temperature of the exhaust gases above the dewpoint. Stacks and ductwork should be leakproof.
- 6.13 Unacceptable emissions of droplets could possibly occur from wet arrestment plant where the linear velocity within the associated ductwork exceeds 9 m/sec. The use of mist eliminators reduces the potential for droplet emissions.
- ▶ Where a linear velocity of 9 m/sec is exceeded in the ductwork of existing wet arrestment plant, it should be reduced to the extent that is practicable to ensure that droplet fallout does not occur.
  - ▶ Flues and ductwork should be cleaned to prevent accumulation of materials, as part of the routine maintenance programme.
  - ▶ Exhaust gases discharged through a stack or vent should achieve an exit velocity greater than 15 m/sec during normal operating conditions to achieve adequate dispersion.
  - ▶ Stacks or vents should not be fitted with any restriction at the final opening such as a plate, cap or cowl, with the exception of a cone which may be necessary to increase the exit velocity of the emissions.

**Management****Management techniques**

- 6.14 Important elements for effective control of emissions include:
- proper management, supervision and training for process operations;
  - proper use of equipment;
  - effective preventative maintenance on all plant and equipment concerned with the control of emissions to the air; and
  - it is good practice to ensure that spares and consumables are available at short notice in order to rectify breakdowns rapidly. This is important with respect to arrestment plant and other necessary environmental controls. It is useful to have an audited list of essential items.

- ▶ Spares and consumables - in particular, those subject to continual wear - should be held on site, or should be available at short notice from guaranteed suppliers, so that plant breakdowns can be rectified rapidly.

### Appropriate management systems

- 6.15 Effective management is central to environmental performance; It is an important component of BAT and of achieving compliance with permit conditions. It requires a commitment to establishing objectives, setting targets, measuring progress and revising the objectives according to results. This includes managing risks under normal operating conditions and in accidents and emergencies. It is therefore desirable that processes put in place some form of structured environmental management approach, whether by adopting published standards (ISO 14001 or the EU Eco Management and Audit Scheme [EMAS]) or by setting up an environmental management system (EMS) tailored to the nature and size of the particular process. Operators may also find that an EMS will help identify business savings.

Regulators should use their discretion, in consultation with individual operators, in agreeing the appropriate level of environmental management. Simple systems which ensure that LAPC considerations are taken account of in the day-to-day running of a process may well suffice, especially for small and medium-sized enterprises. While authorities may wish to encourage wider adoption of EMS, it is outside the legal scope of an LAPC authorisation/LA-PPC permit to require an EMS for purposes other than LAPC/LA-PPC compliance. For further information/advice on EMS refer to EMS Additional Information in [Section 8](#).

### Training

- 6.16 Staff at all levels need the necessary training and instruction in their duties relating to control of the process and emissions to air. In order to minimise risk of emissions, particular emphasis should be given to control procedures during start-up, shut down and abnormal conditions.

Training may often sensibly be addressed in the EMS referred to above.

- ▶ Training of all staff with responsibility for operating the process should include:
  - awareness of their responsibilities under the permit
  - minimising emissions on start up and shut down
  - action to minimise emissions during abnormal conditions
- ▶ The operator should maintain a statement of training requirements for each operational post and keep a record of the training received by each person whose actions may have an impact on the environment. These documents should be made available to the regulator on request.

### Maintenance

- 6.17 Effective preventative maintenance should be employed on all aspects of the process including all plant, buildings and the equipment concerned with the control of emissions to air. In particular:
- ▶ A written maintenance programme should be provided to the regulator with respect to pollution control equipment; and
  - ▶ A record of such maintenance should be made available for inspection.

### Odour Response Procedure

- 6.18 Where abatement equipment is fitted, the operator should prepare an Odour Response Procedure as outlined in Appendix 3. This is a summary of the foreseeable situations which may compromise his ability to prevent and/or minimise odorous releases from the process and the actions to be taken to minimise the impact. It is intended to be used by operational staff on a day-to-day basis and should detail the person responsible for initiating the action.
- ▶ The Odour Response Procedure should include a list of essential spares for any odour arrestment equipment that is needed. The equipment manufacturer should recommend which spares are subject to wear and foreseeable failure and are critical for the correct operation of the odour arrestment equipment (such as pumps,

nozzles etc.) and these should be held on site. It may be acceptable for certain spares to be available on guaranteed short delivery if the absence of a supply at the site would not lead to complete failure of the odour arrestment equipment or to offensive odours beyond the site boundary.

