Health & Safety at Composting Sites:

A Guide for Site Managers

3rd Edition

Association for
Organics Recycling

Sponsored by:

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Endorsement from LondonWaste

As a significant waste management company situated in the capital, LondonWaste is proud to be the main sponsor of AfOR's revised Health & Safety Guide for biological-waste sites and to reaffirm its support for the Association for Organics Recycling. This guide will assist in promoting safe working conditions throughout the biological-waste industry.

Whilst LondonWaste operates a large, busy and diverse range of facilities, we are proud of our health and safety record. Through our lengthy association with AfOR we recognise the Association's work in driving up health & safety standards throughout the biological-waste industry and we commend this publication as a means of assisting site managers to improve their health and safety compliance and to reduce accidents on their sites.

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Health and Safety Executive Endoresement

'The Health and Safety Executive acknowledges this guidance which has been developed by the Association for Organics Recycling (AfOR) to help those undertaking composting and related activities make health and safety improvements. The guidance may go further than the minimum you need to do to comply with the law.'

Wayne Williams, HM Inspector of Health and Safety

OPSTD - Agriculture, Waste and Recycling Sector

Table of Contents

Chapter 1
Introduction

1.1 Scope of this Guide

The treatment of biodegradable wastes at composting, anaerobic digestion and mechanical biological treatment facilities across the UK is set to increase substantially in the future. More workers will need to be employed to manage and operate these systems, presenting new challenges in occupational health and safety management.

In an attempt to address some of the issues relating to the competent operation of composting facilities, this updated Guide has been written for site managers, and aims to impart sound practical advice regarding occupational health and safety. It is intended that this new updated Guide will enable managers to make employees aware of their legal obligations and to ensure that appropriate on-site procedures are implemented. It builds on the previous version by including sections on updated legislation associated with noise, fire and explosion, machinery and other work equipment, and the Animal By-Products Regulations. It also updates the summaries of key aspects of the law relating to health and safety that are relevant to the composting industry – and the publications that are applicable.

The organic waste treatment industry is similar to the agricultural industry. Many of the hazards associated with large scale composting also occur within an agricultural environment, for example the operation of noisy, heavy machinery. As such, advice from the Health and Safety Executive (HSE) regarding agricultural practices is referenced throughout this Guide due to its relevance and usefulness to the composting industry.

The physical hazards associated with the operation of machinery can often be easily assessed and simple practical measures introduced to reduce the risk of injury. Suppliers of equipment should provide users with the appropriate information, most of which will be specific to a particular make and model. This is still the case, and this updated Guide provides help towards that – particularly regarding the PUWER regulations.

Many of the hazards at composting sites which can cause harm to human health are, however, far less easy to identify, especially when they cannot be seen directly by the naked eye. An assessment of the associated risks is therefore particularly difficult unless the nature of the hazards is understood. Composting site activities, by their very nature, generate dusts and bioaerosols. The latter are made up of very small biological particles which remain suspended in the air (as aerosols), and can be inhaled by people working in the vicinity. This issue remains extremely important in composting, and hence this updated Guide still explains precisely what bioaerosols are and how they can adversely affect human health, to enable managers of composting facilities to undertake effective health risk assessments. Further reading on how to approach such assessments is added as an appendix.

Since the introduction of the Animal By-Products Regulations in 2003 (amended in 2005), there has been an increase in the use of in-vessel composting systems. This Guide addresses both open-air turned-windrow systems, and in-vessel systems which enclose part (or all) of the composting process. In both of these methods of organic waste treatment, the basic principles and flow of materials through a site remains the same (Figure 1.1). This Guide is therefore applicable to a range of facilities, such as in-vessel composting, anaerobic digestion systems, mechanical biological treatment plants and anaerobic digestion, all of which rely on a managed, controlled biological treatment process. The principles underlying the recommendations contained within this document remain the same irrespective of the system used.

The approach to the management of composting facilities advocated in previous versions of this Guide remains the same. The British Standards Institution Publicly Available Specification 100 (BSI PAS 100 2011) and the third party certification scheme managed by The Association for Organics Recycling (AfOR) continues to be a point of reference for issues regarding working methods designed specifically to identify, evaluate and control hazards. Rather than repeat what has been stated in the BSI PAS 100, appropriate reference to it has been retained.

This Guide is now in its third edition. It is a working document which will be revised periodically. Changes will be made where appropriate to accommodate legislative changes, relevant scientific and technical advances. Constructive comments on information contained within the document are always welcome.

The HSE publish a comprehensive range of booklets and leaflets which cover specific aspects relating to health and safety at work. Many of these are available free of charge, and, where relevant, reference to them has been made throughout this document. It is strongly recommended that these specific publications are read in conjunction with this Guide.

The Waste Industry Safety and Health (WISH) forum brings

together waste management professionals and the HSE to consider key industry health and safety issues and continue to provide guidance to the waste industry on a number of issues. Members of WISH have read and provided feedback to this document. You can find out more information about WISH at http://www.hse.gov.uk/waste/wish.htm.

Definitions of key terms are denoted throughout the text by a symbol.

Several recommendations have been made, which relate to specific site management practices. These are denoted by a ✔ symbol and are based upon current awareness at the time of publication.

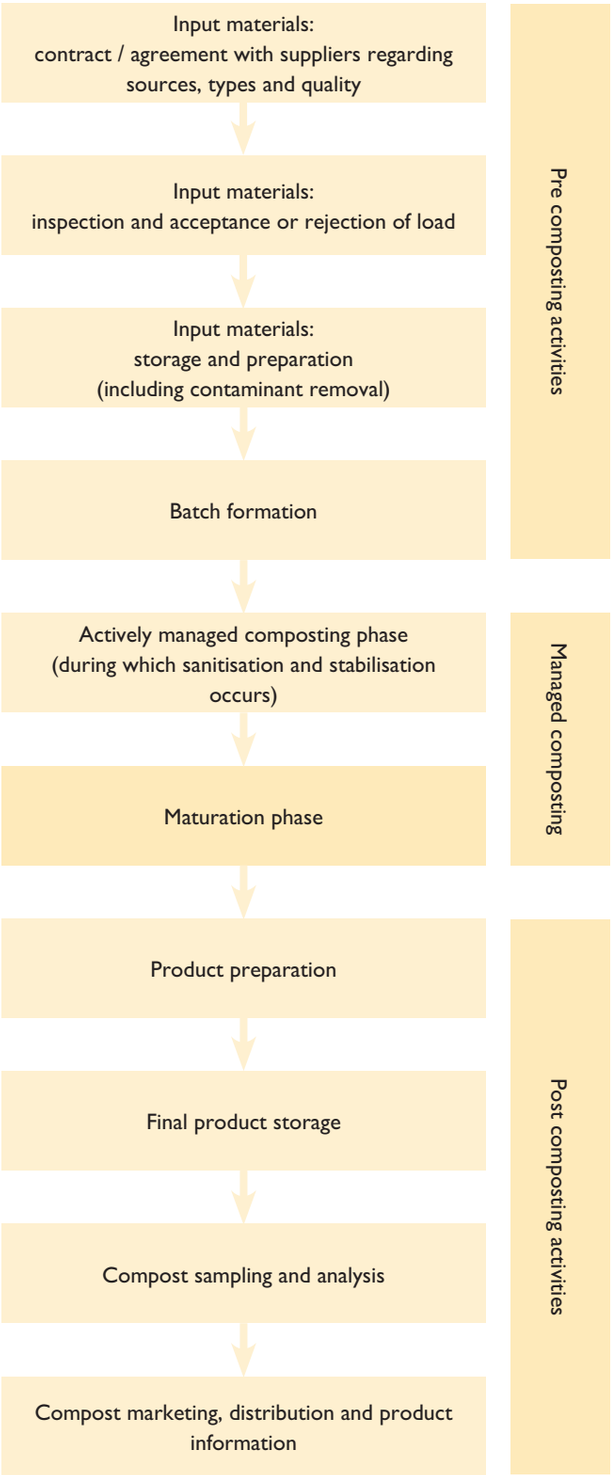

Figure 1.1 Generic flow diagram for compost production processes

Chapter 2
Legal Obligations

This chapter provides an overview of health and safety legislation that is applicable to composting facilities. It summarises the key points of the following legislation:

- Health and Safety at Work etc Act 1974
- The Management of Health and Safety at Work Regulations 1999

The chapter then lists other regulations of relevance to the composting industry.

2.1 Introduction

There are a range of health and safety regulations relevant to the composting industry. As directors and managers can be held personally responsible for failing to manage health and safety effectively, it is important they understand their legal obligations. A summary of the legislation that is directly relevant to the composting industry is given below.

2.2 Health and Safety at Work etc Act 1974

This Act sets out a broad framework for health and safety in any workplace. It requires employers to ensure, *'so far as is reasonably practicable'*, the health, safety and welfare of their employees at work. The Act requires a company to provide, *inter alia:*

- Appropriate information, instruction, training and supervision for employees
- Plant and systems of work that are safe and without risks to health
- A safe working environment
- Appropriate welfare facilities
- A company safety policy statement. This is mandatory for organisations with more than five employees

The Act is the basis for most of the legislation that covers health and safety at work. Specific regulations are made under the Act which have been approved by Parliament and are therefore law.

A note on *'so far as is reasonably practicable'* (SFAIRP)

This term most often used in the Health and Safety at Work etc Act and in a variety of Regulations. You may also see 'as low as is reasonably practicable' (ALARP), the two can be used interchangeably. The term is about weighing the risk against the sacrifice needed to further reduce it. The decision is weighted in favour of health and safety because the presumption is that the duty-holder should implement the risk reduction measure. To avoid having to make this sacrifice, the duty-holder must be able to show that it would be grossly disproportionate to the benefits of risk reduction that would be achieved. Thus, the process is not one of balancing the costs and benefits of measures but, rather, of adopting measures except where they are ruled out because they involve grossly disproportionate sacrifices (HSE 'ALARP'

2.3 The Management of Health and Safety at Work Regulations 1999

HAZARD
Anything that can cause harm

RISK
The chance or likelihood of someone being harmed by a hazard

This specifies what employers are required to do to manage health and safety. It requires employers to:

- **Undertake risk assessments on all work activities**
  This means that all hazards should be identified which relate to worker health and safety, with the associated risks assessed, including severity of outcome.

  Health hazards include inhaling bioaerosols from compost, excessive manual handling etc., whilst safety hazards include unguarded machinery, working at height and vehicle movements, for example.

  Once the hazard is identified, measures must be introduced to eliminate, reduce or control the residual risk. The significant findings must be recorded if there are more than five employees.

- **Plan effectively for health and safety**
  This means that measures should be introduced through "planning, organisation, control, monitoring and review" to

establish adequate arrangements to ensure health and safety.

- **Provide health surveillance, where required**
  This will depend upon the outcome of the risk assessments, and is also a requirement under the Control of Substances Hazardous to Health Regulations (2002). COSHH is discussed in detail in Chapter 4.

- **Appoint competent persons to help carry out employers' responsibilities**
  Sometimes, it may not be possible for individuals to do everything themselves. Some identified problems may need specialist assistance to solve them. In other cases, specified individuals may need to be trained to assist employers to comply with the appropriate health and safety legislation, and to assist them in devising and implementing safe ways of working.

- **Provide information and training to employees**
  This should include easily understandable information on the risks present in the workplace, the preventive and protective measures which should be employed, and those tasks/duties which should be carried out only by appointed competent persons with specific training, experience or knowledge. Information and training is discussed in detail in Chapter 3.

- **Set up procedures for serious and imminent danger and for danger areas**
  This should include nominating a competent person (and ensuring a point of contact for external emergency services), setting specific procedures which must be followed in situations which pose a serious or imminent danger to persons at work and to prevent access to danger areas unless appropriate training is given. Emergency procedures are also required, e.g. to enable a building evacuation in the event of fire.

- **Work together with employers sharing the same workplace**
  This is to ensure that all employees, irrespective of employer, (including visiting drivers or perhaps sub-contractors) are given sufficient information and are made aware of any risks relevant to them within a common workplace.

Other duties are also specified within the Management Regulations. However, it is recommended that the Approved Code of Practice (L21) is consulted for further information.

2.4 Other regulations

Other regulations relevant to the composting industry are listed below.

- *Control of Substances Hazardous to Health (COSHH) Regulations 2002 (as amended)*: refer to Chapter 5
- *Personal Protective Equipment (PPE) Regulations 2002*: refer to Chapter 8
- *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR) (revised with new guidance in 2012)*: refer to Chapter 6
- *Health and Safety (Consultation with Employees) Regulations 1996*: refer to Chapter 3
- *Health and Safety (Safety Signs and Signals) Regulations 1996*: refer to Chapter 3
- *Electricity at Work Regulations 1989*: this requires people in control of electrical systems to ensure they are safe to use and maintained in a safe condition: refer to Chapter 7
- *Manual Handling Operations Regulations 1992*: this covers the moving of objects by hand or by bodily force: refer to Chapter 7
- *The Control of Noise at Work Regulations 2005*: this requires employers to take action to protect employees hearing: refer to Chapter 7
- *Provision and Use of Work Equipment Regulations (PUWER) 1998*: this requires that equipment provided for use at work is safe: refer to Chapter 7
- *Dangerous Substances and Explosive Atmosphere DSEAR) Regulations 2002*. This requires safe systems of work and zoning where there is the possibility of explosive atmospheres to be present
- *Confined Spaces Regulations 1997*: this requires the control of entry to spaces where the conditions are detrimental to health

The following regulations may also apply but are not fully explored in this updated Guide. Further information can be obtained direct from the HSE.

- *Employers' Liability (Compulsory Insurance) Regulations 1998*: this requires employers to take out insurance against accidents and ill health to their employees
- *Health and Safety (First Aid) Regulations 1981*: this covers the requirements for first aid
- *Health and Safety Information for Employees Regulations 1989 and (Amendment) Regulations 2009 (and The Health and Safety Information for Employees (Modifications and Repeals) Regulations 1995)*: it has been a legal requirement

to either display an approved health and safety law poster or to provide employees with the equivalent leaflet since 1 July 2000. The approved poster and leaflet were revised in 2009, but employers can continue to use earlier versions of approved poster and leaflet, until 2 April 2014.

- *Workplace (Health, Safety and Welfare) Regulations 1992:* this covers a wide range of basic health, safety and welfare issues
- *Lifting Operations and Lifting Equipment Regulations (LOLER) 1998*: Includes any equipment used at work for lifting and lowering loads, e.g. fork lift trucks, cranes, telescopic handlers, chains, tail lifts etc

The **Waste Industry Safety and Health (WISH) Forum** has produced guidance specific to the waste management industry which can be found at http://www.hse.gov.uk/waste/wish.htm.

Relevant HSE publications

Leaflets and guidance

- A Guide to Risk Assessment Requirements - INDG 218(L)
- An introduction to health and safety: Health and safety in small businesses (INDG259)
- Health and safety regulation: a short guide (HSC13)
- Working with Substances Hazardous to Health. What you need to know about COSHH (INDG136)
- Employers' Liability (Compulsory Insurance) Act 1969 - A guide for employees and their representatives (HSE39)
- Employers' Liability (Compulsory Insurance) Act 1969 – A guide for employers (HSE40)
- A Guide to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (L73) ISBN 978 0 7176 6290 6
- Five steps to risk assessment (INDG163) ISBN 978 0 7 176 6 440 5
- Leading Health & Safety at Work – Leadership Actions for Directors and Board Members (INDG417) ISBN 978 0 7176 6267 8
- Health and Safety Regulation - A short guide (HSC13)
- Managing health and safety - Five steps to success (INDG275) ISBN 978 0 7176 2170 5
- Signpost to the Health and Safety (Safety Signs and Signals) Regulations 1996 (INDG184) ISBN 978 0 7176 1139 3
- First Aid at Work: Health and Safety (First Aid) Regulations 1981: Approved code of practice and guidance (L74) ISBN 978 0 7176 6260 9
- Workplace health, safety and welfare - A short guide for managers (INDG244) ISBN 978 0 7176 6279 1
- LOLER. How the Regulations apply to agriculture (AIS28)
- Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved code of practice and guidance. (L113) ISBN 978 0 7176 1628 2
- Waste industry safety and health: Reducing the risk (INDG359) ISBN 978 0 7176 2514 7
- Safe use of skip loaders: Advice for employees (INDG378) ISBN 978 0 7176 2216 0:
- Health and Safety Law: What you need to know ISBN 978 0 7176 6352 1
- ALARP at a glance. http://www.hse.gov.uk/risk/theory/alarpglance.htm

Posters

- Health and Safety law poster. What you need to know. ISBN 978 0 7176 6314 9; Rigid PVC ISBN 978 0 7176 6339 2
- Basic advice on first aid at work ISBN 978 0 7176 6432 0

Books

- Consulting Workers on Health & Safety. Safety Representatives and Safety Committees Regulations 1977 (as amended) and Health and Safety (Consultation with Employees) Regulations 1996 (as amended). Approved Code of Practice and Guidance. (L146) ISBN 978 0 7176 6311 8
- A guide to the reporting of injuries, diseases and dangerous occurrences regulations 1995 (L73) ISBN 978 0 7176 6290 6
- A step by step guide to COSHH assessment (HSG97) ISBN 978 0 7176 2785 1
- Essentials of health and safety at work ISBN 978 0 7176 6179 4
- Control of substances hazardous to health (Fifth edition). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved code of practice and guidance. (L5) ISBN 978 0 7176 2981 7
- Health risk management - A practical guide for managers in small and medium-sized enterprises (HSG137) ISBN: 978 0 7176 0905 5
- Management of health and safety at work Regulations 1999 - Approved Code of Practice and guidance (L21)

ISBN 978 0 7176 2488 1

- Personal protective equipment at work (Second Edition) -PPE at work Regulations 1992 (as amended) Guidance on Regulations (L25) ISBN 978 0 7176 6139 8
- Respiratory protective equipment at work. A Practical Guide (HSG53) ISBN 978 0 7176 2904 6
- Safety signs and signals. The Health and Safety (Safety Signs and Signals) Regulations 1996 - Guidance on Regulations (L64) ISBN 978 0 7176 6359 0
- Successful health and safety management (HSG65) ISBN 978 0 7176 1276 5
- Workplace health, safety and welfare. Workplace (Health, Safety and Welfare) Regulations 1992 (as amended by the Quarries Miscellaneous Health and Safety Provisions Regulations 1995). Approved Code of Practice and guidance. (L24) ISBN 978 0 7176 0413 5
- Booklet Safe Work in Confined Spaces INDG258
- Provision and Use of Work Equipment Regulations 1998: Open learning guidance ISBN 978 0 7176 6285 2
- Dangerous Substances and Explosive Atmospheres Regulations 2002 Approved Code of Practice and guidance LN138 ISBN 978 0 7176 2203 0
- Effective health and safety training - A trainer's resource pack (HSG222) ISBN 978 0 7176 2109 5

Chapter 3

Consulting, Informing and Training Employees

This chapter provides details of employers' obligations to consult with employees and provide training and education about health and safety measures. It outlines the requirements of both employers and employees under the:

- Management of Health and Safety at Work Regulations (the Management Regulations) 1999 (as amended in 2006)
- Control of Hazardous Substances (COSHH) Regulations 2002 (as amended in 2003 and 2004); and
- Health and Safety (Consultation with Employees) Regulations 1996 (as amended in 2004 and 2006)
- The Health and Safety (First-Aid) Regulations 1981

The chapter then provides advice on communicating information in an effective and accessible manner. The chapter is divided into sections as follows:

- Introduction
- Consulting employees
- Employee information and training
- Provision of safety signs
- Promoting a constructive attitude towards health and safety

3.1 Introduction

One of the most difficult aspects of running any organisation is ensuring that both managers and workers communicate effectively. Common sense tells us that this is essential if health and safety is to be managed competently, however, in practice it often falls far short of what is both desired and what is required by law.

In order to communicate effectively with employees about health and safety matters, three basic criteria should be met: namely consultation, information and training. This is shown schematically in Figure 3.1.

Complying with the aims and objectives of these three criteria should help ensure that risks to worker health and safety are minimised. It has been estimated by the Health and Safety Executive (HSE) that the costs to UK industry from unsafe working practices lay in the region of £30 billion per annum (HSE 2012). As most of this is uninsured, it represents a significant financial loss! Putting in the time and effort to introduce and maintain adequate health and safety management procedures is likely to represent a considerable investment for any organisation, but should save money and reduce harm in the longer-term.