- ▶ The Odour Response Procedure should include analysis of actions in the case of any arrestment plant breakdown or malfunction. Immediate arrangements should be made to divert odour streams to other suitable arrestment plant. Emergency standby arrangements should be detailed in the Odour Response Procedure.

## 7 Summary of changes

Reasons for the main changes are summarised below.

**Table 4: Summary of changes**

Section / Paragraph/Row	Change	Reason	Comment
Table 2, Row 2	Inclusion of a standard for odour arrestment efficiency	To set a quantitative standard for odour removal	Reflects BAT
Table 2, Rows 3 and 4	Inclusion of provisions to limit the sulphur content of fuel where a thermal system is used for odour arrestment	To minimise oxides of sulphur releases.	Reflects BAT
Table 2, Row 6	Reduced emission limits for particulate matter from dry emission sources to 20 mg/m <sup>3</sup>	BAT for particulate matter control will achieve better emissions than those required by the previous note	Reflects BAT
Table 2, Row 7	Introduction of emission limits for volatile organic compounds from cell expansion operations.	To minimise VOC losses.	Reflects BAT
Paragraph 5.7 and 5.8	Assessment of process and releases in the case of odours being detected, abnormal conditions or complaints	To identify causes and solutions to possible odour releases	Clarification of previous guidance
Paragraph 5.11	Clarification of continuous monitoring provisions for particulate arrestment plant	BAT for operational control - also clarification of previous guidance	Continuous recording of monitors for flows >100 m <sup>3</sup> /min replaced with alarm recording
Paragraph 5.10	Inclusion of continuous monitoring provisions for odour arrestment plant	BAT for operational control - also clarification of previous guidance and addition of thermal systems	Recording of monitors continuously replaced with alarm recording
Paragraph 5.7	Daily inspection of odour arrestment and air handling plant	To identify abnormal activities	Replaces requirement for daily olfactory assessment
Paragraph 5.15	Testing of odour arrestment efficiency and inclusion of BS EN method	Reflects BAT - quantifies odour plant performance	New methods available
Paragraph 5.16	Provision for sulphur contents of fuel to be certificated	Odour plant may be an oil-fired thermal system	Reflects EU requirements
<b>Control Techniques</b>			
Paragraph 6.4	Removal of condensable gases before scrubbing	Optimise odour arrestment	Reflects BAT
Paragraph 6.5 and 6.6	Details on design and operation of odour arrestment equipment	Additional guidance	Reflects BAT
Paragraph 6.7	Details on design and operation of dust arrestment equipment	Additional guidance	Reflects BAT
Paragraph 6.8	Details on design and operation of VOC arrestment equipment	Additional guidance	Reflects BAT
Paragraph 6.9	Provision for management of effluent from odour arrestment equipment	Additional guidance	Reflects BAT

**Table 4: Summary of changes**

<b>Section / Paragraph/Row</b>	<b>Change</b>	<b>Reason</b>	<b>Comment</b>
Paragraph <b>6.18</b>	Provision for an Odour Response Procedure	Abnormal conditions are a key odour risk and there needs to be a documented procedure in advance of the problem	Expanding previous guidance
Appendix 2	Additional guidance on the assessment and measurement of odour and offensiveness	To provide additional guidance for operators and regulators	Reflects current knowledge
Appendix 3	Guidance on preparation of an Odour Response Plan	To provide additional guidance for operators and regulators	Reflects current knowledge
Appendix 4	Appendix 4: Guidance on the Application of BS EN 13725 (Dilution Olfactometry) to the Assessment of Odours from Tobacco Processing	To provide additional guidance on the use of dynamic dilution olfactometry	Reflects current knowledge

## 8 Definitions and further information

This guidance	Process Guidance Note NIPG 6/36 Version 2
Previous guidance	Process Guidance Note NIPG 6/36 Version 1
LAPC	explained in the Introduction of this guidance
LAPPC	explained in the Introduction of this guidance
Permit	the written permission to operate an installation prescribed for LAPPC – (the replacement for authorisation under LAPC)
Authorisation	the written authority to operate a process prescribed for LAPC - (will be replaced by permit under LAPPC)
Existing process	<p>should be taken to have the following meaning:</p> <ul style="list-style-type: none"> <li>• a process which was being carried on at some time in the 12 months immediately preceding the first day of the month following publication of this guidance note</li> <li>• a process which is to be carried on at a works, plant or factory or by means of mobile plant which was under construction or in the course of manufacture or in the course of commission on the first day of the month following publication of this guidance note, or the construction or supply of which was the subject of a contract entered into before that date</li> </ul>
New process	not an existing process.
Installation	should be interpreted in accordance with the guidance contained in the General Guidance Manual on Policy and Procedures for Part C installations
Process	the term “process” has been used in this guidance note to refer to both “processes” under the Industrial Pollution Control (NI) Order 1997 and “installations” under the Environment (NI) Order 2002.