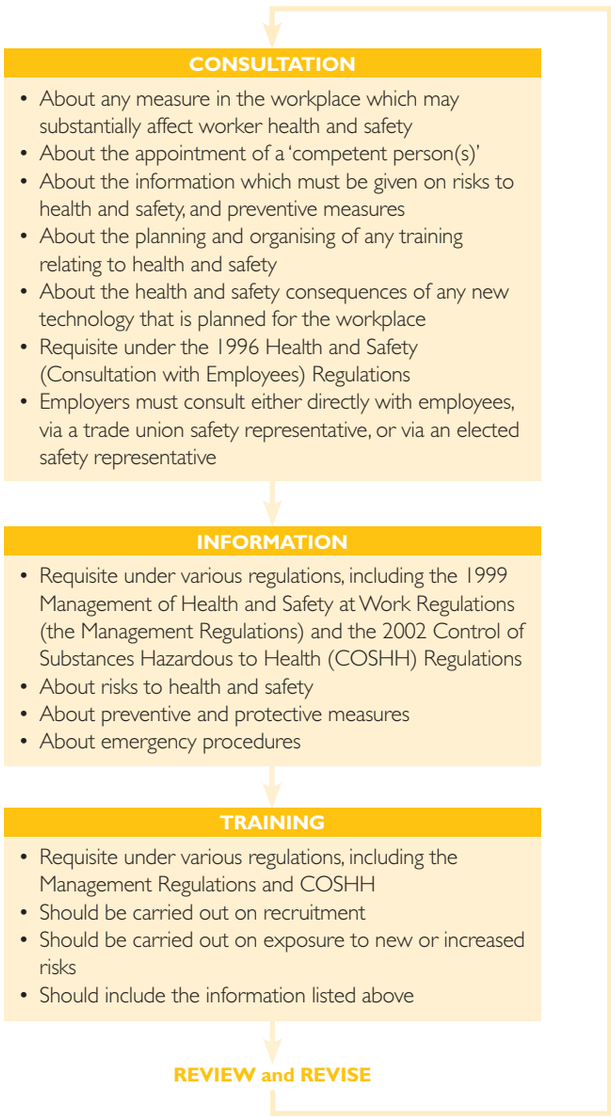

Figure 3.1 Effective communication within an organisation with respect to health and safety management

Insurance costs

- Covering injury, ill health and damage

Uninsured costs

- Lost time
- Extra wages, overtime payments
- Sick pay
- Production delays
- Fines
- Loss of contracts
- Legal costs
- Damage to products, plant, buildings, tools, equipment
- Cleaning the site
- Investigation time
- Excess on any claim
- Loss of business reputation

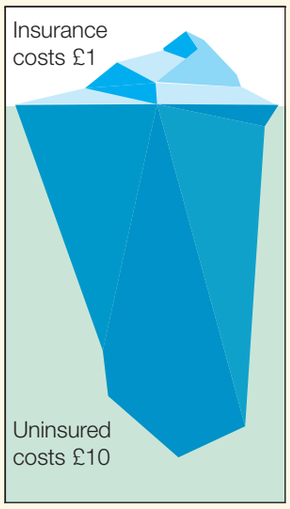

Figure 3.2 Costs iceberg (Picture reproduced from INDG275) (HSE 2011)

3.2 Consulting employees

This is a requirement under the Health and Safety (Consultation with Employees) Regulations 1996 (as amended in 2004 and 2006) (referred to in this Guide as the Consultation Regulations). It means that an employer must **consult with** the opinions of employees and **take account** of what they say before any decisions are made. This distinguishes it from merely 'informing' employees.

In principle, it aims to ensure that employees are consulted on all matters that affect their health and safety. In practice, it means that an employer must consult employees about the following matters:

- **The introduction of any measure in the workplace that may substantially affect their health and safety**
  This means that **before** any changes are introduced, employees' opinions should be sought and taken into consideration.
- **The arrangements for appointing or nominating a competent person(s)**
  The Management of Health and Safety at Work Regulations (the Management Regulations) require the appointment of a 'competent person' to assist an employer comply with the appropriate health and safety legislation. The Consultation Regulations mean than employees must be asked for their views on how a competent person should be appointed.
- **The information that must be given on risks to health and safety, and / or preventive measures**
  Employees must be consulted on the provision of information about risks and preventive measures prior to dissemination. The information that must be given to employees is covered by other regulations (see below).
- **The planning and organising of any training relating to health and safety**
  Employee training is requisite under both the Management and COSHH Regulations (see below). The Consultation Regulations mean that employees should be asked about the planning and organising of training before it is introduced.
- **The health and safety consequences of any new technology that is planned for the workplace**
  This means any new technology that may have implications for health and safety.

Employees must be consulted on these matters "in good time". This means employees should be given information about any proposals and be allowed sufficient time to review it and express their opinions. Employers should leave sufficient time to take account of these views before making any decisions.

Where employees are represented by a trade union, the appointed union representative should be consulted. Where employees are not served by a trade union, then they must be consulted either directly or via an elected representative. Employers must provide adequate facilities, appropriate training and allow representatives paid time off in order to carry out their duties.

Consulting employees might appear to be a time-consuming process; however, there can be clear benefits for all concerned. Chapter 8 described the use of personal protective equipment (PPE) to control risks. Unfortunately wearing PPE (and, in particular, respiratory protective equipment (RPE)) is often perceived by workers to be inappropriate and not very 'macho', and can also be decidedly uncomfortable. Liaising directly with employees about the choice of suitable PPE will go a long way towards ensuring that it is worn appropriately. Merely distributing PPE and expecting employees to wear it is rarely effective; after all it is not the managers who have to wear respirators for long periods of time on hot summer days! Consultation can therefore be advantageous to both

employers and employees. Employers are reminded that PPE/RPE is a last resort for protection for staff, when all other control measures have not fully removed the risk to staff.

3.3 Employee information and training

Employee education and training is requisite under a number of different regulations. The Management Regulations requires information to be provided on the following:

- **Risks to health and safety**
  This should include risks associated with the operation of machinery and those posed by bioaerosols, dusts, noise and vibration.
- **Preventive and protective measures**
  This should include the safe operation and maintenance of machinery and the appropriate mitigation and if need be use of PPE.
- **Emergency procedures**
  This should include information on, and appropriate practice of, procedures to be followed in the event of an incident, such as a fire, that requires immediate remedial action, evacuation of the area, or a call for assistance from fire ambulance or police services. Designated members of staff must be given appropriate training and authority to act in an emergency.
- **First aid arrangements**
  This should include relevant information on the measures the employer has made to appoint and train the relevant number of persons and locations of provided first aid kits and whether any specialist equipment is provided, e.g. a defibrillator.

They also require health and safety training (which should be repeated as appropriate):

- On recruitment
- On being exposed to new or increased risks

In addition to the *Management Regulations* and associated safe working practices e.g. transport, PUWER, machinery etc., perhaps the most pertinent legislation of relevance to the composting industry is the 2002 *Control of Hazardous Substances (COSHH) Regulations*. (These are described in more detail in Chapter 5). Under COSHH, employees are required to:

- Co-operate with their employers to ensure that employers meet their obligations under COSHH, and
- Make full and proper use of any control measures

However, unless employees have been adequately informed of all the hazards and the associated risks present within a working environment, it is unlikely that they will comply with the various procedures that have been established to protect them.

The COSHH Regulations therefore also specify that employees should be properly informed, trained and supervised about:

- **The nature of the substances they work with and the risks created by exposure to those substances**
  This means that operatives at a composting facility should be told about bioaerosols and dusts, and the adverse health effects that may result through inhaling these substances.
- **The precautions they should take**
  This means any control measures and the use of PPE (see below).

Specifically, employees should receive sufficient information and instruction on:

- **Control measures, their purpose and how to use them**
  The use of RPE should only be considered when it is not possible to eliminate or significantly reduce exposure to airborne contaminants. In practice, at a composting facility, this means the use of RPE to control exposure to bioaerosols and dusts. It is crucial that operatives understand **why** it is important to wear RPE. It is also of course important to have appropriate fit test, storage and maintenance procedures.

  People's perceptions about hazards and risks vary enormously and are potentially linked to severity. However, it would not be unreasonable to assume that hazards at a composting facility that present a safety risk are easier to comprehend than those that might, less obviously, affect a person's health. For example, the operation of a shredder is a hazardous process that has the potential to injure a person seriously. The risks associated with its use can be easily

assessed by non-technical persons. Unfortunately, the risks associated with the presence of hazardous substances, such as bioaerosols and dusts, are not as apparent. What cannot be seen is often assumed to carry no risk!

- **How to use personal protective equipment and clothing provided**
  It is very important that operatives receive adequate information and training on how to wear the PPE provided and what the limitations of its use are. The level of protection afforded by equipment, such as respirators, is often dependent upon 'face fit' and the way in which it is worn. For example, simple filtering respirators are only effective if they form a tight seal with the wearer's face. Operatives should also be informed that respirators never provide 100 % protection against bioaerosols and dusts; they merely reduce the concentrations to what are thought to be acceptable levels.
- **The reasons for and the results of any exposure monitoring and health surveillance**
  This should include, where appropriate, the collective results of the surveillance questionnaires described in Chapter 6, on an anonymised basis so specific individuals are not referred to.
- **Emergency procedures**
  Operatives must be made aware of the procedures that should be followed in the event of an emergency involving a hazardous substance. It is important that operatives know precisely what to do if for instance if a personal respirator fails during use.

Information, instruction and training should involve, whenever possible, the use of multi media techniques. Information disseminated in more than one way is more likely to be understood and remembered than the use of a single medium.

For instance information and instructions can be disseminated in written form (for example, some of the HSE leaflets listed throughout this Guide), which can be kept by workers for future reference. However, it should be remembered that simply distributing a leaflet or letter does not necessarily mean that it will either be read or understood. Certain individuals may have reading problems or learning difficulties, or language barriers, and may even be unaware that they do not understand the information provided. Hence the use of pictures may add valuable further information.

Depending upon the number of employees, a training session might prove to be invaluable. This will give employees the opportunity to ask questions or voice concerns that they may be reluctant, or find impractical, to do otherwise. It can also be used as a consultation exercise, thereby promoting a constructive health and safety culture within the organisation. The most relevant suggestions regarding safe working practices may be made by the persons who are directly involved in the work itself.

Training, ideally incorporating a theory class followed by a practical session, will help reinforce the basic principles. It is at this stage that some problems might be identified and acted upon straight away. A practical session is also more likely to be of interest.

Training in the use of RPE should specifically include the following:

- The nature of the hazardous substances and the risks involved
- The reasons why it is important to wear RPE
- The selection of the most suitable types of RPE and fit testing, if appropriate
- The limitations of the equipment
- Working practices, or other factors, that might reduce the level of protection provided by the equipment
- How to put on the equipment, adjust it to fit properly, and how it should be used
- How the equipment should be cleaned, maintained (e.g. changing filters) and stored
- How to report damage or malfunctions in the equipment

A lot of the information specified above should also be documented in the appropriate COSHH assessment form which should be made available at all times for reference by employees (see Chapter 5).

3.4 Provision of Safety Signs

The *Health and Safety (Safety Signs and Signals) Regulations 1996* require employers to display a safety sign where there is a significant risk to health and safety that has not been avoided or controlled by other means. Both the Management Regulations and COSHH require employers to carry out risk assessments and to introduce appropriate control measures. Safety signs should then be displayed where there is a significant risk remaining after control measures have been introduced.

There are four main types of safety signs:

- **Warning signs**
- These give warning of a hazard or danger and comprise a triangle with a black pictogram on a yellow background, (the yellow part to take up at least 50% of the area of the sign).

- **Mandatory signs**
- These prescribe specific actions that must be followed, for example, the use of specific items of personal protective equipment. They comprise a circle with a white pictogram on a blue background (the blue part to take up at least 50% of the area of the sign).

- **Prohibition signs**
- These prohibit certain actions that are likely to increase or cause danger, for example, smoking. They comprise a circle with a black pictogram on a white background with a red edging and diagonal line (the red part to take up at least 35% of the area of the sign).

- **Emergency escape or first-aid signs**
- These give information on emergency exits, first-aid or rescue facilities and are either square or rectangular in shape, with a white pictogram on a green background (the green part to take up at least 50% of the area of the sign).

- **Fire fighting signs**
- These give information on fire equipment and are either square or rectangular in shape, with a white pictogram on a red background (the red part to take up at least 50% of the area of the sign).

Examples of safety signs that might be displayed at composting facilities are shown in Figure 3.3.

Biological hazard | Safety boots must be worn | No smoking

Emergency first-aid | Fire fighting

Figure 3.3 Examples of safety signs that might be displayed at a composting facility

3.5 Promoting a constructive attitude towards health and safety

The *Consultation Regulations* require employers to seek employees' opinions about matters that affect their health and safety. However, if an organisation is to manage health and safety effectively, then a more progressive approach should be adopted.

It has been estimated by the HSE's Accident Prevention Advisory Unit that human error is a major factor in 90 % of accidents, of which 70 % could have been prevented by management intervention (Human Factors in Reliability Group, HSE 1995). Human error is rarely a deliberate action; rather it is often a combination of various factors, which can include:

- Inadequate information
- Lapses in attention
- Mistaken actions
- Misperceptions
- Mistaken priorities
- Personal factors
- Wilfulness

Employees' attitudes towards health and safety can be affected (both positively and negatively) by the organisation in which they work, the job they undertake and personal factors. This is shown schematically in Figure 3.4.

Striving to achieve the 'positive' factors listed in Figure 3.4 should help ensure that organisations achieve an acceptable, safe and healthy working environment. Effective communication through consultation, information and training, is the key to success.

THE ORGANISATION	THE JOB	PERSONAL FACTORS
POSITIVE FACTORS		
• Communication • Face-to-face discussions • Written information • Active consultation • Feedback • Taking note and acting on employees' opinions • Constructive behaviour by managers • Being seen to comply with health and safety rules • Wearing appropriate PPE when visiting a site • Team building • Encouragement to report potential problems or concerns on health and safety matters	• Job rotation • Sharing tasks to reduce monotony • Supervision • Knowledge that health and safety rules must be followed and that disregarding them will not be tolerated • Clear instructions and information • Relevant training • Encouragement	• Interest in the job • Enthusiasm for the job • Contentment at home
NEGATIVE FACTORS		
• Lack of interest by managers on health and safety matters • Disregard of health and safety rules my managers • Little or no communication • Lack of consultation • Reprimanding employees for reporting potential problems	• Monotony • Little or no supervision • Knowledge that health and safety rules can be ignored without the likelihood of disciplinary action • Lack of information or instruction • Inadequate / irrelevant / lack of training • Unnecessary criticism	• Dissatisfaction with job • Lack of interest in job • Drug / alcohol abuse • Problems at home

Figure 3.4 Factors that can affect employees' attitudes towards health and safety

Relevant HSE publications

Information

- (HSE 2012) Benefits and costs. http://www.hse.gov.uk/leadership/benefits.htm

Leaflets

- Signpost to the Health and Safety (Safety Signs and Signals) Regulations 1996 (INDG184) ISBN 978 0 7176 1139 3
- Consulting employees on health and safety: A brief guide to the law. (INDG232REV1) ISBN 978 0 7176 6312 5
- Managing health and safety: Five steps to success. (INDG 275) Web version.
- First aid at work, The Health and Safety (First-Aid) Regulations 1981 Approved Code of Practice and guidance (L74) ISBN 978 0 7176 6260 9

Books

- Consulting Workers on Health & Safety. Safety Representatives and Safety Committees Regulations 1977 (as amended) and Health and Safety (Consultation with Employees) Regulations 1996 (as amended). Approved Code of Practice and Guidance. (L146) ISBN 978 0 7176 6311 8
- Reducing error and influencing behaviour (HSG48) ISBN 978 0 7176 2452 2
- Safety signs and signals. The Health and Safety (Safety Signs and Signals) Regulations 1996 - Guidance on Regulations (L64) ISBN 978 0 7176 6359 0
- Successful health and safety management (HSG65) ISBN 978 0 7176 1276 5
- Human Factors in Reliability Group (1995) Improving compliance with safety procedures (HSE) ISBN 0 7176 0970 7

Chapter 4

Composting and Bioaerosols

This chapter examines the presence of micro-organisms during the composting process, the formation of bioaerosols and the potential health implications for site workers. The chapter is divided into three sections as follows:

- The role of micro-organisms in the composting process
- Bioaerosols and health
  This sections explains why bioaerosols are formed during the composting process and examines the potential adverse health effects associated with inhaling bioaerosols
- Similar occupational diseases
  This section provides examples of the effects of bioaerosols in industries other than composting

4.1 Introduction

Composting relies on the actions of a diverse range of micro-organisms to break down biodegradable feedstocks and convert them into compost (Figure 4.1). This is a natural process and is responsible for the recycling of nutrients across the world.

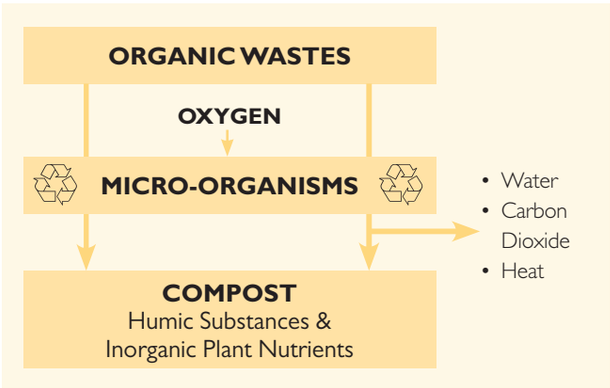

Figure 4.1 The role of micro-organisms in the composting process

By harnessing this process at a composting facility, man has scaled-up a natural process which therefore needs to be managed. Manufacturing compost can release some of these micro-organisms into the atmosphere where they can be breathed in and have the potential to harm human health.

4.2 Micro-organisms and composting

Micro-organisms (or microbes) can be defined as organisms which are capable of living on their own. By definition they are very small (microscopic) and can be found all over the earth in a very diverse range of environments, including volcanic hot springs, polar ice-caps and the intestines of animals, including man! Microbes are fundamental to the recycling of nutrients globally, and are therefore an integral part of the composting process.

The microbes primarily associated with composting are bacteria (which include a specific group called 'actinomycetes') and fungi (which include both 'moulds' and 'yeasts'). Together these are responsible for degrading organic wastes and

converting them into the substance we call 'compost'.

ACTINOMYCETES
A specific group of bacteria that are capable of forming very small spores

BACTERIA
A group of micro-organisms with a primitive cellular structure, in which the hereditary genetic material is not retained within an internal membrane (nucleus).

FUNGI
A group of micro-organisms with a more complicated cellular structure than bacteria, in which the hereditary genetic material is retained within an internal membrane forming a nucleus.

MICRO-ORGANISMS
Microscopic organisms that are capable of living on their own. Often called simply '**MICROBES**'.

SPORE
A general term describing a bacterial or fungal cell that is in a dormant form. They are a potential risk to health because they can be inhaled.

During the composting process, the activities of these microbes cause the temperature of the composting materials to rise. This is why actively degrading compost feels hot and accounts for the clouds of steam observed when the materials are turned. Hot compost contains different types of microbes from those in cold, mature compost, because only those that are specifically adapted to living at high temperatures are able to survive. Those microbes that are not adapted die.

Composting therefore selects for certain types of microbes, which can survive at high temperatures. These are termed 'thermophiles' and include certain species of fungi and some bacteria which can produce spores, including a specific group called the actinomycetes. The significance of this is explained below.

Most of the microbes that are present during the composting process are very small, especially the spores produced by some fungi and actinomycetes. They are typically between 1 - 10 µm in length, which means that it would take between 1,000 and 10,000 stretched out end-to-end to cover one centimetre (Figures 4.2 and 4.3).

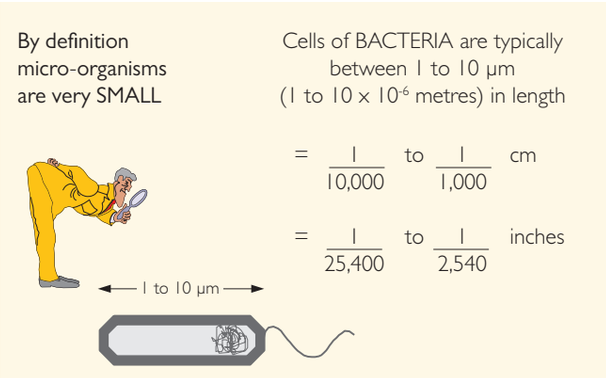

Figure 4.2 The size of bacteria

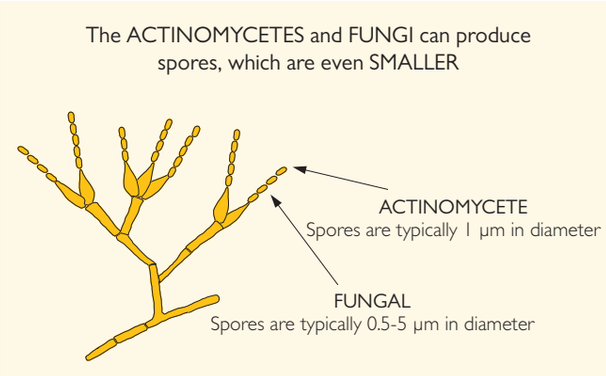

Figure 4.3 The size of spores

In a single gram of compost there are a very large number of microbial cells, possibly as many as 10^9 bacteria (1,000,000,000), 10^8 actinomycetes and 10^6 fungi. When composting materials are moved around, for example during the shredding, turning or screening processes, large numbers of microbes (both alive and intact dead cells), spores, plus various parts of cells that have broken up, are released into the air (Figure 4.4).

To complicate matters further, it is not just the intact microbes that are present in compost. When microbes die their cells break up and can release a range of different chemicals, such as endotoxin (found in the cell walls of gram negative bacteria), ß 1-3 glucans (found in the cell wall of fungi) and enzymes.

As these microbes are microscopically small, they tend to remain airborne for long periods of time, forming what is known as a '**bioaerosol**' - an aerosol (very small particles suspended in the air) of biological particles. They can be breathed in (inhaled) and have the potential to harm human health because they are so small and are present in such high concentrations.

BIOAEROSOLS

Micro-organisms and/or other tiny biological particles suspended in air, comprising of live cells, dead cells, spores and cell constituents and fragments. They are a potential risk to health because they can be inhaled.