## Health and safety

Operators of processes and installations must protect people at work as well as the environment:

- requirements of a permit or authorisation should not put at risk the health, safety or welfare of people at work
- equally, the permit or authorisation must not contain conditions whose only purpose is to secure the health of people at work. That is the job of the health and safety enforcing authorities

Where emission limits quoted in this guidance conflict with health and safety limits, the tighter limit should prevail because:

- emission limits under the Industrial Pollution Control (NI) Order 1997 or the Environment (NI) Order 2002 relate to the concentration of pollutant released into the air from prescribed activities
- exposure limits under health and safety legislation relate to the concentration of pollutant in the air breathed by workers
- these limits may differ since they are set according to different criteria. It will normally be quite appropriate to have different standards for the same pollutant, but in some cases they may be in conflict (for example, where air discharged from a process is breathed by workers). In such cases, the tighter limit should be applied to prevent a relaxation of control

## EMS additional information

Further information/advice on EMS may be found from the following:

- Envirowise at [www.envirowise.gov.uk](http://www.envirowise.gov.uk) and [www.energy-efficiency.gov.uk](http://www.energy-efficiency.gov.uk) and Environment and Energy Helpline freephone 0800 585794
- ISO 14001 [www.bsi.org.uk](http://www.bsi.org.uk) or telephone BSI information centre (020 8966 7022)
- EU Eco Management and Audit Scheme (EMAS) [www.emas.co.uk](http://www.emas.co.uk) or telephone the Institute of Environmental Management and Assessment (01522 540069)

Regulators and process operators may also like to be aware of:

BS 8555: a new standard to help SMEs implement an EMS, by offering a five-phase approach, is contained in BS 8555 which was published in 2003 following on from work undertaken by the Acorn Trust. The Institute of Environmental Management and Assessment, which has taken over the Trust's activities, is developing a scheme of accredited recognition for companies achieving different phases of BS 8555. BS 8555 can be used to achieve ISO 14001 and registration to the higher standard, EMAS.

Some of the **High Street banks**, such as NatWest and the Coop, now offer preferential loan rates to organisations that can demonstrate they are committed to improving their environmental performance. The NatWest also produce a self help guide for SMEs, 'The Better Business Pack', focusing on waste, utilities, transport and supply chain issues. It gives tools, guidance and examples. Contact: WWF-UK on 01483 426444.

## References

- (a) the Department's guide on LAPPC "General Guidance Manual on Policy and Procedures for Part C Installations", September 2003 - available from the Department at [www.doeni.gov.uk/epd](http://www.doeni.gov.uk/epd)
- (b) Current air quality objectives are specified in The Air Quality (NI) Regulations 2003 (2003 No 342)
- (c) HMIP Technical Guidance Note D1: "Guidelines on Discharge Stack Heights for Polluting Emissions", published by The Stationery Office, ISBN 0-11-752794-7.
- (d) M1 Sampling requirements for monitoring stack emissions to air from industrial installations, Environment Agency June 2005 ([www.environment-agency.gov.uk](http://www.environment-agency.gov.uk))
- (e) M2 Monitoring of stack emissions to air. Environment Agency June 2005 ([www.environment-agency.gov.uk](http://www.environment-agency.gov.uk))
- (f) BS EN 13284:2002 Stationary source emissions - Determination. of low range mass concentration of dust - Part 1 Manual gravimetric method.
- (g) BS EN13725:2003 - "Air Quality - Determination of Odour Concentration by Dynamic Olfactometry".
- (h) Odour Measurement and Control- An Update published by National Environmental Technology Centre, Culham, Abingdon. Oxon OX14 3DB. ISBN 0-85624-8258.
- (i) "Assessment of Community Response to Odorous Emissions", R&D Technical Report P4-095/TR, published by the Environment Agency, July 2002, ISBN 1 857059 247

## Web addresses

Web-site of the Department's Environmental Policy Division: [www.doeni.gov.uk/epd](http://www.doeni.gov.uk/epd)

Web-site of the Department's Environment and Heritage Service: [www.ehsni.gov.uk/](http://www.ehsni.gov.uk/) .