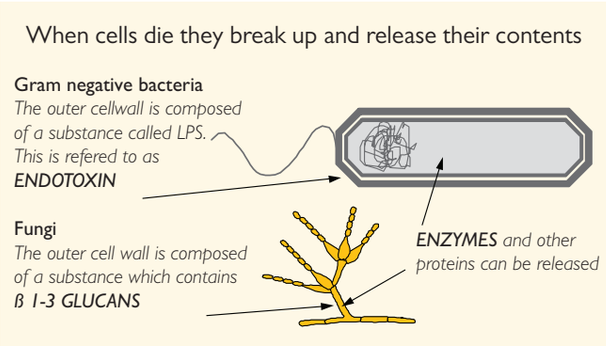

Figure 4.4 Fragments of micro-organisms

Composting therefore creates large numbers of very small micro-organisms, which can be formed into bioaerosols.

Even though the organisms that predominate during the composting process have been identified, it is extremely difficult to characterise bioaerosol emissions from composting activities as the concentrations and type of micro-organisms present are affected by the nature of the compost material, the temperature and moisture content of the compost, the process design and site operations and practices, geographical, topographical and meteorological conditions.

Studies have shown that very high levels of bacteria and fungi can be present in and around composting operational areas. Concentrations of bacteria and fungi frequently exceed 10^5 cfu/m^3 and in excess of 1 million cfu/m^3 (10^6) on occasion during operations such as windrow turning.

The bioaerosol emission data that currently exists relates primarily to open-windrow composting. Other treatment processes such as in-vessel or Mechanical Biological Treatment (MBT) facilities have the potential to reduce environmental emissions by maintaining optimum conditions in biofilters and by using other technology such as wet scrubbing. There is however the possibility that treating waste with a high biological content indoors may significantly increase workers' exposure. There is a lack of data regarding worker's exposure to bioaerosols at enclosed facilities but it has been estimated that working indoors can increase workers' exposures by 5-20 times compared to composting in the open air. Employers must ensure that effective risk assessment and risk control measures are in place to effectively manage these risks. (see Chapter 5)

A note on biofilters

Biofilters are reactors in which a humid polluted air stream is passed through a porous packed bed that supports a mixed culture of pollutant-degrading organism within a biofilm. Biofilters are installed primarily to reduce odours but have also been employed with the assumption that they reduce bioaerosols. The choice of filter medium is diverse and can include (but not exclusively) compost and oversize (woodchip or bark), peat, soil, shells, inorganic media, etc. Many of these materials will have a high microbiological load. They can clog, fail, and will need to be changed and maintained on a fairly regular basis.

✔ **The Association for Organics Recycling recommends that appropriate RPE is worn whenever biofilter material is changed or maintained, for example by agitation, unless the protection is afforded by other means (such as a filtered cabin).**

✔ **The Association for Organics Recycling recommends that detailed task specific risks assessments are conducted for biofilter materials that are changed that identify the most suitable RPE taking into consideration the task, its location and duration and the wearer of the RPE.**

4.3 Bioaerosols and health

People who work with composting materials, or those who are located in close proximity to the agitated compost, can potentially inhale large amounts of bioaerosols. The human respiratory system can adequately filter out larger dust particles through a combination of hairs which line the nose and specialised cells in the upper parts of our airways. Unfortunately, the smaller bioaerosol particles escape capture by these mechanisms and can penetrate deep into the lungs (Figure 4.5). As our lungs have a very large surface area and carry out a specialised function, they can easily be affected by bioaerosols.

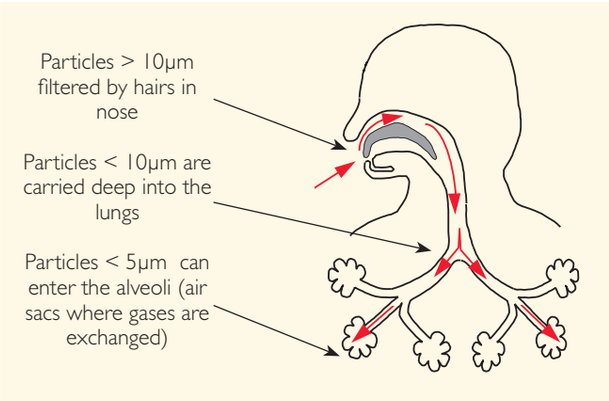

Figure 4.5 Bioaerosols can penetrate deep into the lungs

During the course of our daily activities, we inhale airborne microbes. This is as much a feature of normal everyday life as eating or drinking. Most individuals' bodies are perfectly capable of coping adequately with the presence of these 'invaders' and do not suffer any ill effects. It is only when airborne microbes, such as those generated during the composting process, are present in high concentrations that they may become harmful to human health. As an example, we all need to eat and drink everyday, however, too much can have detrimental effects.

Composting results in the formation of high concentrations of bioaerosols and selects for certain types of microbes which tend to produce very tiny spores. However, without even being close to composting activities, **we continually encounter these same microbes in our everyday lives at low concentrations**. They are present naturally and are essential in the 'recycling' of nutrients in our gardens, parks and countryside.

We all react to bioaerosols in different ways. It depends upon a variety of factors and is difficult to predict; some people have worked at composting sites for many years without apparently displaying any adverse health effects. But although they seem healthy today, does not mean there will be no long-term risks; a precautionary approach is always recommended.

Factors, such as prior exposure to bioaerosols, individual susceptibility, bioaerosol concentration and composition (the numbers and types of microbes present) and the length of time and frequency to which people are exposed all contribute to the way in which their bodies react. There are three main types of response:

- **Allergy**
  This is an immunological response that results in the body becoming 'sensitised' following exposure. The next time the body encounters the substance it 'over-reacts', even if the substance is present in extremely low concentrations. When such a substance affects a person's lungs in this way it is referred to as a '**respiratory sensitiser**'.
  Sensitisation does not usually occur immediately; rather it is a consequence of inhaling a substance over a period of months or even years.

- **Inflammation**
  This is a response of body tissues to an injury. It typically results in swelling, redness and pain.

- **Toxin poisoning**
  This is a disturbance of the normal bodily functions caused by a specific substance, known as a toxin. It differs from both allergic and inflammatory responses.

SIGN
Irregularity in a person's health that can be determined through examination e.g. breathlessness, wheezing.

SYMPTOM
Abnormal sensation a person experiences, which is not obvious through examination. These are described by the patient e.g. headache, nausea.

The effects of bioaerosol exposure can range from mild acute symptoms that initially have very little impact on everyday life to severe chronic conditions that are considerable and debilitating in nature. The most common conditions and associated signs and symptoms are listed in Figure 4.6.

It is important to note that these conditions are **not** due to **infections**. A clear distinction must be made between these allergic, irritative or toxic conditions and infections.

INFECTION
The invasion by and growth of micro-organisms in body tissues.

PATHOGEN
A micro-organism that causes disease through infection.

Condition	Cause	Common Signs & Symptoms
Asthma	An irritation / hypersensitivity of the lungs 'Over-reaction' of lungs following exposure to a respiratory sensitiser	• Difficulty in breathing • Wheezing
Alveolitis	Irritative inflammation of the alveoli (sac-like structures where gas exchange takes place) in the lungs. There are two types: Toxic alveolitis • Also known as Organic Dust Toxic Syndrome (ODTS) • Caused by exposure to endotoxin Allergic alveolitis • Allergic reaction • Includes the condition known as 'Farmer's lung'	Similar to the 'flu: • Fever • Fatigue • Difficulty breathing • Brief illness of flu-like symptoms occurring 6-12 hours after exposure lasting for about 4 hours. • Lasts for a long time
Mucous membrane irritation	Inflammation / irritation of exposed tissues in the eyes, nose and throat. (Rhinitis or conjunctivitis could also be present).	• Watering/prickly eyes • Running or stuffy nose • Sore throat
Chronic bronchitis and coughs (COPD – Chronic Obstructive Pulmonary Disease)	An inflammation of the respiratory tract caused by long-term exposure to noxious dusts, biological agents and gases.	• Coughing • Wheezing • Long-term illness
Gastro-intestinal disorders	Toxin poisoning	• Nausea • Vomiting • Diarrhoea • Occurs within hours of exposure
Skin disorders	Exposure to high levels of endotoxin or dust containing bacteria and fungi	• Sore, inflamed skin • May result in eczema

Figure 4.6 Conditions that may be caused by inhaling bioaerosols

Infections are caused by **pathogenic** microbes which are capable of invading body tissues and growing within an individual. Spots and boils are both examples of microbial infections.

Organic wastes which contain materials of animal origin such as food waste may contain a number of human pathogens (microbes that are capable of infecting humans) on delivery to a facility, such as the stomach bugs *Escherichia coli* (or *E. coli*, as it is commonly called) and *Salmonella*.

The fungus, *Aspergillus fumigatus*, is particularly associated with composting plant materials and is a product of material breakdown. It is found all over the world, especially in soils, as it is capable of degrading cellulose (which is a major compound in plants) and surviving at high temperatures ('in excess of' 60°C). As part of its life cycle, *Aspergillus fumigatus* produces very tiny spores. If inhaled as a bioaerosol, these spores may cause allergies and inflammations, resulting in some of the conditions described in Figure 4.6.

However, *Aspergillus fumigatus* can also infect certain people, a condition caused aspergillosis. Aspergillus species are therefore classed as opportunistic pathogens which means that they will only infect an individual whose immune system does not work properly. Such altered immunity sometimes develops as a consequence of special medical treatment, such as those that prevent rejection of a transplanted organ, or as a result of an existing infection with another microbe (e.g. HIV). Allergic

Bronchopulmonary Aspergillosis (ABPA), although very rare, has been reported following exposure to Aspergillus species, particularly *Aspergillus fumigatus*. This condition usually occurs in individuals with pre-existing respiratory conditions such as asthma or cystic fibrosis and exacerbates existing symptoms of sufferers.

A note on Volatile Organic Compounds (VOCs)
These are organic chemicals in the gaseous phase and are known to be emitted during the composting process as part of microbial breakdown of material, particularly during the early stages of the composting process. The types and concentrations of VOC emissions from composting activities are not well characterised at this current time but VOCs are known respiratory irritants and are also known to act in combination with other bioaerosol components to increase the human immunological response following exposure. However, it is important to note that being able to smell a gas does not necessarily mean it is harmful, our noses are very sensitive!

4.4 Similar occupational diseases

The adverse health effects described above are by no means unique to composting. Whilst there is still limited understanding of the risks to compost worker's health from exposure to the bioaerosols generated during composting, other industries such as agriculture, swine and poultry farming, textile and cotton mills have reported adverse health effects in workers form exposure to agents known to be present in compost bioaerosols. For this reason the hazard potential of compost bioaerosols should be recognised and, in the absence of definite evidence, employers should adopt a precautionary approach in managing these potential risks. Chapter 5 embraces this concept and identifies the need for employers to reduce workers exposure to bioaerosols *'so far as is reasonable practical'* in accordance with health and safety legislation.

Examples of recognised occupational diseases from exposure to organic dust or bioaerosols include:

- **Farmer's lung**
  Associated with the handling of mouldy grains, straw and hay and working in intensive livestock barns
- **Mushroom worker's lung**
  Associated with the production of mushroom substrate
- **Bird breeder's or Pigeon Fancier's lung**
  Caused by bacteria from feathers and droppings

Medically these are referred to as 'extrinsic allergic alveolitis' and occur as a result of inhalation of spores.

Relevant publications

- Farmer's lung (AS5) (2006) HSE Leaflet Web Friendly Version. Available from: hse.gov.uk/pubns/as5.pdf
- Occupational Asthma. A Guide for Employers, Workers and their Representatives. (2010) British Occupational Health Research Foundation. BOHRF: London Web Version. Available from: bohrf.org.uk/downloads/OA_Guide-2.pdf
- Occupational and environmental exposure to bioaerosols from compost and potential health effects – A critical review of published data. Swan J.R.M, Gilbert E.J., Klesey A. and Crook B. (2003) HSE Research Report 130 ISBN 978 0 7176 2707 3
- Monitoring of particulate matter in ambient air around waste facilities. Technical Guidance Document (Monitoring) M17. The Environment Agency (2004) ISBN 1 844 322610
- Review of Environmental and Health Effects of Waste Management: Solid Waste and Similar Wastes. DEFRA (2004) PB9052A
- Exposure-response Relationships for Bioaerosols Emissions from Waste Treatment Processes. Searl A. (2008). Edinburgh: IOM.

Chapter 5

Control of Substances Hazardous to Health Regulations 2002

This chapter outlines the purpose and implementation of the Control of Substances Hazardous to Health Regulations 2002, commonly known as COSHH. The chapter is divided into sections as follows:

- The fundamentals of COSHH
- Duties under COSHH
- Identifying hazardous substances at composting facilities
- Assessing risks
- Preventing exposure
- Controlling exposure
- Monitoring exposure
- Health Surveillance
- Information, Instruction and Training
- Documenting the assessment and preventive / control measures implemented

5.1 The fundamentals of COSHH

The *Control of Substances Hazardous to Health Regulations 2002* (COSHH), aim to protect the health of all people who may be exposed to hazardous substances as a result of their work. It requires employers to assess the **risks** associated with various work activities which are a result of their exposure to **hazardous** substances (whether directly connected with the work or if exposure is incidental) then to introduce procedures to eliminate, control or minimise the risk. The objectives of COSHH are shown schematically in Figure 5.1.

5.2 What COSHH Covers

COSHH has been updated a number of times since its first inception, mainly to implement new information on various substances and a variety of European Directives. However; the fundamentals and general principles remain largely the same.

As the composting process results in the formation of bioaerosols, which may cause a number of different medical conditions if inhaled (as discussed in Chapter 4), bioaerosols, or biological agents as they are termed in the COSHH Regulations, are classified as hazardous substances because of their potential to cause harm to human health. In this document COSHH is used to assess hazardous substances which may be either present or formed during the composting process, then provides information on the procedures involved in making a COSHH assessment, focusing, in particular, on the potential risks from bioaerosols.

More specifically, as many of the organisms present in compost bioaerosols are a potential cause of occupational asthma, the specific provisions relating to occupational asthmagens (Appendix 3 of the COSHH ACOP) apply to the exposures encountered by compost workers. These provisions require that exposure to substances with the potential to cause asthma be prevented. If this is not possible, exposures must be reduced *'so far as is reasonably practicable'*. The provisions also require that all employees likely to be exposed to agents that may cause occupational asthma be under appropriate health surveillance and be provided with appropriate instruction, information and training about the risks they are exposed to.

It is also worth noting that COSHH covers a broad range of biological and chemical hazards which are not specifically covered in this chapter but extensive guidance documents are available from the HSE.

Reminder:

- The **hazard** presented by a substance is its potential to cause harm.
- The **risk** posed by a substance is dependant on the likelihood that exposure will occur and the severity of the impact following exposure.

Identify what the *hazardous substances* are

- Bioaerosols which may include pathogens
- Dusts
- Others, e.g. VOCs

Assess the *risks* associated with *exposure*

• How are people exposed to the substance	e.g. through inhalation
• What are the potential adverse health effects	e.g. asthma, bronchitis
• Who is exposed	e.g. operatives, visitors, susceptible individuals
• When are they exposed	e.g. shredding, turning windrows, screening
• How long are they exposed for	e.g. four hours for five days a week
• What quantities are present	

Record the assessment

- Written format
- Available to all employees, sub-contractors/persons potentially exposed to the hazard

Prevent exposure

- Totally enclose the process
- Place a limit on the number of people exposed
- Restrict access and/or reduce, as much as possible, an individuals exposure

Control Exposure through a hierarchy of measures

• Control access	e.g. introduce site zoning
• Introduce engineering controls	e.g. partially enclose the system use machinery with a cab and air filtration
• Operational controls	e.g. the way the facility is operated
• Personal protective equipment	e.g. use of respirators

Inform, instruct and **train** employees

• About the nature of the hazardous substances	
• About safe practices and correct use of engineered control measures	
• About the proper use of control measures	e.g. personal protective equipment

Monitor exposure

- Where there could be a serious risk to health if control measures fail
- If you are not sure that concentrations are below levels associated with adverse effects
- Where you cannot be sure that certain control measures are adequate

Monitor health of employees

- Where employees are exposed to a substance known to adversely affect human health; and
- There is a reasonable likelihood of a specific disease or adverse health effect occurring under the conditions of work; and
- It is possible to detect the disease / adverse health effect

Review assessment

- At least annually
- If any significant changes in work practices are made
- After any accident* or dangerous occurrence*
- After evidence of ill health that might indicate deleterious effects of working conditions*

* Requires reporting under RIDDOR; refer to Chapter 6

Figure 5.1 The objectives of COSHH

5.3 Duties under COSHH

Duty for the protection of:			
Duty of employer	**Employees**	**Other persons at the premises**	**Other persons likely to be affected by the work**
Assessment	YES	SFRP	SFRP
Prevention or control of exposure	YES	SFRP	SFRP
Use of control measures & maintenance, examination and test of control measures	YES	SFRP	SFRP
Monitoring exposure at workplace	YES, where requisite	SFRP	NO
Health surveillance	YES, as identified in the risk assessment	NO	NO
Information, training etc	YES	SFRP	NO

Figure 5.2 Employers' duties under COSHH
SFRP, So Far as is Reasonably Practicable
Source: Adapted from the General COSHH ACOP (Crown copyright) (HMSO, 2005)
Reproduced with the permission of the Controller of Her Majesty's Stationery Office.

COSHH places responsibilities on both employers and employees. Employers' duties are summarised in Figure 5.2.

Employees also have legal obligations to:

- Co-operate with their employers to ensure that employers meet their obligations under COSHH (e.g. to carry out the work in the manner indicated by the employer)
- To make full and proper use of any control measures and to report such defects in such measures

This means that employees are **obliged** to comply with instructions given by their employer regarding safe practices and to use any control measures provided. This was discussed previously in Chapter 3.

5.4 Identifying hazardous substances at composting facilities

Although COSHH relates primarily to specific hazardous substances, such as toxic chemicals used in the workplace, it also relates to any hazards that may be produced as part of any process. Operators are also advised to take into account that the generation of bioaerosols and dusts at composting facilities is also included within the COSHH framework. The information provided in Chapter 4 describes the potential adverse health effects which may be caused by inhaling bioaerosols.

The complex composition of compost bioaerosols has been discussed in detail in Chapter 4. However, the concentration and types of species present in compost emissions are known to be highly variable. These will largely depend upon the feedstock and how the composting materials are processed and handled. As this is an area that has been poorly researched to date, it is difficult to predict precisely what substances will be present at all times during the composting process, what substances may be present under certain conditions (for example, if the windrows are allowed to turn anaerobic), and what substances are unlikely to be formed under any circumstances.

Consequently, as a result of the complex composition of compost bioaerosols, it is not feasible to identify all the individual hazardous substances that might be present and measure their concentrations. This therefore makes an assessment of the associated risks particularly arduous.

As the composting process actively encourages the growth of organisms known to be associated with adverse health outcomes and in particular to the requirements of COSHH, substances known to be related to the development of

occupational asthma, exposures to compost bioaerosols must be reduced *"so far as is reasonably practicable'*. Monitoring the concentration of certain compost organisms or indicators of biomass, such as endotoxin, present in dust arising form compost activities may be a useful practice in assisting with the development of effective risk assessments to ensure that control measures are proportionate to the risks faced by workers, in accordance with the legal requirements.

A summary of the hazardous substances that can potentially be present or formed during the composting process is given in Figure 5.3.

Substance type	Composition	Comments
Biological		
Bioaerosols	• Cells and spores of bacteria and fungi • Fragments of cells e.g. endotoxin and Glucans	• Potential to cause allergy and inflammation • Will always be formed in large quantities • Invisible
Dust	• Fragments of composting materials • Aggregates of microbes	• Potential to cause allergy and inflammation • Will always be formed in large quantities • Mostly visible
Infective agents	• Pathogenic micro-organisms E.g. *E. coli, Salmonella* species	• Potential to cause infection • Primarily present in feedstocks of animal or human origin
Chemical		
Volatile organic compounds (VOCs)	Compounds that contain primarily carbon and evaporate easily at ambient temperatures	• Potentially odorous and toxic • Often only formed in appreciable quantities under anaerobic conditions
	• E.g. *Fatty acids, alcohols*	• Research suggests they are unlikely to be present at concentrations exceeding those permitted in the workplace, especially in an outdoor environment
	• E.g. *Methane*	• Unlikely to be formed unless conditions are allowed to become very anaerobic • Inflammable
Nitrogenous compounds	Compounds that contain primarily nitrogen • E.g. *Ammonia*	• Often odorous and toxic • Only formed in appreciable quantities if too much nitrogen and not enough carbon in the feedstock (low C : N ratio)
	• E.g. *Cyanide*	• Associated with laurel bushes; hydrogen cyanide is released when the plants are cut or crushed • Concentrations are only likely to be problematic if laurel bushes are shredded in a poorly ventilated area
Sulphurous compounds	Compounds that contain primarily sulphur • E.g. *Hydrogen sulphide*	• Often odorous and toxic • Primarily formed under anaerobic conditions
Carbon monoxide/dioxide	Carbon monoxide/Carbon dioxide	• Often toxic, produced from internal combustion engines • Concentrations are only likely to be problematic if poorly ventilated area
Polycyclic aromatic hydrocarbons.	PAHs	• Potentially toxic, produced from diesel powered engines • Concentrations are only likely to be problematic if poorly ventilated area

** List is not definitive.*

Figure 5.3 Hazardous substances that may be present or formed during the composting process and related operational activity.

Inhalation is not the only risk that should be assessed under COSHH. Some composting feedstocks, such as sewage sludges and animal-derived materials (faeces, carcasses, possibly food wastes etc.), are likely to contain pathogenic microbes that can infect humans (for example, *E. coli* and *Salmonella* species). Under most circumstances, the most likely route of infection for these types of organisms will be through ingestion (swallowing) rather than inhalation. Ingestion may result if operatives transfer pathogens which have been inadvertently picked up on their hands or work implements (such as a pen) into their mouths. This can occur if good hygienic practices, such as washing hands prior to eating, drinking or smoking, are not carried out. Open wounds or cuts can be a possible route of infection so the covering of any such wounds should be covered in good first aid and hygiene practices. Good hygienic practice is discussed in Chapter 9.

It should also be considered that feedstocks, such as source-segregated household wastes, may be contaminated with these materials, (and others even though they are not permitted). After all, it is impossible to govern precisely what a householder will put in a collection container. As such, it is prudent, when assessing risks, to assume that some human pathogens may be present. Vaccinations are discussed in Chapter 6.

Other activities when operating the facility are also possible sources of hazards. These could include but be far from limited to possible hazards from engine fumes, especially if operating an enclosed operation with diesel powered plant. Another possible area of consideration is the aerosolising of compost liquor, e.g. recirculation to be used for spraying on to fresh batches to increase moisture content.

With the increasing number of in vessel facilities, there are a number of risks that are not always shared with open windrow composting, e.g. confined spaces and DSEAR. These will be discussed in more detail in Chapter 7.

The liquor, or runoff, from the process is also a hazard. This liquor can contain a variety of substances which could include but not be limited to pathogens, VOCs heavy metals and ammonia. These will be discussed in more detail in chapter 7.

5.5 Assessing risks

Once the hazardous substances have been identified, COSHH then requires exposure and the associated risks to be assessed. Again, this is a difficult task, as individual exposure levels and susceptibilities are known to vary considerably. It is advised to manage this uncertainty by adopting a precautionary approach to demonstrate that the risks have been reduced *'so far as is reasonably practicable'*.

Concentrations of bioaerosols and other airborne hazards are likely to be high in operational areas, which include:

- Where bulk quantities of waste are being moved
- Around an operational shredder
- Around an operational windrow turner or vehicle that is being used to turn windrows
- Around an operational screen
- A bowser (or other device) that is being used to spray captured leachate
- CO and PAHs from plant exhaust outlets in an enclosed and poorly ventilated facility structure

There are many interrelated factors that affect how they are dispersed in the atmosphere, including wind direction, speed, turbulence, temperature etc. As it will be impracticable to assess this every time an activity is carried out, it is recommended that a simple 'rule of thumb' assumption be used.

As most of the chemical compounds listed in Figure 5.3 have a detectable odour, it might be possible to detect whether they are present. There may also be visual signs, such as vapour or smoke that also indicate the presence of a possible hazard. Factors such as the feedstock, the site-management regimes in place, whether there have been any interruptions (for example, if a shredder has broken down), climatic conditions, and whether any of the processes are carried out indoors can all influence the formation and relative concentrations of such compounds.

It would be prudent to assume that bioaerosols and dusts (and to some extent other airborne hazards) will always be present in sufficient quantities to potentially harm individuals **who work within a distance of about 30 metres of the 'source'**.[1]

[1] *Current research suggests that bioaerosol concentrations decrease with distance from the source of the emissions and in most cases are substantially reduced at 30m from the sources (Stagg et al, 2010)*

Suggested Value	Bacteria cfu/m^3	Gram -ve bacteria cfu/m^3	Fungi cfu/m^3	Actino-mycetes cfu/m^3	Total micro-organisms	Endotoxin EU/m^3	Organic Dust mg/m^3	References
Suggested OELs in Scandinavia		1,000	10^5					Rylander *et al* 1994
Threshold values			5,000					Peterson & Vikstrom
OEL		1,000			5-10,000			Makros 1992
OEL		2×10^4		2×10^4	1×10^4			Dutkiewitz & Jablonski 1989
Increased risk EAA & ODTS					$> 10^6$			Lacey *et al* 1990
Threshold values		1,000						Lacey *et al* 1990
Suggested OEL 8 hr average	5-10,000	1,000						Sigsgaard 1990
Health based OEL*		2×10^4	5×10^4	2×10^4	1×10^5			Dutkiewitz 1997
Number of spores necessary for development acute symptoms					108			Miller 1992
Provisional Dutch guidelines for indoor air at work	10,000							Dutch Occupational Health Association NWA 1989
Suggested OEL in Scandinavia		Toxic pneumonitis 10^5 Respiratory inflam. 10^2	Toxic pneumonitis 10^7 Respiratory inflam. 10^5					Rylander 1994
Proposed Dutch OEL 8hr average						90		DECOS 2010
Threshold values						Airways inflam100 Systemic effects 1000 Toxic pneumonitis 2000		Rylander 1997
Scandinavian OEL							5	AFS 2005:17
Danish OEL							3	Arbejdstilsynet 2007

Figure 5.4: Guidelines on exposure to bioaerosols

* OEL Health based when continuous exposure to micro-organisms concentrations above 10^5 cfu/m^3 occurs work-related respiratory disorders in workers are very common.

Adapted from Research Report 130 (HSE, 2003)

Concentrations will also be high inside in-vessel systems and indoor facilities, and these should be risk assessed during loading, unloading and maintenance. This is discussed further in Chapter 7. An FAQ on how a risk assessment might be conducted can be seen in Appendix I.

At this time, insufficient data exists to determine the exposure levels required to elicit an adverse effect for both acute and chronic effects. Suggested threshold levels for some of the agents present in compost bioaerosols have been suggested and are detailed in Figure 5.4 below. At this time however, there are no legal Workplace Exposure Limits (WELs) that exist in the UK for compost bioaerosols or any components likely to be present.

It must therefore be assumed that, in the absence of any agreed legal exposure limits in the UK, it is advised that any of the composting activities (shredding, turning, screening, moving bulk compost / waste or spraying captured leachate, or entering an in-vessel system) potentially presents a risk to human health in any of the ways discussed in Chapter 4.

It is known that workers' exposure levels to bioaerosols will differ from site to site and between the various activities undertaken on site. Consequently generic risk assessment approaches will be unsuitable in managing these risks. A detailed **site specific, task-specific assessment** will be required to ensure that proportionate controls are identified to reduce the potential risks to employees from bioaerosol exposure *'so far as is reasonably practicable'*. This assessment must also consider employees likely to be susceptible to these

exposures and also any instances where members of the public or visitors could be potentially exposed.

People who may come into contact with a site, such as the general public walking on an adjacent public footpath or visiting an adjoining recycling centre, should also be considered in any risk assessment. In practice, it is extremely difficult to quantify these risks, which are probably very low; therefore the best option is to try to locate sources away from public areas where practicable.

Drivers of vehicles who use adjacent roads will be exposed for very short time frames. Based upon current knowledge, it is not thought that risks to these users would be significant.

5.6 Preventing exposure

Under COSHH, the priority is **always** to **prevent exposure**. Unfortunately this is not possible in many instances due to the nature of the activities required or the design of the site or activities.

Access to non-essential employees should be prevented from all enclosed areas, e.g. mechanical biological treatment facilities, enclosed reception and processing areas, in-vessel and enclosed windrow systems.

Restricting the number of employees in high exposure areas to a bare minimum will limit the absolute number of people exposed, though control measures are still needed to reduce these individuals' exposure. Organising the staff work schedule so that each individual staff member has a minimum exposure time to a potential hazard, may also be a possible part of a control system.

5.7 Controlling exposure

If exposure to hazardous substances cannot be prevented, then the COSHH Regulations state that exposure must be controlled. The nature of the composting process means that this is often the only feasible option. However, under COSHH, this is still deemed to be a last-measure resort.

Exposure can be controlled through a hierarchy of measures:

- **Operational Controls such as limiting bioaerosol release from source**
  This can be achieved form a number of practices such as wetting down dry compost to suppress dust emission, avoid large stockpiling of waste, minimising drop heights when waste is being moved or processed, restricting the movement of waste outdoors during high winds.
- **Changing working practices**
  Where possible, the introduction of risk zones (high, medium and low) is recommended to assist with the effective management of worker's exposures to dust and bioaerosols. This has been suggested in a recent study conducted by Stagg et al (2010) on composting sites. Introducing zonal areas, based on workers' exposure levels (anticipated or measured) would enable work practices to be controlled and proportionate risk control measures to be implemented in accordance with the potential risks identified in these zones This could include, for example, site rules prohibiting the opening of vehicle windows and doors, or exiting vehicles when in high risk zones such as operational areas where waste is being moved or agitated or within a building. Stagg et al (2010) suggest that exposure levels reduce substantially when 50m and 100m downwind of the activities involving the agitation of waste. As a general guide therefore high risk zones could be areas where waste is being moved or treated or within a building. Medium risk zones could be established at a 50m radius away from operational areas and low risk zones could be offices and restrooms away from the operational areas where workers have to decontaminate prior to entry. It is recommended however that each site undertake a site specific risk assessment as local site conditions will vary considerably
- **Engineering controls**
  Engineering controls should be considered to reduce exposure by limiting the airborne concentration in the breathing zone (e.g.: through extraction, ventilation of enclosed work areas or siting workers some distance from the activity or within an enclosed controlled environment with filtered air such as a vehicle cabin or control room. The provision of a cabin or workstation with a filtered or separate air supply is often a practical solution. (See Chapter 8)
- **Use of personal protective equipment**
  This is the final level of defence to be used where other methods are not reasonably practicable or where a combination of controls are deemed appropriate. It includes the use of respiratory protective equipment. (See Chapter 8)
- **Use of work only clothing**
  If the risk of bioaerosols is to be taken seriously it must be noted that staff member's clothes have the possibility to

collect dusts on them and become a source themselves. Hence it is recommended that sites issue staff with work only clothes. These can be in the form of overalls or trousers/tops. These items are then only worn at work and laundered separately to staff's own clothes.

Note:
Employers have a duty under COSHH to ensure that any control measures provided are maintained in good working order and are serviced at appropriate intervals. **Employees** are required to use those control measures provided in a correct manner and to report any defects they may find.

5.8 Monitoring exposure

The COSHH Approved Code of Practice requires concentrations of hazardous substances to be monitored under certain circumstances if:

- There could be a serious risk to health if control measures fail
- There is a possibility that concentrations may increase above workplace Exposure Limits (WELs) or in-house standard may be exceeded.
- As an additional check on the effectiveness of existing control measures.

At this time there is no specific guidance in relation to the need to measure worker's exposure to bioaerosols and moreover, no guidance in relation to the preferred monitoring methods and the bioaerosol components that should be assessed.

The necessity for worker's exposure levels to be assessed should arise from the findings of the risk assessment and therefore will be dependant on the potential for the exposures to occur but also to confirm that workers exposure levels are acceptably low as a result of effective control measures being in place.

Because of their complex nature and the variation in peoples' responses to exposure to bioaerosols, no WELs have been assigned specifically for bioaerosols (either individual micro-organisms, their constituent parts, or the complex mixture of both that will be present at composting facilities), and it seems unlikely that this will happen in the foreseeable future and therefore quantitative determination of worker's exposure to bioaerosols is difficult.

However the adverse health effects associated with the inhalation of dusts containing biological material have been well-documented over many years in other industries such as grain handling, swine and poultry farming and the textile and cotton industry.

These exposures, whilst different to compost bioaerosols share similar components and in the absence of specific guidance and specific research to base assessment of the risks to compost workers, this Guide advocates a precautionary stance on the management of bioaerosols.

✔ **The Association for Organics Recycling recommends that a risk-based judgement to be made regarding the need for monitoring to be undertaken to assess worker's exposure to agents present in composting bioaerosols known to be of concern but also to demonstrate the efficacy of existing control measures. This monitoring data will be useful in informing the extent and type of control measures needed to reduce workers exposure 'so far as is reasonably practicable'.**

This is a highly technical area and specialist expertise will be needed to undertake this type of monitoring.

WORKPLACE EXPOSURE LIMIT (WEL)
This is the maximum concentration of an airborne substance, averaged over a reference period, to which employees may be exposed by inhalation under any circumstance (i.e. is set for substances which may cause the most serious health effects).

TOTAL INHALABLE DUST
This is airborne material which is capable of entering the nose and mouth during breathing and is thereby available for deposition in the respiratory tract

RESPIRABLE DUST
This is airborne material which is capable of penetrating to the gas exchange region of the lung, i.e. to the deepest parts of the lung.

The COSHH Regulations state that "dust of any kind, when present in a substantial concentration in air" is a substance hazardous to health. The COSHH Approved Code of Practice states that a 'substantial' concentration of dust should be taken as:

- 10 milligrams per cubic metre of air (mg / m^3) of **total inhalable** dust (8-hour time-weighted average [TWA]) and
- 4 mg / m^3 of **respirable** dust (8-hour TWA).

The composition of 'dust' dictates what its likely effects on human health will be, for example, its particle size distribution (i.e. whether it is respirable or not) and its biological and chemical composition. This is reflected in the different WELs (total inhalable fraction) that have been set for a number of different dusts of biological origin: grain dust (10 mg / m^3 8-hour TWA), hard wood dust (5 mg / m^3 8-hour TWA), soft wood dust (5 mg / m^3 8-hour TWA) and wool process dust (10 mg / m^3 8-hour TWA).

Studies have shown that compost workers exposures to dust are generally low (Sykes et al, 2010), but even when dust levels are low, the levels of biological material present in the dust may be higher than levels though to be related to adverse symptoms.

Information on dusts from compost sites

It has been suggested that COSHH WELs, set for general nuisance dust, are inappropriate for dusts containing biological material because of their increased toxic potential. The limited data available suggests an increase in respiratory symptoms at inhalable dust levels exceeding 5 mg/m^3 (Gladding *et al* 2003). In recognition of this, Occupational Exposure Standards for '**organic** dust' (dust containing biological material) have been set in Denmark of 3 mg/m^3 [8hour TWA].

Analysis conducted by Sykes *et al* (2010) suggest that an inhalable dust level of 1.53 mg/m^3 would be needed if workers' exposures to endotoxin were to be kept below the regulatory level of 90 EU/m^3 currently in force in the Netherlands (Decos, 2010). This is obviously significantly below current WELs for dust. There is no separate regulatory requirement for organic dusts within the UK at the present time.

Standard methods for the assessment of respirable and total inhalable dust do exist, and are detailed in the HSE guidance *MHDS 14/3: General methods for sampling and gravimetric analysis of respirable and inhalable dust* (HSE, 2000). Clearly, monitoring dust concentrations on a gravimetric (weight) basis at a composting facility will provide valuable background information on personal exposure levels and levels present in certain work areas, since compost 'dust' comprises largely of bioaerosols, measurements by gravimetric methods will not necessarily provide an adequate indication of their full potential to harm human health.

Consideration should therefore be given to undertake a specialised assessment of workers' exposure to micro-organisms (see below) and known toxic components of compost bioaerosols such as endotoxin so that high exposure activities/zones can be identified and an appropriate risk mitigation strategy can be developed.

✔ **The Association for Organics Recycling recommends that the assessment of personal exposures to dust (as per MHDS 14/3) and total mesophilic bacteria, Gram negative bacteria and *Aspergillus fumigatus* are conducted by using IOM sampling heads, filters and the same media as the current AfOR guidance, "A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities" (AFOR 2009). In addition consideration should also be given to measuring thermophilic actinomycetes and total fungi present as these are known to be of have clinical significance and also predominate during the composting process. For more complex sites or where very high exposures to viable bioaerosols are recorded, endotoxin monitoring should be considered.**

5.9 Health surveillance

The COSHH Regulations specify that health surveillance is required:

- Where employees are exposed to a substance which is known to adversely affect human health; and
- There is a reasonable likelihood of a specific disease or adverse health effect occurring under the conditions of work; and
- It is possible to detect the disease/adverse health effect.

As the inhalation of bioaerosols formed at composting facilities is known to cause a number of diseases, such as asthma, which can be easily detected, then employers have a duty to ensure that their employees' health is monitored. The extent and detail of the health surveillance should be related to the degree of risk identified during the COSHH assessment. This is discussed in more detail in Chapter 6.

5.10 Information, Instruction and Training

COSHH requires that the employer provides information, training and instruction for employees who work with substances hazardous to health. This includes cleaning and maintenance staff. Hence all staff on an organic waste treatment site should be kept informed of the issues that could affect them on a site.

Employees need to understand the outcome of any risk assessment and what this means for them. This includes:

- what the hazards and risks are, e.g. traffic hazards or the risks associated with bioaerosol exposure;
- about any workplace exposure limit e.g. inhalable dust at 10 mg/m3 as a time weighted average;
- the results of any monitoring of exposure e.g. any dust measurements;
- the general results of health surveillance e.g. anonymised information about health on the site;
- what to do if there is an accident (e.g. spillage), or emergency (e.g. if there is a fire).

Employees should have access to safety data sheets.

It is also important to keep employees informed about planned future changes in processes or substances used on site, this might be particularly important if a planned change in tonnage, working practices or materials accepted on site were to occur.

There is also a requirement to provide training when a contractor comes on site; they need to know what the risks are and how you are controlling them. Additionally you need to know if they are bringing hazardous substances onto your premises, and how they will prevent harm to your employees.

Finally, employers should keep basic training records. This also demonstrates that training is provided should an incident occur.

5.11 Documenting the assessment and preventive / control measures

Once a COSHH assessment has been carried out, the information needs to be written down and made available for all employees to read. Ideally it should:

- Be written in clear, **plain English**. It should not contain 'jargon' words or phrases which may not be fully understood by every employee. Remember that certain individuals may have reading problems or learning difficulties or language barriers.
- Contain clear information regarding the **nature** of the **hazardous substances** to which people are exposed (principally bioaerosols and dusts at composting facilities).
- Be site specific and task specific so that local exposure scenarios and control options are being considered.
- Consider all employees, including susceptible individuals, and visitors to the site.
- Contain clear instructions regarding the **measures** which should be adopted to either **prevent** or **control** exposure to these substances, for example, when personal protective equipment should be used.
- Employers have a duty to ensure that all employees receive adequate training in **how** to use the control measures provided and the reasons **why** it is important to use them.
- Contain clear instructions regarding **emergency procedures**.
- Always be available for **reference** by those people who are at risk of exposure (e.g. placed in the rest room or office).
- Be a **working document** which is signed, dated and regularly reviewed.

It may be helpful to produce a standard form (endorsing 'local rules') that can then be updated when appropriate. This will help ensure that a consistent approach for each assessment is undertaken, and is more likely to be read and understood by the operatives.

It is vitally important that an effective and proportionate assessment be made. A lack of attention to hazards will create problems; however, an overreaction may lead to unnecessary anxiety in the work force or a lack of compliance with the Regulations.

It is advised that the COSHH assessment be reviewed:

- At least annually (as a check that it is still relevant);
- Whenever there is a reason to believe that the assessment is no longer valid. For example, if there has been an accident or dangerous occurrence, or if there is evidence of ill health among employee(s) that might indicate deleterious working conditions, or
- Where there has been a significant change in the work.

A specimen COSHH assessment form is shown in Figure 5.5.

COSHH ASSESSMENT – Vehicle operators COMPOST-IT-ALL LTD			
COMPOSTING SITE			
Rottingthorpe Somewhere Town			
RELEVANT SITE ACTIVITIES			
• Shredding any materials • Turning windrows • Screening compost • Moving compost or waste around the site			
HAZARD			
Breathing in dusts and bioaerosols			
RISK (without controls)		HIGH	
CONTROL MEASURES			
• Vehicle cab to be maintained in a clean condition and free form clutter. The vehicle must be cleaned in accordance with the local rules e.g. vehicle cleaning schedule • Boots and over clothing must be clean to avoid cab contamination. • Where practicable, drivers should not exit their vehicles in operational areas. If possible drivers should exit their vehicles in low risk areas only (>30m away form site operations) • Drivers MUST keep windows and doors closed at all times • Daily checks are required to ensure the vehicle air filtration system is operating effectively. • The vehicle air filtering system must be ON at all times. • The vehicle air filtration system must be regularly serviced and the filters changed at least in accordance with the manufacturer's guidance.			
MONITORING REQUIRED		YES (to establish the efficacy of controls)	
HEALTH SURVEILLANCE REQUIRED		YES	
RESIDUAL RISK (after controls)		LOW	
HYGIENE			
This is important to prevent you picking up harmful organisms on your hands and transferring them to your: • Mouth, where they may cause a stomach upset, or FACE • Eyes, where they may cause irritation or an infection • You must NEVER smoke, drink or eat on the site itself as it is unhygienic, smoking may also cause a fire. Eating and drinking are only permitted in the rest room. Smoking is only permitted in the designated area. • Prior to entering low risk areas such as offices and rest rooms you must - Remove dirty boots and soiled over clothing - Thoroughly wash you hands using anti-bactericidal soap - Consider if your face is dusty and wipe this too			
GENERAL			
1. You must report any illnesses which you think are the result of your work to Mr Other, the health and safety rep (or line manager), on 123456.			
DATE OF ASSESSMENT	ASSESSOR	SIGNED	DATE OF NEXT REVIEW
30th Sept 20XX	Mr A N Other	A N Other	Annually
Please note: This assessment is based on the assumption that the control measures suggested are effective in reducing vehicle cab operators' exposures to dust and bioaerosols to an acceptable level. Suitable RPE may be needed as an additional control in certain circumstances (See Chapter 8).			

Figure 5.5 Specimen COSHH assessment form

(Please note this is provided as a guide only and site specific risk assessments relating to site activities will be required.)