Energy saving and environmental management measures can increase industry profits. Envirowise (formerly E.T.B.P.P.) show how at [www.envirowise.gov.uk](http://www.envirowise.gov.uk) (or freephone 0800 585794).

# Appendix 1: Extract from Pollution Prevention and Control Regulations (NI) 2003

DEFINITION OF THE TREATMENT OF ANIMAL AND VEGETABLE MATTER AND FOOD INDUSTRIES IN SCHEDULE 1 TO THE POLLUTION PREVENTION AND CONTROL REGULATIONS (NI) 2003, 2003 No 46\*.

(The processes for district council air pollution prevention and control are listed under "Part C". The "Part A" and Part "B" processes are for Chief Inspector control.)

## SECTION 6.8

THE TREATMENT OF ANIMAL AND VEGETABLE MATTER AND FOOD INDUSTRIES

### Part A

(a) Tanning hides and skins at plant with a treatment capacity of more than 12 tonnes of finished products per day.

(b) Slaughtering animals at plant with a carcass production capacity of more than 50 tonnes per day.

(c) Disposing of or recycling animal carcasses or animal waste otherwise than by incineration falling within section 5.1 of this Part of this Schedule at plant with a treatment capacity exceeding 10 tonnes per day of animal carcasses or animal waste or, in aggregate, of both.

(d) Treating and processing materials intended for the production of food products from -

(i) animal raw materials (other than milk) at plant with a finished product production capacity of more than 75 tonnes per day;

(ii) vegetable raw materials at plant with a finished product production capacity of more than 300 tonnes per day (average value on a quarterly basis).

(e) Treating and processing milk, the quantity of milk received being more than 200 tonnes per day (average value on an annual basis).

(f) Processing, storing or drying by the application of heat of the whole or part of any dead animal or any vegetable matter (other than the treatment of effluent so as to permit its discharge into waterways, underground strata or into a sewer unless the treatment involves the drying of any material with a view to its use as animal feedstuff) if -

(i) the processing, storing or drying does not fall within another Section of this Schedule or paragraph I of this Part of this Section and is not an exempt activity; and

(ii) it may result in the release into water of any substance listed in paragraph 13 of Part 2 of this Schedule in a quantity which, in any period of 12 months, is greater than the background quantity by more than the amount specified in relation to the substance in that paragraph.

## Part B

Unless falling within Part A of this Section, treating feathers by hydrolysis where hydrogen sulphide or other sulphur containing compounds may be released into the air.

## Part C

(a) Processing, storing or drying by the application of heat of the whole or part of any dead animal or any vegetable matter (other than the treatment of effluent so as to permit its discharge into waterways, underground strata or into a sewer unless the treatment involves the drying of any material with a view to its use as animal feedstuff) if -

(i) the processing, storing or drying does not fall within another Section of this Schedule or Part A or B of this Section and is not an exempt activity; and

(ii) the processing, storing or drying may result in the release into the air of a substance described in paragraph 12 of Part 2 of this Schedule or any offensive smell noticeable outside the premises on which the activity is carried out.

(b) Breeding maggots in any case where 5 kg or more of animal matter or of vegetable matter or, in aggregate, of both are introduced into the process in any week.

### *Interpretation of Section 6.8*

In this Section -

"animal" includes a bird or a fish;

"exempt activity" means -

(i) any activity carried out in a farm or agricultural holding other than the manufacture of goods for sale;

(ii) the manufacture or preparation of food or drink for human consumption but excluding -

(a) the extraction, distillation or purification of animal or vegetable oil or fat otherwise than as a activity incidental to the cooking of food for human consumption;

(b) any activity involving the use of green offal or the boiling of blood except the cooking of food (other than tripe) for human consumption;

(c) the cooking of tripe for human consumption elsewhere than on premises on which it is to be consumed;

(iii) the fleshing, cleaning and drying of pelts of fur-bearing mammals;

(iv) any activity carried on in connection with the operation of a knacker's yard, as defined in the Animal By-Products Order (Northern Ireland) 2002( );

(v) any activity for the manufacture of soap not falling within Part A of Section 4.1;

(vi) the storage of vegetable matter not falling within any other Section of this Schedule;

(vii) the cleaning of shellfish shells;

(viii) the manufacture of starch;

(ix) the processing of animal or vegetable matter at premises for feeding a recognised pack of hounds registered under the Animal By-Products Order (Northern Ireland) 2002;

(x) the salting of hides or skins, unless related to any other activity listed in this Schedule;

(xi) any activity for composting animal or vegetable matter or a combination of both, except where that activity is carried on for the purposes of cultivating mushrooms;

(xii) any activity for cleaning, and any related activity for drying or dressing, seeds, bulbs, corms or tubers;

(xiii) the drying of grain or pulses;

(xiv) any activity for the production of cotton yarn from raw cotton or for the conversion of cotton yarn into cloth;

"food" includes -

(i) drink;

(ii) articles and substances of no nutritional value which are used for human consumption; and

(iii) articles and substances used as ingredients in the preparation of food;

"green offal" means the stomach and intestines of any animal, other than poultry or fish, and their contents;

"underground strata" has the same meaning as in Article 2(2) of the Water (Northern Ireland) Order 1999( );

"waterways" has the same meaning as in Article 2(2) of the Water (Northern Ireland) Order 1999.

\*Every effort has been taken to ensure that this Appendix is correct at the date of issue of this Note, but readers should note that the Regulations are likely to be subject to periodic amendment, and this Appendix should not therefore be relied upon as representing the up-to-date position after the issue date.

## Appendix 2: Method for sampling of emissions from biological (earth, peat and heather) filters using gas detection tubes

### METHOD FOR SAMPLING OF EMISSIONS FROM BIOLOGICAL (EARTH, PEAT AND HEATHER) FILTERS USING GAS DETECTION TUBES

- (1) Routine monitoring of emissions from biological filters can be readily undertaken using gas detection tubes. However, it is important to ensure that a number of representative samples are obtained and that care is taken in the interpretation of results. The number of samples necessary will depend upon the gas distribution within the biological filter.
- (2) It is essential that samples are taken from a representative volume of emitted gas as near surface dispersion will significantly affect measured concentrations. Therefore, it is necessary to reduce dispersion and obtain a volume of gas from which to sample. This can be achieved by placing a purpose-made enclosure on top of the filter bed and allowing the emitted gases to accumulate.
- (3) The enclosure itself should be approximately 0.5 m<sup>3</sup> - 1 m<sup>3</sup> in volume, preferably with a 1 m square open base. The top of the enclosure should have an opening of approximately 50 mm diameter to facilitate sampling. The enclosure can be simply fabricated using a timber frame and plywood or hardboard sides and top with mastic or other suitable sealant applied to the side and top joints.
- (4) It will be extremely difficult to achieve a seal at the filter bed surface, however the enclosure should be located in order to minimise leakage from the points of contact with the filter bed. The enclosure should remain at the sample location for at least 10 minutes prior to sampling to ensure that a representative sample of emissions is obtained (allowing the volume of the enclosure to be purged three times).
- (5) The operator should agree with the regulator the gas detection tubes to be used for testing purposes, and the indicative values that demonstrate good biofilter performance. Care should be taken that when selecting the species to be tested there are no other components present that could interfere with the result.
- (6) This method is only suitable for open biomass type biofilters where no final discharge vent or stack exists.
- (7) Additional information is available in BS.EN13725:2003 - "Air Quality - Determination of Odour Concentration by Dynamic Olfactometry" and "Odour Measurement and Control" Update "published by National Environmental Technology Centre, Culham, Abingdon. Oxon OX14 3DB. ISBN 0-85624-8258.

## Appendix 3: Guidance on the Preparation of an Odour Response Procedure

What is an Odour Response Procedure?

An Odour Response Procedure is a summary, provided by the operator, of the foreseeable situations which may compromise his ability to prevent and/or minimise odorous releases from the process and the actions to be taken to minimise the impact. It is intended to be used by operational staff on a day-to-day basis and should detail the person responsible for initiating the action.

The procedure is intended primarily to document foreseeable events which are outside of the control of the operator and those that are preventable by maintenance and operational control (for example pump failure, biofilter compaction or filter breakthrough). The procedure should include a maintenance programme for all odour arrestment equipment and other odour containment measures (such as building structure, ventilation plant).

What is the Format for the Odour Response Procedure?

The Odour Response Procedure should be a written document which is available on-site and should be submitted to the regulator. The regulator may wish to set conditions in the permit/authorisation which reflect the undertakings given in the Procedure (for example maximum arrestment plant by-pass times, reduced throughput etc).

What should be included in the Odour Response Procedure?

There are four main reasons for releases which may lead to emissions of offensive odour which are:

1. changes in process conditions leading to more odour generation or a change in the odour characteristics
2. conditions which result in fugitive releases due to reduced odour containment
3. failures or reduced performance of odour arrestment equipment
4. factors affecting the dispersion between the source and the receptor.