Relevant publications

Leaflets

- Five Steps to Risk Assessment. (INDG136(Rev3) ISBN 978 0 7176 6440 5
- Controlling grain dust on farms (AIS3) ISBN 978 0 7176 2981 7
- Working with substances hazardous to health. What you need to know about COSHH (INDG136(rev4)) ISBN 978 0 7176 6363 7
- COSHH essentials for farmers. AG0 Advice for managers.
- COSHH essentials for farmers. AG7 Composting.
- Farmer's lung (AS5) (2006)
- Grain dust (EH 66) ISBN 978 0 7176 1535 3
- Grain dust in non-agricultural workplaces may effect your health (INDG140)
- Understanding health surveillance at work - An introduction for employers (INDG304) (1999) ISBN 978 0 7176 1712 8
- General methods for sampling and gravimetric analysis of respirable and inhalable dust (MDHS 14/3) ISBN 0 7176 1749 1
- Respiratory sensitisers and COSHH - Breathe freely - An employers' leaflet on preventing occupational asthma (INDG95(Rev 2)) ISBN 978 0 7176 0914 7

Books

- A step by step guide to COSHH assessment. 2nd Edition (HSG97) (2004) ISBN 978 0 7176 2785 1
- The technical basis for COSHH essentials: Easy steps to control chemicals. HSE
- Control of substances hazardous to health (Fifth edition). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved code of practice and guidance. (L5) (2005) ISBN 978 0 7176 2981 7
- Health risk management - A practical guide for managers in small and medium-sized enterprises (HSG137) (1995) ISBN 978 0 7176 0905 5
- EH40/2005 Workplace Exposure Limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended). (2011) ISBN 978 0 7176 6446 7 (*NB. Frequently updated)
- Health surveillance at work (HSG61) ISBN 978 0 7176 1705 0

Resources

- Five Steps to Risk Assessment. Web access: http://www.hse.gov.uk/risk/fivesteps.htm
- COSHH Essentials Guidance Publications. HSE Leaflets. Web Only. Available from: hse.gov.uk/pubns/guidance/index.htm
- COSHH Essentials. Web Only. Available from: hse.gov.uk/coshh/essentials/index.htm
- Asthmagen? Critical assessments of the evidence for agents implicated in occupational asthma. Available from hse.gov.uk/asthma/asthmagen.pdf
- Gladding, T.L., Thorn, J., Stott, D. (2003). Organic dust exposure and work-related effects among recycling workers. American Journal of Industrial Medicine, 42(6), 584-591.
- Sykes P. Morris RHK. Allen JA. Wildsmith JD. & Jones KP. (2011). Worker Exposure to Dust, Endotoxin, and 1-3 ß Glucan at Four Large-Scale Composting Facilities in the UK. Waste Management. 31.pp 423-430.
- Swan, J. R. M., Kelsey, A., Crook, B. & Gilbert, E. J., (2003). Occupational and environmental exposure to bioaerosols from composts and potential health effects - A critical review of published data. Health and Safety Executive Research Report: RR130. Norwich: HSE Books.

Chapter 6

Health Surveillance

This chapter outlines employer's obligations to monitor the health of workers at composting facilities. It then provides detailed advice and recommendations on how health surveillance should be carried out. The chapter is divided into the following sections:

- Employers' obligations
- Health record
- Pre-exposure questionnaire
- Periodic questionnaires
- Vaccinations
- Reporting adverse health effects

6.1 Employers' obligations

The potential adverse health effects associated with the inhalation of bioaerosols have been discussed in Chapter 4. In some circumstances severe debilitating conditions can result after many years of exposure. Whilst they do not form the only risks to human health, the problems associated with bioaerosols may only manifest themselves over long periods of time. Health surveillance should therefore be undertaken to try to detect any signs of ill health at an early stage.

Under the *COSHH Regulations*, an employer has a duty to monitor the health of employees where:

- Employees are exposed to a substance linked to a particular disease or adverse health effect, and
- There is a reasonable likelihood under the conditions of the work that a specific disease or adverse health effect occurring, and
- It is possible to detect the disease / adverse health effect.

Occupational asthma caused by the inhalation of respiratory sensitisers (certain bioaerosols and dusts) is therefore included in this definition, hence health surveillance of **all employees** exposed to these substances is required - irrespective of whether or not they are directly involved in handling organic materials.

The nature and extent of the surveillance required will be dependant on the findings of the risk assessment for the activities conducted by staff. Surveillance may take the form of:

- Questionnaires – pre employment and during employment. These should ask whether the employee has had, or currently experiences, any respiratory symptoms.
- Tests - such as lung function or hearing tests
- Samples - such as blood samples.

Surveillance should be carried out by a designated **responsible person** who has been appropriately trained by either an **occupational health nurse** or **doctor**. Training should enable the appointed responsible person to recognise specific signs and symptoms that might indicate respiratory sensitisation.

The designated responsible person on site should be someone

in authority within the workplace, such as a supervisor or foreman, who has the trust of the workforce. It should be his / her responsibility to ensure that:

- Employees complete a questionnaire at the appropriate time intervals.
- The results of the questionnaires are recorded in the employees' health records (see below).
- That any signs or symptoms which might indicate respiratory sensitisation are reported **immediately** to either an occupational health nurse or doctor for further investigation. It is important to note that the responsible person should not make a judgement on the causes of the signs or symptoms themselves.

6.2 Health records

The results of any health surveillance must be kept as a health record and contain the following minimum information:

- Surname and forenames
- Sex
- Date of Birth
- Permanent address, including post code
- National Insurance Number
- Date of commencement of present employment, including a historical record of jobs involving exposure to bioaerosols and dusts and any other health hazards
- Details and conclusions of all other health surveillance procedures. This should be expressed in terms of the employee's fitness for work, and can include a copy of the surveillance questionnaires.

For confidentiality reasons, **no clinical information** should be kept on the record: this should only be recorded and kept by qualified health-care professionals.

All records should be kept by an employer for at least 40 years from the date of the last record. If a company ceases to trade before this date, all records should be passed on to the HSE.

6.3 Pre-exposure questionnaire

This should be carried out **before** a person is exposed to the bioaerosols and dusts, which generally means before they begin working at the composting facility. A sample form which contains all the relevant information is shown in Figure 6.1.

✔ **The Association for Organics Recycling recommends that every employee exposed to bioaerosols undergoes appropriate health surveillance before starting to work at a composting facility. Employees should complete a pre-exposure questionnaire (such as the one shown in Figure 6.1) and consideration should also be given to conducting lung function (spirometry) testing. Expert advice will need to be sought for these to be carried out.**

An individual answering 'YES' to any of the questions listed should be referred to an occupational health nurse or doctor for further investigation. The responsible person should ensure that this is documented and reported immediately.

A history of asthma or other respiratory disorder need not exclude an individual from employment. A judgement should be made by an occupational health nurse or doctor.

All operatives must be informed of the potential respiratory problems which can result from working at a composting facility. They should also be made aware of the associated signs and symptoms, and be instructed to report any breathing difficulties to the designated responsible person within the organisation and to see their general practitioner immediately. The HSE produce a number of leaflets specifically for employees who work with respiratory sensitisers, telling them about these substances, and how and why they should report any suspected illnesses to their doctor (see list at the end of the chapter).

6.4 Periodic questionnaires

In order to assess the health of operatives after they begin working at a composting facility, a follow-on surveillance is required. Health questionnaires should be completed by the operative. An example is shown in Figure 6.2. This asks similar questions to those in the pre-exposure questionnaire and

Figure 6.1 Initial questionnaire for surveillance of persons who will be working with known respiratory sensitisers (bioaerosols and dusts)

Source: Modified from 'Preventing asthma at work - How to control respiratory sensitisers' (Crown copyright).

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To be completed by the responsible person:

Company Name	Address

The composting process is known to produce dusts and so-called bioaerosols ('bugs' and 'spores') which have been known to cause allergic chest problems. Following the risk assessment under the Control of Substances Hazardous to Health 2002 (COSHH) Regulation 6, management have decided to carry out a programme of pre-exposure and periodic health surveillance COSHH 2002 Reg 11 (2b).

In some cases further advice may be required from the company occupational health adviser.

I understand that a programme of health surveillance is necessary in this employment and will form part of my management health record.

Signature of employee	Date
Signature of responsible person	Date

To be completed by the employee
Would you please answer the following questions:

1 Personal details

Surname	Forenames
Home address	Date of birth
	National Insurance number
Post Code	Date started working at composting site (commencement of exposure)
Tel number	

2	YES	NO
Have you had any chest problems, such as periods of breathlessness, wheeze, chest tightness or persistent coughing?		

3	YES	NO
Do you believe that your chest has suffered as a result of any previous employment?		

4	YES	NO
Do you have or have you ever had any of the following? (Do not include isolated colds, sore throats or 'flu)		
a) Recurring soreness of or watering of eyes		
b) Recurring blocked or running nose		
c) Bouts of coughing		
d) Chest tightness		
e) Wheezing		
f) Breathlessness		
g) Any other persistent or history of chest problems		

To be completed by the responsible person

No further action required

Refer to company occupational health adviser

Signed (responsible person)	Date

I confirm that the responses given by me are correct and that I have received a copy of the completed questionnaire.

Signed	Date

seeks to find out whether the operative is experiencing any respiratory problems, so that they can be identified at an early stage.

✔ **The Association for Organics Recycling recommends that every operative completes a health questionnaire (such as the one shown in Figure 6.2) at the following intervals after starting to work at a composting facility:**

- **Six weeks, then**
- **Six months, then**
- **Annually**

If an individual answers 'YES' to any of the questions listed, then the operative should be referred to an occupational health nurse or doctor for further investigation. The responsible person should ensure that this is documented and reported immediately.

In addition to the questions about respiratory problems, operatives should be encouraged to report any other adverse health effects immediately if they think they are a result of working practices.

To be completed by the responsible person:			
Company Name	Works no.		
The questionnaire should be completed six weeks, six months and annually after employment commences or as advised by the company occupational health adviser. Further advice will be required from the company occupational health adviser if any 'yes' box is ticked.			
To be completed by the employee			
Since starting your present job have you had any of the following symptoms either at work or at home? (Do not include isolated colds, sore throats or 'flu)		YES	NO
a) Recurring soreness of or watering of eyes		☐	☐
b) Recurring blocked or running nose		☐	☐
c) Bouts of coughing		☐	☐
d) Chest tightness		☐	☐
e) Wheezing		☐	☐
f) Breathlessness		☐	☐
g) Night-time flu symptoms(lasting about 4 hours)		☐	☐
h) Have you consulted your doctor about chest problems since the last questionnaire		☐	☐
To be completed by the responsible person			
No further action required		☐	
Refer to company occupational health adviser		☐	
Signed (responsible person)	Date		
I confirm that the responses given by me are correct and that I have received a copy of the completed questionnaire.			
Signed	Date		

Figure 6.2Health questionnaire for on-going surveillance of persons working at a composting facility (exposed to bioaerosols and dusts).

Source: Preventing asthma at work - How to control respiratory sensitisers (Crown copyright).

Reproduced with the permission of the Controller of Her Majesty's Stationery Office.

✔ The Association for Organics Recycling recommends that lung function (spirometry) is undertaken and carried out at regular intervals during employment to determine early signs of the potential effects from exposure. Consideration should also be given to immunological testing.

6.5 Reporting adverse health effects

The *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995* (RIDDOR) specifies that occurrences of **occupational asthma** and **farmer's lung** must be reported to the local office of the Health and Safety Executive. In addition, death, major injury or an injury at work resulting in an absence from work for over seven days must also be reported. Guidance on the reporting procedure is available on the HSE website (http://www.hse.gov.uk/riddor/report.htm).

In the event of any of the above, risks must be re-assessed and changes made to working procedures to reduce the likelihood of similar occurrences.

6.6 Vaccinations

In addition to the completion of the pre-exposure questionnaire, vaccination against **tetanus** (which lasts for up to 10 years) should also be up to date. Workers should be checked to ensure they have had a **polio** vaccine at some point (only one is required for life). It is worth noting that:

- Experiencing tetanus does not in itself produce immunity to a second infection. People who have had tetanus should still be immunised when they have recovered.
- Children are immunised with a live vaccine for polio and it is possible for an adult to contract polio from a used nappy, which may end up at a composting facility.

Relevant HSC/E publications

Leaflets

- Breathe freely - A workers' information card on respiratory sensitisers (INDG172 Rev1) (2012)
- Working with substances hazardous to health. What you need to know about COSHH (INDG136(rev4)) ISBN 978 0 7176 6363 7
- RIDDOR – Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995. Available from: hse.gov.uk/riddor/index.htm
- Medical aspects of occupational asthma. Medical Series Guides Health and Safety Executive (MS25) ISBN 978 0 7176 1547 6
- Understanding Health Surveillance at Work. An Introduction for Employers. (INDG304) ISBN 978 0 7176 1712 8
- Occupational Asthma. A Guide for Employers, Workers and their Representatives. British Occupational Health Research Foundation. March 2010 Available from: http://www.bohrf.org.uk/downloads/index.html
- Health Surveillance for Occupational Asthma. COSHH Essentials: General Guidance (G402) (2011)

Books

- A Guide to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (L73) ISBN 978 0 7176 6290 6
- Health surveillance at work. Second Edition (HSG61) 1999 ISBN 978 0 7176 1705 0

Forms

- These can be obtained from: http://www.hse.gov.uk/riddor/report.htm

Chapter 7

Safe Working Practices

This chapter provides information on a variety of issues that can affect the safety of employees. They are often not unique to composting and extend to other waste management practices and agriculture. The potential for accidents is discussed in general and recommendations are made about safe operating procedures on:

- Safe operation and use of machinery including vehicles
- Electricity
- Noise
- Manual handling issues
- The implications of the Animal By-Products Regulations

7.1 Accidents

There are many reasons why accidents happen. The equipment may be at fault, there may be an unsafe system of work, or indeed operator error can easily be the problem. Slips, trips and falls are potential accidents waiting to happen on composting sites, particularly if a site is untidy. However, falls from heights are also a possibility, such as from ladders or the top of windrows. It is worth thinking – does that person really need to be up there?

However, the potential for low frequency but high severity accidents should also be considered. On composting sites, incidents concerning machinery and vehicles could fall into this category. These are dealt with separately below.

Accidents are expensive – costs not only include compensation and fines, but could also mean lost customers, lost reputation, insurance increases and of course social costs to the employee involved, and their family. Accidents are almost always avoidable – and keeping a record of lesser incidents may help you avoid more significant incidents. Sites are required to:

- Keep an accident book ('The Accident Book' BI510 supplied by the HSE). As from 31 December 2003 accident recording must also comply with the Data Protection Act 1998 (DPA).
- Appoint a nominated first aid person with adequate training (it may be worth considering appointing more than one person to allow for holiday/sickness), to record any accidents that occur (which should also be notified to the site manager), and have the necessary first aid facilities.
- Have in place communication and transport arrangements in case an accident should occur.

The severity and frequency of accidents should be considered. It is not just the more serious incidents that should be reviewed; small and frequently occurring accidents as well as near misses can indicate a more serious problem. Figure 7.1 lists some of the issues with machinery that may contribute towards accidents:

Unsafe Condition	Unsafe Practice
Defective equipment, materials etc	Using defective equipment
Poor housekeeping/ maintenance	Operation of defective equipment (with or without permission)
Inadequate protective equipment/guards etc.	Rendering protective devices inoperative/not taking precautions needed
Incorrect loading/location	Operation at incorrect area or at incorrect speed
Lack of warning information	Failure to give warning, fooling around
Inadequate illumination/ ventilation/work space	Continuing to work despite lack of correct working area

Figure 7.1 Potential accident hazards when operating machinery

Risk assessments can usually identify most of these issues. However, unsafe practices can occur despite the best of efforts in carrying out risk assessments and mandating safe working procedures. **Only training, training, training and an effective disciplinary system can help to counter-effect the operative who decides to carry out an unsafe practice.** They may think they are being helpful by not holding up production! However, it should be clear at all times that **unsafe work practices are not allowed for any reason.**

Reminder:

RIDDOR requires the reporting of accidents to the HSE if:

- A major injury occurs, e.g. a broken arm or leg, or
- If someone is off work for more than seven days as a result of an accident at work.
- Of equal importance are near misses - if a serious accident *nearly* occurs this must also be reported to the HSE as

a dangerous occurrence if it is one of the prescribed 'dangerous occurrences'.
- A reportable disease is contracted by an individual under employment.

Accidents where someone is off work for more than three days must be recorded but does not need to be reported.

7.2 Machinery

A variety of machinery may be present on a composting site, depending on throughput, its operation and method of composting. All such equipment is subject to the Provision and use of Work Equipment Regulations (PUWER) 1998. These regulations require that work equipment is:

- Suitable for the intended use
- Safe for use, maintained in a safe condition and inspected to ensure this remains the case
- Used only by those with adequate information, instruction and training
- Accompanied by suitable safety measures, e.g. protective devices, markings, warnings, systems of work etc.

The most commonly used machinery on compost sites are heavy powered plant, which could include:

- Screens/sizers
- Compactors
- Shredders / Crushers
- Various handling vehicles, e.g. 360 grabs, front end loaders etc.
- Conveyors, bailers and similar
- All other similar equipment or combinations of equipment

7.2.1 Static powered plant

For each item of heavy static plant it is recommended the following must be kept on site to be used as inputs into risk assessments and operating procedures and as a source document for maintenance and repair work:

- Operating manual – any safety rules in manuals must be included in operating procedures and maintenance rules in maintenance schedules and schemes
- Design specification including power ratings, wiring and hydraulic diagrams, speed rating, structural details etc. (The Electricity at Work 1989 Regulations may also apply here)
- Drawings and specifications including guard positions, and the location of interlocks, lock-offs and emergency stops etc.
- The locations of any danger areas not protected by fixed or movable guards, such as areas protected by distance guarding
- Certificate of declaration of conformity as required under the Supply of Machinery (Safety) Regulations (1992) including a list of the standards used during design and build (but do not rely on this to indicate your equipment is safe!)
- Certificates of incorporation for any modifications
- Records of training received by all staff authorized to operate each piece of plant

Often, once a piece of machinery has been operating on-site it may be necessary to carry out a small modification to improve the machine's operation or throughput. If any modifications are to be made then it is recommended that these are risk assessed in advance and any safety issues are approved by a designated competent person for the site. Modifications should be noted in detail in the design specifications kept for that item of plant. After modifications have been carried out then a review of the risk assessments and operating procedures should be carried out and employees re-inducted in its use. All documentation should be kept for the life of the machinery.

Protective tripping systems provide a defence against excursions beyond the safe operating limits by detecting an excursion beyond set points related to the safe operating limits (i.e. the onset of a hazard) and taking timely action to maintain or restore the equipment under control to a safe state.

Protective interlocks prevent those control actions which might initiate a hazard from being undertaken by an operator or process control system, and are by nature self-resetting.

Lock-offs could consist of a padlock or similar to prevent access.

7.2.2 Risk Assessments and operating procedures for heavy static plant

For each item of heavy static plant risk assessments should be compiled covering:

- Operation of the plant
- Cleaning of the plant
- Clearing of blockages
- Maintenance and repair

As a requirement of Provision and Use of Work Equipment Regulations (1998) risk assessments and operating procedures should, where appropriate, be written (and kept for the life of the plant). Suggestions for covering this include:

- Safe working procedures when operating including locations of emergency stops and guarding provision on the item of plant. Particular attention should be given to mobile plant where guards etc. could be removed during transport
- Situations when lock-off is required, such as during cleaning, blockage clearance, maintenance/repair work and entry into any danger areas
- The method of lock-off and which employees are authorised (i.e. nominated persons) to carry-out lock-off activities
- 'Danger' areas in and around the item of plant e.g. can access be gained to chutes into a shredder for instance?
- Foreseeable problems which may occur and how to address them, such as blockages, overloading, breakdown of plant etc. and additional safety measures to cope with unforeseen issues e.g. if a person gained access to a chute a hanging emergency stop provision can be made
- That breaches in following operating procedures will result in disciplinary action
- That anyone found tampering with guards, interlocks and other items provided will be subjected to mandatory disciplinary action with dismissal as the normal outcome barring exceptional circumstances

✔ **The Association for Organics Recycling recommends that all items of heavy static plant should be subjected to daily safety checks before being used. When the item of plant is not used daily, checks must be made before use as required.**

These daily/pre-use checks should consist of a general visual inspection of the plant to determine that:

- All emergency stops and any isolation points are clean and operative (if several are present these should be clearly numbered and tested in rotation)
- All interlocks and other safety systems are in place and operative (if several are present these should be clearly numbered and tested in rotation)
- All guards are in place and undamaged
- All fixed guards are secured in place by the correct number and type of bolts and other fixings required
- Lock-off padlocks and lock-off plates are available
- Any other items identified in operating manuals supplied with the plant are present and in good working order

All of the above should be noted on a daily checklist form (and filed for a reasonable time, e.g. three years). If defects are noted during the checks they should be reported to the manager and nominated person immediately and rectified before the item of plant is used.

When the machinery is in operation, a 30 m exclusion zone around machine for all staff should be designated for health purposes (see Chapter 4, Stagg et al 2010). A wandering lead/remote control for the operator to use is recommended. This will keep operatives away from entrapment hazards and the often unpleasant if not hazardous conditions close to the machine, such as dust and flying debris etc.

Adequate arrangements should be made for contractors on site, who are subject to the same risk assessment process as employees. Contractors are at particular risk as they may not be as familiar with the site and operations, and employees may not know contractors are working nearby. Communication and planning are key - employees should know contractors are due on site, where they are, what they are doing and how long this is expected to take. It is worth enforcing the contractor to complete a health and safety course for the site, but a site induction should be considered as a minimum.