The occurrence of 2 and 3 above can be limited by the production of, and compliance with, an effective plant and building maintenance programme. Examples of other issues which should be considered in each of these categories are given in the Table below.

In order to prepare an assessment of possible abnormal conditions and the options for mitigation of the odour, the operator will need to consider:

- the activity which produces the odour and the point of odour release
- possible process or control failures or abnormal situations
- potential outcome of a failure in respect of the likely odour impact on local sensitive receptors
- what actions are to be taken to mitigate the effect of the odour release and details of the persons responsible for the actions at the site.

**Table 5: Examples of issues to consider relating to odour release**

Factors leading to odour release	Examples of issues to consider
Those which have potential to affect the process and the generation of odour	<ul style="list-style-type: none"> <li>• Materials input - seasonal variation in weather may affect odour of materials particularly if putrescible.</li> <li>• Process parameters such as changes in temperature/pressures</li> <li>• Rate of throughput or increased hours of operation</li> <li>• High levels of ammonia within the process buildings (possibly due to high ambient temperatures).</li> </ul>
Those which affect the ability to abate/mini-mise odour	<ul style="list-style-type: none"> <li>• Poor performance of biofiltration or poisoning (may be the result of poor maintenance or mis-operation)</li> <li>• Flooding of the biofilter due to abnormally high rainfall</li> <li>• External failure of other utilities, e.g. water supply, gas supply for combustion equipment where the operator has signed up to an interruptible gas supply</li> <li>• Mechanical breakdown of arrestment equipment such as pumps, fans etc.</li> <li>• Power failure</li> <li>• Compaction of the biofilter or surface fissures</li> <li>• Saturation of a carbon filter bed and subsequent breakthrough of odours</li> <li>• Below optimum temperature of a thermal oxidiser or boiler etc.</li> <li>• Saturation of scrubber liquor, blocked injection nozzles etc.</li> </ul>
Those which affect the ability to contain odour	<ul style="list-style-type: none"> <li>• Building damage which affects integrity due to for example storms</li> <li>• Power failure</li> <li>• Failure of automatic doors, i.e. in open position</li> <li>• Failure in procedures to maintain containment (human error)</li> </ul>
Those affecting dispersion between the source and sensitive receptors‡	<ul style="list-style-type: none"> <li>• Short term weather patterns which fall outside of the normal conditions for that area and are highly unusual (not just the normal meteorological pattern) - inversions and other conditions unfavourable to dispersion should have been considered in designing the process</li> <li>• Weather - wind direction, temperature, inversion conditions if these are normal variants of local weather</li> <li>• Loss of plume buoyancy/temperature</li> </ul>
<p>‡ The process design should incorporate control measures to ensure that under the normal range of meteorological conditions for the area, no emissions result in offensive odour that is detectable beyond the process boundary.</p>	

# Appendix 4: Guidance on the Application of BS EN 13725 (Dilution Olfactometry) to the Assessment of Odours from Tobacco Processing

British Standard BS EN 13725: 2003 "Air Quality - Determination of Odour Concentration by Dynamic Olfactometry" can be applied to the assessment of odours from tobacco processing. However, research\* has established that certain practical steps need to be taken in connection with the collection of odour samples to minimise errors and maximise the repeatability of results.

These steps comprise:-

1. Analyse samples as soon as possible, preferably within 12 hours of sampling (when samples age for more than 12 hours, decay is likely to cause a reduction in odour concentration to half the original concentration at age 30 hours).
2. Use sampling bags made of Nalophan NA or benchmark the performance of other materials against Nalophan NA before using alternative materials.
3. Use pre-dilution when sampling only for the purpose of avoiding condensation during sample storage. Use an appropriate minimum dilution factor to avoid condensation.
4. Both nitrogen and high-purity (synthetic) air are suitable gases for use as neutral gas for pre-dilution.
5. When sampling tobacco odours, use an odourless filter to remove particles. This practice removes a source of variation and avoids contamination of equipment. The effect on results, despite being consistently lower in odour concentration, is not meaningful in terms of perceived intensity or annoyance potential, as the bias caused is small relative to the uncertainties of sensory analysis and the concentration differences that are relevant in terms of perceived difference of sensation.

\* "Odour Concentration Decay and Stability in Gas Sampling Bags", A. Ph. (Ton) van Harreveld, published January 2003 in volume 53 of the *Journal of the Air and Waste Management Association* at page 51.