7.2.3 Maintenance, cleaning and clearing blockages

Maintenance and cleaning should also be assessed and have written procedures. Other than routine cleaning, blockage clearance, routine daily oiling and greasing etc. (which should be covered by strict operating procedure as outlined above), all maintenance and repair work (whether contracted or carried out in-house) should be carried out under a safe system of work for which an operation may designate a permit to work. It is also important to remember that the highest exposures to dusts and bioaerosols can occur during maintenance and cleaning - so an appropriate task specific risk assessment must be carried out for these activities.

Following any maintenance or repair (except those routine tasks described above) the area worked on should be inspected to ensure that all guards have been replaced and all interlocks and other safety devices are in place and operating. This can be carried out using the daily plant check form for the item of plant being worked on. The permit to work for the task should not be signed as complete until all such checks have been made by a competent nominated person.

In common with machines of this type, routine cleaning is required as material builds-up. The clearing of such detritus presents the risk of exposure to bioaerosols, contact with bacterial contamination, small sharps and other contaminants in the materials. The operating procedure for any shredder, screen or conveyors must include a specific section on cleaning.

For cleaning the following rules should be in place:

- Specifying the use of tools such as rakes, shovels, poles etc wherever possible rather than hands
- Ensuring that PPE is worn, such as goggles (not glasses) or a full face visor, gloves, overalls, safety boots, respirator, and a hard hat
- Ensuring that the machine must be locked-off and its wheels chocked. If cleaning involves going underneath the machine by an operative (an action that should be avoided if at all possible) then the tow hoop needs to be supported to prevent the equipment falling
- Specifying that cleaning is a two-man job – one doing and one watching which necessarily requires adequate supervisory arrangements
- Compressed air should never be used for cleaning - this aerosolises micro-organisms leading to high exposures and so risk to employees.

Clearing blockages also needs to be included in the operating procedure as a specific section. Generally blockages can be cleared by simply reversing the belt. This should be noted as the first step to be attempted and that no manual un-blocking should be attempted unless automatic means fail.

The Association for Organic Recycling recommends that the procedures to clear blockages needs to specify the following:

- **All blockage clearances must be carried out under lock-off**
- **It is a two-man job – one doing and one watching/ supervising**
- **How access to the machine will be made to prevent falls etc. This may involve the use of steps, tower scaffolds or lashed ladders, for example. The risk assessment should take into account the type of work to be carried out and the duration of exposure to the risk.**

Risk assessments and written procedures should be kept for the life of the plant and reviewed regularly, particularly if the operation of the machine is changed or modified.

7.2.4 Guarding

Guarding is found both on both static plant and on transportable items such as shredders, crushers etc. Indeed, equipment that is folded for transport can cause problems with guarding. Prior to the equipment being operated, hot spots or danger zones should be identified and ideally removed. Each hot spot should be assessed for the likelihood and severity of the risk it presents. Where guarding is provided it should be to relevant British Standards and harmonised European Standards, legislation and guidance; equipment supplier should be able to advise on this.

General requirements for guarding are outlined below:

- Fixed guards should not generally be used if access is required more than once every two/three weeks, for example, for cleaning, blockage clearance etc. unless the use of interlocks or retained key systems would be impractical
- Mobile and hinged guards should be used if access is required more than once every two/three weeks, e.g. hinged guards can be used on chutes so that access can be gained to remove blockages, but should be small enough to prevent a person fitting through it. Where guards can be removed to move transportable plant, thorough re-fitting instructions should be made available
- If an item of equipment has a moving element, e.g. a conveyor, consideration should be given to guarding on all head, tail and deflection rollers. Potential nip points should be guarded to a standard such as BS5667 (Part 19)
- All mobile and hinged guards should be protected by suitable interlocking and/or retained key systems, such as Castell keys and/or padlocks with the keys retained by management
- The level and type of interlock used will be as a result of the risk assessment based on the likely severity of any injury,

the frequency of access required and the probability of an accident occurring
- Fixed guards in easily accessible places should be fitted with security bolts
- All guards which rely on distance must comply with the ergonomic data provided by British and European Standards and any hazard protected by distance noted as a danger zone in the operating procedures

Any changes to the level or type of guarding and/or interlock fitted to static plant must be risk assessed and approved by a competent person, and must comply with the relevant British Standard.

The critical issue here is the design of the machinery. Ideally any potential problems should be addressed at the design stage. Guards may look functional, but thought will need to be given to the practical issues – is it strong enough to withstand heavy use? Will detritus build up behind it and have to be removed? Therefore it is recommended that buyers of equipment should review and assess the equipment prior to purchase, and should have the option of changing or modifying the machinery if high risk points are identified. For instance, all routine tasks such as greasing or unblocking a chute should be safe and accessible without having to remove guards and/or gaining access to dangerous parts of machinery.

The design of guarding should take into account the need to remove blockages and build-up of material:

- Manual handling issues for those removing and replacing guards and the provision of suitable handholds etc.
- The risk of guards falling open and/or off causing injury
- Increases in exposure to dust and bioaerosols when dealing with guarding and machinery in close proximity

The key points to note with machinery are that most accidents causing severe injury involve:

- The absence or inadequacy of guards during normal operation
- The removal of guards (e.g. for blockage clearance or maintenance and failure to replace)
- Failure to isolate the machine adequately prior to blockage clearance or maintenance
- Falling from machines caused by failure to provide an adequate workplace (working platforms with guardrails etc.) during cleaning or maintenance

7.2.5 Vehicles

Vehicles are work equipment that fall under the requirements listed in PUWER as outlined above. All vehicles should have a removable key (so they cannot be started by an unauthorised person) and an efficient braking system.

Additional points to consider include the following:

- Before any vehicle or plant is used there should be a pre-start inspection. This should be at the first use of the day
- Training should be provided to all drivers of vehicles. Records need to be kept to show this has been carried out. It is important to note that specific types of vehicles (e.g. forklifts) carry licensing systems which drivers must pass before using vehicles at work. The local HSE office will be able to advise on specific vehicles if this is required
- People should not be carried on vehicles unless there is specific provision to do so: for example, riding on linkages, drawbars or steps should be strictly prohibited
- People riding on mobile equipment, including the driver, should be protected from falling out of the cabin and from unexpected movement while being carried
- If the equipment can roll over (a real problem on composting sites where plant may climb a windrow in order to turn it), rollover protection structures and seat restraints are required to protect individuals from being crushed. A specific risk assessment should be carried out for this activity and steps should be taken to prevent this occurrence, e.g. fitting a structure which ensures that work equipment can only tip on its side
- Climbing on heaps should be discouraged if possible as drivers can hit overhead power lines, the stability of the heap could cause the vehicle to slip and rollover, a driver can become disorientated due to the steam generated during

turning and exposures to dust and bioaerosols could be greatly increased due to the proximity and location of the material directly below the cab

- Appropriate lighting may need to be fitted if night work is carried out, and fire fighting equipment if quick exit from the vehicle cannot be facilitated
- No person should walk under any part that is being supported by hydraulic or electrical power unless a brace or support bar has been locked in place before doing so.

✔ **The Association for Organics Recycling recommends that mobile plant are not positioned on top of windrows, heaps or slopes due to the risk of falling, rollover and injury**

Consideration should also be given to occasional special circumstances such as accident damage or modification which could lead to a significant risk to the operator, e.g. a damaged tractor roll bar and/or damage to anchorage points following overturning. Regular inspection is therefore always recommended.

It is important to note that diesel engine exhaust emissions have the potential to cause health problems, for instance irritation of the eyes, and, from longer term exposure, coughing, chestiness and breathlessness. Increased risk of lung cancer is also possible if exposure is over a period of many years. Diesel exhaust emissions will fall under COSHH and so are subject to the same assessments and controls as outlined in Chapter 5.

To reduce exposure where vehicles operate in buildings, doors and windows of the building should be kept open where practicable, if the permit allows vents should be available in enclosed structures or there should be adequate air exchange; personal protective equipment should be used as a last resort. If soot can be seen on the walls or on other surfaces in the workplace this is a useful indicator that diesel fumes are a health issue to workers.

Carbon dioxide can also be an issue with concentrated vehicle fumes - it is heavier than air and can seep into a depression or pit and displace oxygen. Again COSHH assessments will be needed to assess exposure with the appropriate procedures in place, e.g. do not stop to examine the underside of a vehicle in a pit where vehicles have been running in an enclosed space. Ventilation is the key to vehicles fumes.

The HSE has published numerous leaflets on workplace transport, such as loading and unloading, sheeting and unsheeting, reversing, parking, coupling and uncoupling, tipping and overturning. These are available free of charge from the HSE website under the **Workplace Transport** section, and are periodically updated.

In addition, the Waste Industry Safety and Health (WISH) forum also initiates guidance and working groups on transport and equipment issues specific to the waste industry, information can be found at http://www.hse.gov.uk/waste/wish.htm

7.3 Electricity

Electricity can kill! However, it can also cause non-fatal burns and shocks. In 2010/2011 there were seven fatal accidents at work involving electricity, 101 causing major injury and 320 reported where an individual was off work for more than three days. Those using electricity may not be the only ones at risk: poor electrical installations and faulty electrical appliances can lead to fires which may also cause death of injury to others. This is particularly important on a composting site where many operations are outside subject to varying weather conditions. Recommendations for dealing with electricity include:

- Avoiding overhead powerlines with machinery or other long metal objects such as ladders, and avoid erecting metal fences which run parallel with powerlines;
- Checking extension leads to make sure they are free from defects, that they are weather resistant if intended for use outside (i.e. have a earth leakage circuit breaker). It is not advisable to extend a power lead with another. It should be replaced with one that is long enough. Leads should be placed carefully so as to avoid damage during use and so causing a hazard or being a hazard themselves, e.g. as a trip hazard;
- Ensuring fuses have the correct ratings that they are never overridden;
- Protecting lamps that could be broken during site operations.

The *Electricity at Work Regulations 1989* requires precautions to be taken against the risk of death or injury from electricity during work at or near electrical systems (electrical installations and equipment).

When in a vehicle – never forget the ever present threat of overhead power lines! Vehicles do not have to strike an overhead power line to injure people as electricity can easily jump gaps if the vehicle is close enough. If there are overhead power lines (OHPLs) at the composting site, it is wise to post maps showing clearly where they run. The use of 'goal post' controls and warning labels in the cab to alert the driver should be considered. Do not forget contractors who may visit the site and other potential operators of vehicles.

When buying a vehicle, check the reach of the vehicle and the height of the OHPLs (any 33,000 and 11,000 volt OHPLs should be at least 5.2 m from the ground - and do not allow drivers to drive on top of windrows where these critical distances could be reduced and compromise safety). The movable parts of vehicles, such as rising for truck masts and back-hoe arms also need to be considered. These could come into close proximity with OHPLs – electricity can jump between them and metal machinery; contact is not necessary.

Remember to take into account any telescopic handlers, loading shovels and lifting bodies; guidance should be provided to workers to ensure this is retracted when not in use and carried as close to the ground as possible. Also don't forget that underground power lines exist in some areas - so check before digging holes.

If the worst happens and a vehicle does come into contact with a power line, never attempt to disentangle the vehicle until it is confirmed that the line is 'dead' by the line owner. Note overhead powerlines automatically attempt to re-establish power in the event of a 'trip', so contacting the line owner is essential.

✔ **The Association for Organics Recycling recommends full training be given to drivers of vehicles on site; and that appropriate alerts and training are given to drivers to be aware of the dangers of overhead power lines.**

✔ **The Association for Organic Recycling recommends sites should prepare a 'service plan' showing all known possible hazards that are overhead, surface laid and subterranean. This includes, but is not limited to power lines, water services and communications and who owns or is responsible for them.**

Note that whenever any of the following events arise 'out of or in connection with work' (see regulation 2(2) (c) and paragraph 35), it must be reported to the enforcing authority.

To make a report, go to www.hse.gov.uk/riddor:

- any incident involving plant or equipment which comes into contact with overhead electric lines with a voltage exceeding 200 volts, or causes an electric discharge by coming into close proximity with the said line; and
- an electrical short circuit that results in a fire or explosion which causes a plant stoppage of more than 24 hours, or which has the potential to cause the death of any person.

7.4 Noise

NOISE
Any undesired sound. A quiet office may range from 40-50 dB, whilst a road drill can produce 100-110dB.

Noise at work is regulated by the *Control of Noise at Work Regulations 2005* which requires employers to take action to protect employees hearing. Exposure limit values and action values are:

The lower exposure action values are:
- (a) a daily or weekly personal noise exposure of 80 dB (A-weighted); and
- (b) a peak sound pressure of 135 dB (C-weighted).

The upper exposure action values are:
- (a) a daily or weekly personal noise exposure of 85 dB (A-weighted); and
- (b) a peak sound pressure of 137 dB (C-weighted).

The exposure limit values are:
- (a) a daily or weekly personal noise exposure of 87 dB (A-weighted); and
- (b) a peak sound pressure of 140 dB (C-weighted).

These exposure limit values take account of any reduction in exposure provided by hearing protection.

The Regulations contain a requirement to assess noise, including single or combined activities which will subject an individual to noise in excess of the action levels. The assessment must include combined activities and noise throughout the day, and are measured as 'daily personal exposure to noise' measured using decibels (dB). An 'A-weighting' sometimes written as 'dB(A)', is used to measure average noise levels, and a 'C-weighting' or 'dB(C)', to measure peak, impact or explosive

noises. An important point is that every 3 dB doubles the noise, so what might seem like small differences in the numbers can be quite significant.

Where the exposure of an employee to noise varies markedly from day to day, an employer may use weekly personal noise exposure in place of daily personal noise exposure for the purpose of compliance with these Regulations. Don't forget all noise is assessed, including noise from equipment, traffic and that loud stereo! Sound pressure refers to sounds such as a hammer hitting metal - a short sharp but loud sound.

Machinery should be selected, in part, for its noise reduction abilities. Where good machinery is selected, or retrofitted with noise reduction materials, then noise is suppressed AT SOURCE and removes the need for secondary protection such as ear defenders. The need for ear defenders depends upon the level of the noise and the duration of the employee exposure. It is recommended that either a noise assessment be carried out or the supplier of the machinery is contacted for further information. PPE is covered in Chapter 8.

The aim of the noise assessment is to:

- Identify workers at risk from hearing damage
- Determine the daily (or weekly) personal exposure (LEP,d) of workers
- Record whether noise control measures or hearing protection are needed, and if so what type

Records should also be kept of the noise assessment and a plan made to reduce noise exposure to operatives. The noise assessment should be reviewed whenever there is a change in equipment and/or process or every two years. Reductions in noise should be considered prior to resorting to hearing protection. Consideration should be given to using quieter equipment, changing the process or equipment (e.g. fitting of padding to chutes etc.), changing the noise pathways (e.g. by erecting enclosures around machines, using barriers etc.), siting noisy equipment away from workers and by using sound proofing materials. Limiting the amount of time spent in a noisy area may also reduce exposure.

Suppliers should also advise if equipment is noisy as this is a requirement under the Supply of Machinery (Safety) Regulations 2008 (which lists in full the requirements suppliers have to take into consideration, including CE marking). At the point of buying equipment is when the compost operator should review the equipment and ask the manufacturer to consider various options to reduce noise exposure if needed, e.g. investigating mounting equipment and location.

Hearing protection should only be considered as:

- A short-term measure whilst other arrangements are made to control exposure, or
- When all reasonably practical measures have been taken and a risk to hearing remains

Signs indicating that hearing protection is required should be posted in the areas where noise exceeds the first or second action level. Hearing protection (ear muffs, ear plugs or semi-inserts) is discussed further in Chapter 8.

You may have to consider health surveillance for hearing damage in certain circumstances. For instance, health surveillance (hearing checks) for all your employees who are likely to be regularly exposed above the upper exposure action values, or are at risk for any reason, e.g. they already suffer from hearing loss or are particularly sensitive to damage.

✔ **The Association for Organics Recycling recommends that an assessment of noise is carried out on a composting site, particularly if operatives are working in the vicinity of potentially noisy equipment such as shredders etc.**

A specialist consultant may need to be employed to carry out such a survey, but if attempted in house appropriate training on the operation and use of equipment will be required.

7.5 Manual Handling

The *Manual Handling Operations Regulations 1992* (as amended) place duties on employers in respect of handling 'loads' at work. They require employers to:

- Avoid the need for employees to undertake any manual handling operations at work which involve a risk of them being injured
- Carry out a risk assessment where it is not reasonably practicable to avoid manual handling in order to reduce risk to the lowest level possible, and update it if there is a change in the procedure
- Provide employees with details on the load to be handled, e.g. likely weight, and centre of gravity if the load is not evenly centred

MANUAL HANDLING OPERATIONS
This means any transporting or supporting of a load (including the lifting, putting down, pushing, and pulling, carrying or moving) by hand or by other bodily force.

Employees are expected to make use of any systems provided by the employer.

On a composting site, materials are potentially handled mechanically, however it is important not to forget other types of activities which could be subject to these Regulations. For instance, types of activity that should be assessed include: the handling of large removable guards on machinery, moving pieces of equipment around the site, carrying and disposing of contaminants if they are manually removed from compost materials and moving bagged compost.

✔ **The Association for Organics Recycling recommends that a composting site should carry out a manual handling assessment as a matter of course, covering all work activities on site which use manual handling to assess risk to operatives.**

7.6 The Animal By-Products Regulations 2011

This section discusses the *Animal By-Products (Enforcement) (England) Regulations 2011* (The same exists for Scotland, Wales and Northern Island which have their own separately listed regulations).

These Regulations cover the collection, transport, storage, handling, processing and use or disposal of animal by-products, to prevent these products from presenting a risk to animal or public health. They require sites to be approved by Animal Health (previously the State Veterinary Service) in England (and Wales and Scotland, in Northern Ireland remains the Veterinary Service). They require sites to be approved before handling such materials as catering wastes, indeed any products which contain material of animal origin. These regulations are mentioned in this Guide as they require a number of procedures which may impact on general health and safety requirements (and indeed may be beneficial):

- The requirement for Hazard Analysis and Critical Control Point (HACCP) methodology which requires monitoring and checking of the plant and procedures
- Site requirements, such as an enclosed reception area, processing of newly received materials within 24 hours, equipment washing facilities, vermin control etc.
- Operator requirements, such as specified clothing and cleaning intervals and other hygiene controls

These Regulations were introduced because of concerns regarding micro-organisms - (see Chapter 4 as a reminder of the issues) although here the main concern is infectious materials (ABP regulations are not HSE enforced). If the site is dealing with materials which fall under these Regulations, then it goes without saying that all COSHH assessments should be completed accordingly and appropriate controls taken as necessary following the procedures outlined in Chapter 5.

HACCP
Hazard Analysis and Critical Control Point. A system that identifies, evaluates and controls hazards which are significant for safety.

The Regulations also specify that composting be carried out in a 'closed reactor' or 'housed windrow'. Closed composting reactors are often referred to as in-vessel units in the UK. They allow much greater degrees of process control than open windrow systems, and therefore reduce exposure to operatives from bioaerosols and dusts during normal usage. Care, however, needs to be taken whenever maintenance is carried out. If this requires access to the inside of the vessel by operatives or contractors, there are a number of additional factors that need to be risk assessed. These are covered by the *Confined Spaces Regulations 1997*, which specify that:

- Entry to confined spaces is avoided wherever possible
- A safe system of work is followed
- Emergency arrangements are in place before the work starts

It is recommended that a 'buddy' system be implemented, whereby an appointed person stands supervises the individual throughout the entire time they are working inside the vessel. It should be the responsibility of the appointed person to ensure that the maintenance personnel have safely exited the vessel (especially before any doors are closed, or pumps or moving parts switched on). They should also be on hand to implement emergency procedures should that be necessary.

As there are a diverse range of in-vessel systems, safe methods of working and retrieval systems should be risk assessed for each individual system using the HSE guidance that accompanies the Confined Spaces Regulations.

Working inside a vessel or housed windrow where there are composting materials can present additional risks, such as:

- Increased concentrations of bioaerosols, dusts and volatile substances. The risk assessment procedures and use of personal protective equipment highlighted in Chapters 5 and 8 need to be followed
- Increased concentrations of carbon dioxide and reduced oxygen concentrations, which may lead to asphyxiation (see Section 7.2.5)
- Possible presence of Methane (if material has been allowed to become anaerobic in activity)
- Dependant on feedstock but above natural levels of Hydrogen Sulphide, H2S.
- Uneven surfaces, if the operatives need to walk over composting materials
- High temperatures, which may lead to a dangerous increase in body temperature, especially as the operatives should wear appropriate personal protective equipment
- More information about confined spaces is given is Section 7.8

The *Animal By-Products Regulations* of the devolved administrations also require provision for clean areas and vehicles and containers to be cleansed and disinfected. Some of the issues that need to be considered during cleaning are detailed in Section7.2.3. The use of chemical based disinfectants will fall under the scope of the *COSHH Regulations*, and will therefore need to be risk assessed. Provisions also need to be made for safe storage and disposal of used disinfectants.

Some sites may wish to use steam to disinfect floors and equipment. This presents additional risks, such as aerosolising dusts and micro-organisms, as well as the obvious risk of injury through scalds and burns. Where such equipment is used, it will need to be used strictly in accordance with the manufacturer's instructions and maintained appropriately. Appropriate PPE (including PRE) will need to be worn.

7.7 DSEAR

The *Dangerous Substances and Explosive Atmospheres Regulations* 2002 are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace. They set minimum requirements for the protection of workers from fire and explosion risks related to dangerous substances and potentially explosive atmospheres. This applies to most workplaces within the UK where a dangerous substance are, or could be, present.

The regulation should be considered in conjunction with *COSHH* 2002, The *Confined Spaces Regulations (CSR)* 1997, the *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations* 1996 (EPS) and the *Provision and Use of Work Equipment Regulations* 1998 (PUWER)

DSEAR requires the employer to identify all possible dangerous substances that may be present in sufficient quantities to form an explosive or flammable mixture. Whether the substance is vapour, gas or powder is addressed in the mitigation systems that are then put in to place. This includes 'zoning' the work place to areas that are devoid of sources, zones that may have sources and zones that do have sources present. Controls are then put in place to prevent sufficient build up of an explosive atmospheres and/or removal of any sources of ignition from the zones.

There is little possibility that there would be any high risk zones on an open windrow site, with the exception of any closed liquor tanks or fuel stores. In-vessel composting could be different as the facility, by design, encloses the process. Therefore if any material becomes anaerobic and the production of methane begins it is possible a mixture of methane and air could accumulate in the vessels and associated air control systems and pose the risk of explosion. Any liquor and fuel storage would also have the potential to be a high risk zone.

7.8 Confined spaces

The first thing that should always be considered with confined spaces is can entering the area be avoided. This will include a check to see if the work can be done another way so that entry or work in confined spaces is avoided. Better work-planning or a different approach can reduce or remove the need for confined space working.

If there is no option but to carry out the work in a confined space then the *Confined Spaces Regulations 1997* must be followed and in particular provision of a system of work that is safe and without risks to health. You must carry out a suitable and sufficient assessment of the risks for all work activities for the purpose of deciding what measures are necessary for safety (the *Management of Health and Safety at Work Regulations* 1999, Regulation 3). For work in confined spaces this means identifying the hazards present, assessing the risks

and determining what precautions to take. In most cases the assessment will include consideration of:

- the task;
- the working environment;
- working materials and tools;
- the suitability of those carrying out the task;
- arrangements for emergency rescue.

Given the variety of facilities and individual requirements of specific tasks detailed guidance on systems of work to be adopted cannot be given here. However, the main points that need to be included are:

- All work is to be carried out with a 'buddy' and a permit to work. The buddy stays outside the confined space and monitors the person in the confined space. Should any emergency occur they can begin the emergency procedures without entering the confined space or putting themselves at further danger.
- All persons are suitably trained
- All equipment meets PUWER and Equipment and Protective Systems intended for use in potentially explosive atmospheres regulations 1996)
- An emergency plan is in place
- Where possible all moving or electrical systems are isolated and locked off for the duration of the work.

✔ **The Association for Organics Recycling recommends that unless on-site staff has the appropriate training and equipment any confined space work is carried out by specialist contractors with the appropriate training and equipment.**

Relevant HSC/E publications

Leaflets

- Simple guide to the Provision and Use of Work Equipment Regulations 1998 (INDG291) ISBN 978 0 7176 2429 4
- PUWER 98: How the Regulations apply to agriculture and forestry (AIS27)
- Buying new machinery: A short guide to the law and some information on what to do for anyone buying new machinery for use at work. (INDG 271) ISBN 978 0 7176 1559 9
- Using work equipment safely (INDG 229) ISBN 978 0 7176 2389 1
- Electrical safety and you (INDG231) ISBN 978 0 7176 1207 9
- Fatal traction: Practical advice on avoiding agricultural transport accidents (INDG279REV1)
- Safe use of skip loaders: Advice for employees (INDG378) ISBN 978 0 7176 2216 0
- Control back-pain risks from whole body vibration. Advice for employers on the Control of Vibration at Work Regulations 2005 (INDG 242rev1) ISBN 0 7176 6119 9
- Workplace transport safety: An employer's guide. (HSG136) ISBN 978 0 7176 6154 1
- Diesel Engine Exhaust Emissions (INDG286) ISBN 0 7176 1671 1
- Control of diesel engine exhaust emissions in the workplace (HSG187) ISBN 0 7176 1662 2
- Avoidance of danger from overhead electric power lines (GS6) ISBN 978 0 7176 1348 9
- Noise at work. Guidance for employers on the Control of Noise at Work Regulations 2005. (INDG362rev1) ISBN 978 0 7176 6165 7
- Getting to grips with manual handling. A short guide. (INDG143rev2) ISBN 978 0 7176 2828 5
- Managing contractors - A guide for employers (HSG159) ISBN 978 0 7176 6436 8
- Safe work in confined spaces. (INDG 258) ISBN 978 0 7176 1442 4
- Managing confined spaces on farms. (AIS26)
- A guide to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 ISBN 978 0 7176 6459 7
- INDG290 Simple guide to the Lifting Operations and Lifting Equipment Regulations 1998

Books

- Controlling noise at work. The Control of Noise at Work Regulations 2005. Guidance on Regulations. (L108) ISBN 978 0 7176 6164 0
- Accident book (BI510) ISBN 978 0 7176 2603 8
- Vehicle safety on farms. Training films to improve safety on the farm. ISBN 978 0 7176 6252 4 (DVD)
- Farmwise: Your essential guide to health and safety in agriculture. (MISC165) (INDG427)
- Manual Handling. Manual Handling Operations Regulations 1992 (as amended): Guidance on Regulations. (L23) ISBN 978 0 7176 2823 0
- Hazard Analysis and Critical Control Point (HACCP) for Composters (2003). The Association for Organics Recycling, Wellingborough. ISBN 0-9532546-6-6
- Dangerous Substances and Explosive Atmospheres Regulations 2002, Approved Code of Practice and guidance (L138) ISBN 978 0 7176 2203 0

Chapter 8

Personal Protective Equipment

This chapter provides information on the types of personal protective equipment available. It is divided into the following sections:

- Protection of the head and eyes
- Protection of the ears
- Protection of the skin, hands, feet and body
- Protection of the lungs and airways
- Types of respiratory protective equipment
- Selection of respiratory equipment
- Use of respiratory protective equipment
- Vehicle cabin filtration systems

Recommendations are made about which protective equipment should be used at composting sites, and under what circumstances.

8.1 Introduction

The use of personal protective equipment (PPE) is regulated under the Personal Protective Equipment at Work Regulations 2002. This requires PPE to be supplied and used at work wherever there are risks to health and safety at work. A hierarchy of risk control measures should be in place and implemented first, PPE should be considered as a last resort where risk cannot be adequately controlled in other ways. PPE includes, but is not limited to, dust masks, safety footwear, helmets, gloves and goggles.

All PPE should be adjusted properly and fit the employee. Ill-fitting equipment may be just as likely to cause harm to a person as no equipment at all as it can seriously reduce, or fail to achieve, adequate protection.

8.2 Protection of the head, eyes and ears

Large-scale composting operations rely upon the use of heavy machinery (to shred, turn and screen organic materials), which can propel fragments at high speeds some distance from the machine. For example, sharp fragments of wood or metal or other materials may be ejected. These have the potential to seriously injure nearby persons.

✔ **The Association for Organics Recycling recommends that both eye and head protection are worn during the shredding, turning and screening processes, unless the operative is protected by a completely enclosed workstation.**

Safety helmets (e.g. hard hats), which may also incorporate a visor and / or ear defenders, provide head protection. Some powered respirators also incorporate a safety helmet (see below). 'Bump caps' should not be considered adequate head protection.

Eye protection includes safety spectacles, goggles or a face shield. The latter has advantages in that it offers protection to the whole face and not just the eyes; it can be worn over prescription spectacles and is less prone to misting up.

However, unless it forms an integral part of a respirator, it does not fully protect the eyes against dusts. The employer should also confirm that the eye protection conforms to an appropriate BSI standard for impact resistance.

Some materials-handling vehicles incorporate an enclosed cabin which, to a certain extent, protects the operative from injury by projectiles. However, if this is to form an effective barrier, all windows and doors must be kept shut throughout the shredding, turning and screening processes, and must be maintained in an acceptable working condition (for example, cracked windows should be replaced immediately, otherwise the level of protection may be reduced). The suitability of any filters fitted should also be confirmed by the manufacture, or an experienced consultant, to ensure that the required level of protection is being given to the machine operator. The life time of the filter is also a major part of the system and maintenance and replacement schedules should be produced and adhered to.

An assessment should be made of the likely distances from the operating machines within which all persons should wear the appropriate equipment (note, some shredders can eject fragments a considerable distance from the machine). All machinery should be operated in accordance with the manufacturer's instructions and with due consideration for the distance of 30 metres outlined in Chapter 5.

8.3 Protection of the ears

Hearing protection (ear muffs, ear plugs or semi-inserts) should be designed to prevent the harmful effects of noise and must be capable of attenuating the latter to such an extent that the equivalent sound levels the user is exposed to does not under any circumstances exceed the limit values related to exposure to noise at work (see section 7.4).

It is important to note that the level of reduction should not be too great that the user does not become 'separated' from the surroundings. Care should also be taken that the equipment is cleaned regularly and single use item are disposed of after use.

All hearing protection must bear labelling indicating the noise attenuation level and the value of the comfort index provided by the PPE; should this not be possible the labelling must be fixed to the packaging.

There is a requirement to maintain hearing protection equipment, provide information and training to employees and to provide health surveillance to workers if needed. Noise legislation is covered in Chapter 7.

8.4 Protection of the skin, hands, feet and body

Other PPE should also reduce the risk of injury to hands, feet, or body.

Composting materials often contain very sharp fragments, such as shards of wood or rose thorns. To reduce the risk of injury to the hands from these items:

✔ **The Association for Organics Recycling recommends that protective gloves with appropriate cut/needle resistance are worn whenever any waste materials, other than screened compost, are handled.**

To reduce the risk of injury to feet from, either impaction with a falling object, or standing on a sharp object:

✔ **The Association for Organics Recycling recommends that safety boots (incorporating a steel toe-cap and steel midsole) should be worn at all times on site.**

In addition:

✔ **The Association for Organics Recycling recommends that high visibility outer clothing (replacing jacket), minimum of class 2 (intermediary visibility level of two reflective bands minimum), should be worn at all times, it is up to the employer to decide between on colour, compliance with BS EN 471 being the main criteria for choosing PPE.**

Consideration should be given to extremes of weather, as most operatives at composting facilities work outdoors. For example, warm waterproof clothing should be provided for use during cold, wet weather. Attention to the harmful effects of exposure to sunlight during the summer months should also be made, which means that sun block barrier creams may need to be provided.

To ensure adequate hygienic practices are adopted, overalls

should be worn over ordinary clothing. These should be left at the site at the end of every working day, and should not be worn to or from home. It is a legal requirement that the employer (NOT the employee) regularly cleans these items.

It must be noted that staff members' clothes have the possibility to collect dusts and microorganisms and become a source of exposure. A site should investigate the possibility of staff being issued with work only clothes. These can be in the form or overalls or trousers/tops. These items are then are only worn at work and laundered separately to any clothes belonging to staff.

8.5 Protection of the lungs and airways

The composting process creates large quantities of dusts and bioaerosols, which can potentially damage the lungs and airways if inhaled (see Chapter 4.)

The COSHH Regulations require the use of personal protective equipment to control exposure to hazardous substances whenever it is not possible to control exposure by alternative means. The nature of the composting process often makes alternative measures to control bioaerosols and dusts unfeasible. In order to control exposure, thereby helping to protect operative's lungs against possible damage caused by inhaling bioaerosols and dusts, Respiratory Protective Equipment (RPE) should be worn (see Chapter 5).

(Reminder: COSHH specifies that PPE should only ever be used as a **last-measure resort**).

8.5.1 Types of respiratory protective equipment

Different types of RPE have been designed to control either of the following:

- **Particulates**
  Which include the dusts and bioaerosols formed at composting facilities.
- **Gases and vapours**
  Which include volatile substances such as VOCs that can be released into the air.

  The basic types of RPE that can be used at composting sites to control exposure to bioaerosols and dusts are:
- **Respirators**
  These filter contaminated air before it is inhaled. They are designed to protect against either **particulates** or **gases and vapours**, although dual, or multi- function products are available.

  The basic types are listed and detailed schematically in Figure 8.1.

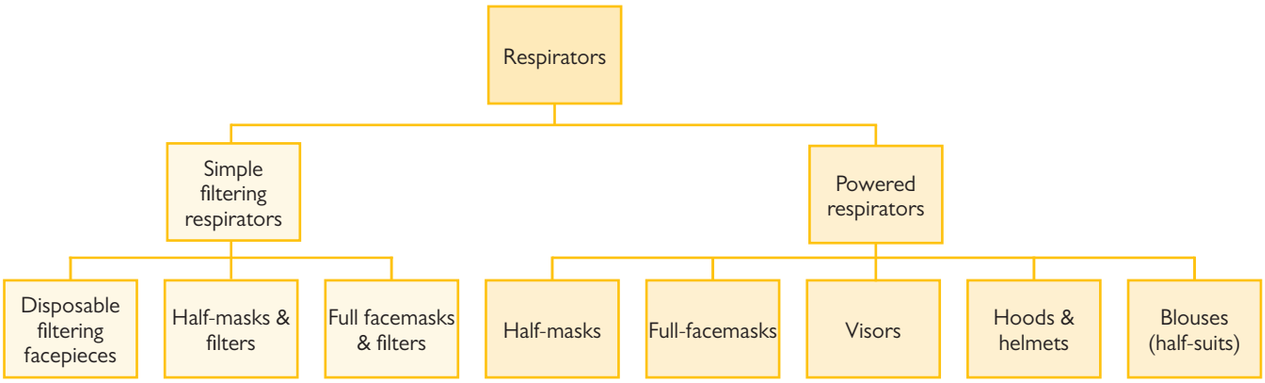

Figure 8.1 Types of respirator

Source: Respiratory protective equipment – A practical guide for users (HSE, 2005)(HSG 53)(Crown copyright).

Reproduced with the permission of the Controller of Her Majesty's Stationary Office.

Note: RPE provides varying levels of protection for the worker depending on the type of device worn. Specialist advice will be required regarding the selection, use and testing of appropriate RPE to ensure adequate protection is being provided to workers from exposure to dust, bioaerosols, gases and vapours.

- **Simple filtering respirators**
  These rely upon the breathing action of the wearer ('negative pressure'). Contaminated air is drawn into the filter when the person inhales, trapping contaminants in the filter. These can be of a very simple, single use nature. They are also available so that the masks are constructed in a manner that it is possible to interchange a range of filters to suit the needed requirements.

- **Powered respirators**
  These 'airfed respirators' pump air through a filter. Clean (de-contaminated air) is supplied to a head piece, which is then expelled with expired air.

  Respirators may incorporate a visor providing eye protection. Powered respirators are available which include both a hard hat and full-face visor and are useful at a composting site, where both head and eye protection are required.

  Powered respirators operate on a positive-pressure basis (continuously filtering air and delivering it to the breathing zone), so the face-piece need not form a tight seal around the wearer's face. They are much more comfortable to wear than simple filtering respirators (which tend to offer more resistance to breathing), especially over long periods of time; the visor is less likely to mist up and it is useful for wearers with beards and/or spectacles.

  Examples of simple filtering respirators are shown in Figure 8.2:

  Examples of powered respirators are shown in Figure 8.3

- **Equipment that supplies clean air from an independent uncontaminated source**
  These differ from respirators in that they do not rely upon filtering contaminated air and are only used under very hazardous conditions. They include breathing apparatus, fresh-air hose equipment and simple compressed-air-supplied equipment.

There are advantages and disadvantages associated with each type of RPE (Figure 8.4). Choice will depend upon a number of different factors. Under most conditions, a respirator incorporating an appropriate filter should be adequate for use at a composting facility. However, the following should always be borne in mind:

The following should always be borne in mind:

NO SINGLE type of respirator EVER AFFORDS 100 % PROTECTION against a hazardous substance.

The choice of suitable RPE will depend on the task undertaken, the working environment, the work-rate of the wearer, the length of time the workers will need to wear the RPE and the individual wearer themselves. When in an airborne state, micro-organisms can be classed as particles, so they can usually be removed by filter-type RPE. It is recommended that for exposure to bioaerosols RPE equipment is fitted with the highest efficiency filter possible (P3) and when in areas where dust levels are anticipated to be high, a protection factor of 40 is required. In areas where dust levels are moderate or low then a protection factor of 20 may be appropriate (HSE, 2010). Further guidance is provided in HSE guidance document - *Respiratory protective equipment at work. A Practical Guide (HSG53)*. As a result of the gases and vapours likely to be present at composting facilities consideration should be given to the selection of an integrated P3 filter masks with gas/vapour filters in addition to the particle filters.

More specifically, if the task specific risk assessment deems RPE necessary, then a non-powered, face-fitted disposable filtering face piece respirator or a half-mask respirator (FFP3 type respirator) with particle filters to BS EN 143 may be appropriate for short periods of work conducted in the open air or in an air-conditioned vehicle cab. Half or full face masks are more suitable for longer periods of work. The composting of waste indoors where high temperatures and humidity levels are experienced, powered respirators fitted with P3 filters may be more suitable to ensure the comfort of the wearer. This

TYPE OF RPE	ADVANTAGES	DISADVANTAGES
Simple filtering respirators	• Cheapest • Often disposable (no maintenance)	• Difficult to breathe through • May cause discomfort • May become wet and soggy • Disposable types often do not fit effectively around the face (especially if person wears spectacles or has a beard) • Not all types capture endotoxin • As filters clog breathing can be restricted
Powered respirators	• Do not rely upon breathing to filter and discharge air • Relatively comfortable	• Expensive • Require maintenance (replacement of filters) • Require batteries and charging
Equipment that supplies clean air from an independent uncontaminated source	• Low resistance to breathing • Breathing apparatus provides highest level of respiratory protection	• Expensive • Require maintenance (replacement of air source) • Heavy and cumbersome • Extensive training required

Figure 8.4: Advantages and disadvantages of various types of RPE

ultimately will increase the probability of the RPE device being worn.

Irrespective of the type of RPE chosen, it is imperative that the following criteria are met:

- **It fits effectively**
  This means that the unit should fit securely around the face; this is particularly important with simple filtering respirators which rely upon an intact seal between the mask and the wearer's face. Consideration should be given to face size and shape, and whether the wearer has a beard and / or wears spectacles.

The Approved Code of Practice to the COSHH Regulations stipulates that tight-fitting RPE must be 'fit tested' as part of the selection process. This will help to ensure that inadequately fitting face pieces are not selected for use. Ill-fitting face pieces can create inward leakages of airborne contaminants. Note: A tight-fitting face piece is a full face mask, a half mask, or a filtering face piece (commonly referred to as a disposable mask). The performance of these types of face pieces, irrespective of whether they are used in negative pressure respirators, power assisted respirators or compressed air supplied breathing apparatus, relies heavily on the quality of fit of the face piece to the wearer's face. An inadequate fit will significantly reduce the protection provided to the wearer.

The presence of facial hair in the region of the face seal will significantly reduce the protection provided.

RPE fit testing should be conducted by a competent person. Competence can be demonstrated through achieving accreditation under the 'Fit2Fit RPE Fit Test Providers Accreditation Scheme'. This Scheme has been developed by the British Safety Industry Federation (BSIF) together with industry stakeholders and is supported by HSE. The scheme is not compulsory and employers are free to take other action to comply with the law. One way employers can demonstrate good practice is by ensuring that the fit tester is appropriately accredited, for the type of service they offer, by the Fit2Fit scheme. Further details on the scheme can be found at the web site: http://www.fit2fit.org

Employers must have documented evidence of the RPE used at their site along with records of fit testing. Fit test reports should be available for all employees that wear RPE incorporating tight-fitting face pieces. These reports should contain the following information:

a) name of the person fit tested;
b) make, model, and size of the face piece;
c) whether the wearer's own mask, company pool mask or a fit test service provider's test mask was used;
d) the test exercises performed during the test;

e) fit test method employed;
- Qualitative for filtering face pieces (FFPs, disposable masks) and half masks
- Quantitative for FFPs (disposable masks), half and full face masks

f) Measured fit factor values for each exercise (if applicable);
g) pass level used;
h) date of the test;
i) the details of the person carrying out the fit test.

These records should be kept and made available for inspection by the HSE if requested.

Further guidance is provided by the HSE (http://www.hse.gov.uk/news/2009/fit-testing-poster.pdf)

- **It is stored and maintained appropriately**

The COSHH Regulations state that RPE, except disposable respirators, should be thoroughly checked, and tested, where appropriate at suitable intervals, on compost sites this should be carried out at least once a month by an appropriately trained, appointed person, such as the health and safety representative. The health of the workforce may depend on the vigilance of this person. The check should include an examination of all straps, face pieces, filters, electric motors and valves.

A record should be kept of each examination for each item of equipment, which should be available for inspection if requested. It should contain the following information:

- Name and address of employer
- Details of the item of equipment, such as make, model and serial number, sufficient to identify it uniquely
- Date of the examination, plus the name and signature of person who carried out the examination
- Condition of the equipment and any defects found during the examination

All equipment should be stored, worn and maintained in accordance with the manufacturer's instructions. Disposable products must always be discarded after the appropriate wear period.

- **All wearers are appropriately trained**

This is requisite under COSHH, the *Personal Protective Equipment at Work Regulations*, and the *Management Regulations*. This means that all wearers should receive training in:

- The nature of the hazardous substances and why RPE should be worn
- How the equipment should be properly worn, maintained and stored (theoretical and practical)
- Factors which might reduce the effectiveness of the equipment, and the inherent limitations in its use.
- The tasks/areas when RPE must be worn

It is imperative that employees are consulted in the choice of any personal protective equipment prior to purchase. These aspects are discussed in Chapter 3.

8.5.2 Use of respiratory protective equipment

It is important that for any activities where waste is agitated or moved, including cleaning operations, employees should wear appropriate RPE.

Guidance has been provided by the HSE to their Field Operations Division Inspectors to require the routine use of RPE to avoid exposure to bioaerosols when shredding, turning, screening or moving composting material or whenever leachate is either sprayed or transferred from one place to another. This precaution is likely to be required by anyone within **30 metres** of such a procedure, and for **five minutes** afterwards if composting in the open air. It is recommended that RPE is worn at all times when in operational areas at enclosed facilities.

(HSE Bioaerosols in composting guidance, http://www.hse.gov.uk/foi/internalops/sectors/manuf/03-10-11/index.htm).

Employers should also develop procedures for staff that are found not to be complying with the procedures and site rules.

✔ The Association for Organics Recycling recommends that for any person (whether an employee or not) appropriate RPE is worn (which is face fit tested) whenever materials are shredded, turned, screened or moved in bulk, and whenever captured leachate is either sprayed or transferred from one place to another, or whenever entering an in-vessel unit, unless the protection is afford by other means (such as a filtered cabin).

✔ The Association for Organics Recycling recommends that detailed task specific risks assessments are conducted that identify the most suitable RPE taking into consideration the task, its location and duration

and the wearer of the RPE. It is likely an FFP2 filter with a valve will be required as a minimum. Higher protection factors may be required in higher risk environments, e.g. entering in vessel units.

It is acknowledged that wearing RPE is generally uncomfortable, especially over long periods of time and during hot weather. However, the importance to persons of wearing RPE cannot be stressed enough. Powered respirators often afford more comfort and user acceptability than simple filtering respirators. The additional costs of purchasing such equipment are probably offset through greater employee compliance (and productivity). Employee training was discussed in Chapter 3.

8.5.3 Vehicle cabin filtration systems

Operatives who work in a protected environment, such as a positive-pressure air-filtered cabin, should not typically have to wear respiratory protective equipment providing existing control measures are deemed to be working effectively and effective risk control procedures are in place.

However, the level of protection afforded to vehicle operators depends upon a number of different factors, such as:

- The type of filtration system present on the vehicle, the way in which it has been fitted, and how well it has been maintained.
- The efficiency of the air pump unit.
- Whether both doors and windows are kept shut during site activities and are only opened to allow employees to enter or leave the cabin away from the source.
- Whether all seams in the cabin, such as welded joints, windows, doors, and the filter unit itself, are sealed correctly and do not allow contaminated air to by-pass the filter.
- That the cab is in a clean condition and free from clutter
- The vehicle operatives boots and over clothing are free from contamination

It has been suggested from laboratory-based trials that in a pressurised vehicle cab where the air supplied is appropriately purified through effective filtration, driver's exposure to pollutants can be reduced by a factor of 10 and dust levels can be reduced up to a factor of 100 when operating at optimum efficiency (Bremer *et al*, 2009, Thorpe *et al*, 1997). However the performance of these systems as the primary means of controlling employees' exposure levels can be significantly affected by cab contamination, driver practices, cab damage and poor maintenance, which all have the potential to reduce the effectiveness of these cab filtration systems. At this present time, very little data exists regarding vehicle filtration systems efficiency in workplace settings, especially in the composting sector.

Research has shown that a protection factor of 100 could not be achieved, independent of the efficiency of the filter, if the protection of the cab were compromised for more than 1% of the time, for example, by having the window open for more that 3 minutes in a five hour shift. This may be problematical in practice for vehicle operators on compost sites who may have to undertake more than one task, requiring them to enter or leave the cab frequently.

There is limited data to characterise the protection afforded to vehicle drivers in practice. It has been reported that a maximum of a 10-fold reduction in dust concentrations is achievable in a field-based trial when outside cab measurements are compared to in-cab measurements (Bartlett et al, 2009). This concurs with the findings of Sykes *et al* (2010) who found that vehicles operating on composting sites have greatly reduced protection factors because of a number of factors including cab cleanliness and maintenance and vehicle operator practices such as opening of doors and windows and disembarking vehicles in operational areas.

✔ **The Association for Organics Recycling recommends that if vehicles with cabin filtration systems are used, then the following criteria must be met:**

- **Appropriate filters are fitted by competent persons.**
- **All vehicle doors and windows are kept shut throughout the duration of the site activities described above**
- **Vehicle doors and windows are only opened away from the source (greater than 30 metres) and preferably not in enclosed buildings.**
- **The air-filtration system is serviced at least in accordance with manufacturers' recommendations and all seams and welds in the cab are tested for possible leakage.**
- **Vehicle cabs are effectively cleaned and maintained in a clean condition.**
- **Operatives should ideally not enter vehicle cabs with contaminated clothing or boots. This will be practically difficult to enforce, hence a cleaning regime for the cab is likely to be required.**
- **Daily checks are required to ensure the vehicle**

air filtration system is operating effectively and switched on at all times.

- Reduction of bioaerosol liberation at source, where possible, to reduce the concentrations of bioaerosols outside the vehicle cab.

If the above controls are adhered to then RPE may not need to be worn within vehicles, in accordance with the results of the site-specific risk assessment for the activities. However, if ANY ONE of these conditions cannot be met, then RPE MUST be worn in accordance with the advice above.

✔ The Association for Organics Recycling recommends that specific advice from vehicle cabin manufacturers or suppliers of bespoke cabin filtration systems should be sought.

Relevant publications

- A Short Guide to the Personal Protective Equipment at Work Regulations 1992 (INDG174REV1) ISBN 0 7176 6141 5.
- Respiratory sensitisers and COSHH. Breathe freely: An employers' leaflet on preventing occupational asthma. INDG95(rev2), revised 03/98, reprinted 05/05
- Personal protective equipment at work (Second Edition) – PPE at work Regulations 1992 (as amended) Guidance on regulations (L25) ISBN 978 0 7176 6139 8
- HSE (2005) The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and Guidance.L5. Norwich: HSE Books. ISBN 0 71762981-3
- HSE (2010) Respiratory protective equipment at work - A practical guide. HSG53 (Third edition). [Electronic version]. ISBN 978 0 7176 2904 6
- BSEN529: 2005: Respiratory protective devices – Recommendations for selection, use, care and maintenance – Guidance document BSI, London.
- Respiratory protective equipment at work, A practical guide ISBN 978 0 7176 2904 6
- Sykes P. Morris RHK. Allen JA. Wildsmith JD. & Jones KP. (2011). Worker Exposure to Dust, Endotoxin, and 1-3 ß Glucan at Four Large-Scale Composting Facilities in the UK. Waste Management. 31 .pp423-430.

Chapter 9

The Management of Composting Facilities

Good management of composting facilities can reduce the risks of accidents and the formation of substances that may harm the health of site workers. This chapter provides recommendations for good practice at sites to minimise these risks. It examines each of the following:

- Pre-treating incoming materials
- Turning windrows
- Windrow temperatures
- Moisture levels
- Good hygienic practices
- Fire

9.1 Introduction

Effective health and safety management at composting facilities necessarily means that sites should be operated to a high standard. Whilst many activities at composting facilities will be site-specific, simple guidelines can be followed that will reduce the risks of accidents occurring, or of operatives becoming ill because of their work.

The British Standards Institution Publicly Available Specification 100 (BSI PAS 100 2011) has been developed to set in place site management procedures and minimum quality criteria for composted materials in order to help develop compost markets. It specifies the minimum requirements for the selection of input materials, the process of composting and control of it, the quality of composted materials, and the marking and information labelling of the product(s). It also covers key aspects of quality management systems such as establishment of a quality policy, document control, record keeping, staff training and reviews of the process control system.

The BSI PAS 100 - 2011 requires operators to set in place a series of Standard Operating Procedures (SOPs) and follow the principles of Hazard Analysis and Critical Control Point (HACCP) assessments. These activities, whilst principally aimed at manufacturing good quality composts, should also go a long way towards implementing safe working practices. Rather than repeat them here, it is therefore recommended that the site management procedures specified in the BSI PAS 100 - 2011 be followed. The third party certification scheme administered by The Association for Organics Recycling aims to ensure that these measures are implemented consistently. Further detailed information on the PAS 100 - 2011 and the certification scheme is available from the Association's website www.organics-recycling.org.uk.

Throughout this chapter, The Association for Organics Recycling has made a number of **recommendations** which should be adopted whenever it is **practically possible** to do so. Ideally they should already be incorporated into the site's Waste Management Licence and Working Plan, Environmental Permit, SOPs, and form part of the HACCP assessment.

Additionally, where animal by-products or catering wastes are processed, the Animal By-Products Regulations (ABPR) also mandate that certain site management practices are carried out.

9.2 Pre-treating incoming materials

Feedstock materials that have been delivered to a composting facility will begin to degrade irrespective of whether or not they have been formed into a windrow or loaded into a vessel. The rate of degradation by micro-organisms will be largely dependent upon the type of material: putrescible wastes, such as grass cuttings, often begin to degrade even before they are collected, whilst woody materials, such as branches and dried leaves, take a lot longer. Unless stockpiled materials are adequately aerated, volatile compounds may be formed which can not only create an odour problem at the site, but may also affect the health of the operatives. Therefore, unless specified elsewhere in the site's Environmental Permit or ABPR Animal Health approval:

✔ **The Association for Organics Recycling recommends that all incoming materials should be treated (this means shredding and forming into windrows, or loading into in-vessel systems) as soon as is practically possible in accordance with the criteria set in the BSI PAS 100- 2011. In particular:**

- **Putrescible materials should be ideally treated within one working day of receipt at site, for ABP feedstocks this is normally a prerequisite of the permit condition**
- **Woody materials should be treated within one working week of receipt at site.**

VOCs can be reduced significantly by managing the carbon:nitrogen ratio of the initial feedstock mix, moisture, temperature and oxygen. Management of the incoming materials for these variables to optimise the process can also assist with reducing emissions such as bioaerosols during the composting process.

9.3 Sanitization processes

Heat destroys pathogenic micro-organisms and plant weed seeds. Destruction depends upon the temperature, the length of time the materials are kept at that temperature, and the moisture content. Managing the sanitization process is therefore important where composts are to be marketed and where materials that fall under the ABPR are treated. It also has implications for worker health. Special considerations for operatives handling animal by-products have been discussed separately in Section 7.

✔ **The Association for Organics Recycling recommends that the temperature and monitoring procedures described in the BSI PAS 100 - 2011 (Figure 9.1a) are followed during the sanitization phase, unless mandated elsewhere (e.g. by the ABPR as in 9.1b).**

Note: The PAS100 - 2011 recommended parameters are just that –recommendations, and other limits may be set if sampling and testing consistently proves that pathogens are being removed. Although if working under ABPR, the limits set are statutory and must be adhered to. Therefore if working to both standards then the HIGHER limit must be used.

SANITIZATION

The process of biological activities that, together with conditions in the composting mass, give rise to compost where the levels of human, animal and plant pathogens have been reduced to low levels.

9.4 Turning windrows

At open-air windrow sites, the turning process not only introduces fresh air (hence oxygen) into a windrow, but it also removes stale 'spent' air. Turning reduces the likelihood that odorous compounds, that are largely the result of anaerobic microbial degradation, will be formed. (Anaerobic means in the absence of oxygen.) Methane can also be formed under anaerobic conditions. This is not only a greenhouse gas (estimated to be 20 - 30 times more potent than carbon dioxide), but it is also inflammable. Methane formation in windrows is therefore not only environmentally undesirable, but it also increases the risk of fire. Frequently turning windrows should prevent them from becoming anaerobic. See Chapter 7 on DSEAR for more information about the dangers and controls of methane and other potentially explosive substances.

Turning also homogenises the composting materials, ensuring that there is an even distribution of moisture and feedstock materials throughout the windrow. As the turning process introduces oxygen into the composting materials, the micro-organisms that are responsible for the composting process

Temperature	Time	Moisture	Mixing or Moving
65 °C	7 days	51% mass/ mass	Applicable if necessary in order to expose the whole batch to the recommended minimum conditions. Number of mixes/turns as applicable to the composting system (incl. machinery

Figure 9.1a Taken from BSI PAS 100:2011, Table B.1 Recommended parameters minimum crucial limit values for eradication of most pathogens during sanitization

ABPR (2011)	2 days	60 °C in all appropriate zones of the composting mass concurrently within an overall period of treatment, typically no less than 5 days. Particle size to be no greater than 40cm.	Twice during 7 days
	1 hour	70 °C in all appropriate zones of the composting mass concurrently within an overall period of treatment, typically no less than 5 days. Particle size <12 mm.	N/A

Figure 9.1b guidance on minimum temperatures and residency to meet sanitization under ABPR (2011) common across all UK ABP regulations

are able to degrade the organic materials at a faster rate than those in an unturned windrow (that does not contain sufficient oxygen).

The fungus *Aspergillus fumigatus* (see Chapter 4), tends to grow on the cooler peripheral layers of a windrow. Frequent turning has been shown to reduce the growth of this potentially harmful fungus. Appendix 1 provides further information on how to risk assess these issues.

If a materials-handling vehicle is used to turn windrows, positioning the vehicle **up-wind** of the composting materials means that clouds of bioaerosols and dusts will be blown **away from** the vehicle and operative. This might be inappropriate on still, calm days. However, on windy days, this can significantly reduce the amount of bioaerosols and dusts that an operative is exposed to. Therefore:

- ✔ **The Association for Organics Recycling recommends that if a materials handling vehicle is used to turn windrows, the vehicle should be positioned up-wind of the windrow whenever it is practicable to do so.**
- ✔ **If it can be avoided, vehicles should not climb onto windrows due to the risk of roll over and hitting overhead power lines.**
- ✔ **Other site and off site activities should also be considered when carrying out turning operations, e.g. persons working outside, but close to downwind site boundary.**

9.5 Moisture levels

Moisture levels contribute to the potential release of dust downwind. If the compost becomes too dry then the risk of dust is increased, and it will inhibit the performance of the composting process. As a result Epstein *et al* (2001)[1] recommended that it is important to maintain the compost at a moisture content of around 60% - 70%, although such high contents may not be practically possible. High moisture contents may also have knock on effects on the porosity and activity of the composting process, and so the operational situation should be reviewed as a whole.

This study also found that the effective management of dust by controlling moisture levels and by using dust control measures significantly reduced the release of *Aspergillus fumigatus* from a composting facility during the construction of windrows, turning and screening processes (Figure 9.2).

1 Epstein E., Wu N., Youngberg C., Croteau G. (2001) 'Dust and Bioaerosols at a Biosolids Composting Facility'. Compost Science & Utilization 9 (3): 250-255

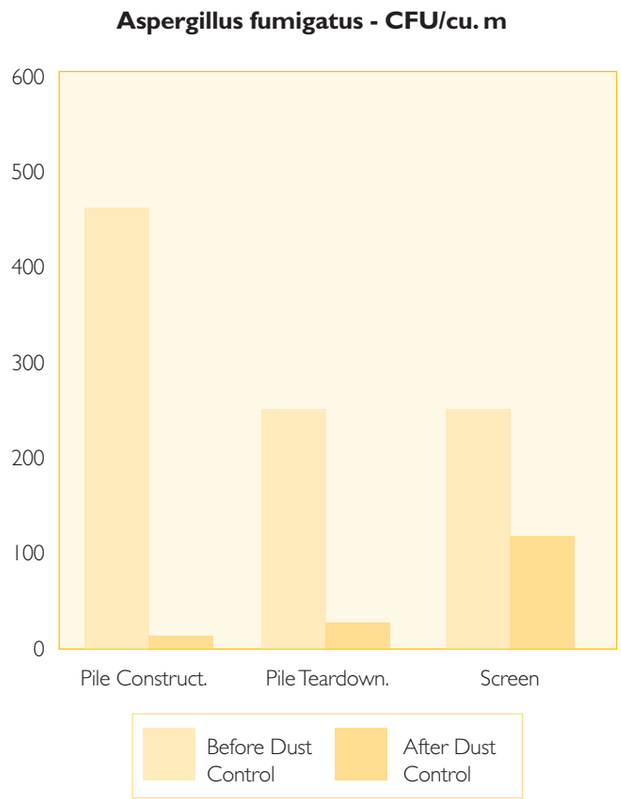

Figure 9.2 Managing dust release in an enclosed composting hall

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By maintaining the moisture content above a certain level, there will be less chance of dusts being dispersed during composting activities and losses occurring through 'wind whipping'. Basically, wetter material is less likely to remain airborne than drier material when agitated.

The amount of moisture in a windrow will depend upon factors such as the feedstock composition and climatic conditions, including ambient temperature, rainfall and incident sunlight. Management practices should be based upon prevailing conditions at the composting facility and the need to screen composts prior to end use.

As moisture levels affect the formation of dusts and bioaerosols:

✔ The Association for Organics Recycling recommends that moisture levels should be maintained between 40 - 60 % (w/w) during the actively managed composting phases of a windrow composting process wherever possible in accordance with the BSI PAS 100 - 2011

✔ The Association for Organics Recycling recommends that active dust control measures be implemented as they significantly reduce environmental and occupational exposure to dust and bioaerosols

9.6 Good hygienic practices

All site operatives should be adequately informed of the need to follow good hygienic practices. This extends from their obligations under the COSHH Regulations.

In addition to the guidance specified for the use of personal protective equipment, The Association for Organics Recycling also recommends that all employees at a composting facility are made aware of good hygienic practices.

✔ The Association for Organics Recycling recommends that operatives:

- Always wash hands using an antibacterial soap under running water prior to:
  - Eating, drinking or smoking
  - Entering any offices or rest rooms
- Be aware that material can be deposited on the face and transferred to the hands, so cleanliness of the face should also be considered.
- Never eat, drink or smoke on the site unless in a designated 'clean' area, such as a rest room
- Immediately wash and disinfect any cuts or abrasions (irrespective of their size) to the skin and cover them with waterproof dressings
- Are issued with 'work only' clothes and these are worn only at work. Staff should change from work clothes before leaving the site. The employer should ensure that these are cleaned on a regular basis

9.7 Good site management

A number of 'common sense' measures can also be adopted that will reduce the possibility of accidents happening and of the facility having an adverse impact on its neighbours.

✔ The Association for Organics Recycling recommends that:

- Sites should always be kept tidy.

- All materials and equipment should have designated storage areas
- Any litter and contaminants must be stored in a secure place or container where they will not be blown away by the wind or spread by animals

- Sites should always be kept clean. Water, liquor and other materials should not be allowed to build up on the operating areas, to reduce the possibility of:
  - Materials becoming smelly, causing odour and potential health problems
  - Vermin being attracted
  - Accidents, such as slips and falls, occurring
- Compressed air should never be used to clean equipment. Dry sweeping should also be avoided
- All operatives should know the waste streams that are being accepted at the site and how to process them
  - Operatives should understand the importance of removing contaminants before the feedstocks are formed into batches, and know the ratios in which the materials should be mixed

9.8 Fire

Combustion of windrows in the UK is fortunately a rare occurrence. Fire can be caused by lightning strikes, arsonists or, simply, poor site management. The latter can be addressed by following a number of practical steps, which include ensuring that: windrows are turned regularly; the moisture content is kept at optimal levels (40 - 60 % [w/w]); materials, such as wood chips, are not allowed to accumulate; and windrows are not allowed to become too large (that is, they are kept to a manageable size).

The layout of the site should take into account the potential and likely consequences of a fire and could, therefore, influence the relative positions of windrows, mess hut, fuel store, evacuation routes and access routes for emergency services.

DSEAR also plays a part in fire prevention see Chapter 7 for information previously discussed.

Relevant publications

Leaflet

- Safe collection of woodwaste: Prevention of fire and explosion (WIS32)

Books

- Hazard Analysis and Critical Control Point (HACCP) for Composters (2003). The Association for Organics Recycling, Wellingborough. ISBN 0-9532546-6-6
- PAS 100: 2011 Specification for Composted Materials. British Standards Institution, January 2011. ISBN 978 0 580 65307 0
- Publicly Available Specification 100:2011 Specification from Composted Materials. British Standards Institution, January 2011. ISBN 978 0 580 65307 0 (update to PAS100)
- Dangerous Substances and Explosive Atmospheres Regulations 2002, Approved Code of Practice and guidance (L138) ISBN 978 0 7176 2203 0

Chapter 10

Glossary of Terms

Actinomycetes
A specific group of bacteria (see below) that are capable of forming very small spores. (Singular = actimomycete)

Aerosol
Tiny particles suspended in air.

Allergy
An immunological 'over-reaction' following exposure to a substance.

As far as is reasonably practicable
A balance between risk (severity of outcome and likelihood) and sacrifice (money, time or trouble). The presumption is always in favour of health and safety unless gains can be shown to be disproportionate to cost.

Asthma
A condition marked by wheezing and difficulty breathing. It may be caused by an allergic reaction.

Bacteria
A group of micro-organisms (see below) with a primitive cellular structure, in which the hereditary genetic material is not retained within an internal membrane (nucleus).

(Singular = bacterium)

Bioaerosol
Micro-organisms and / or other tiny biological particles suspended in air.

(An aerosol of very tiny biological particles.) Invisible.

Bronchitis
Inflammation of one or both of the air tubes (bronchi) that carry air to the lungs.

COSHH
Control of Substances Hazardous to Health Regulations

DSEAR
Dangerous substances and explosive atmosphere regulations

Dust
Context as used in this Guide: small fragments of composting materials, that are larger than bioaerosols, and therefore do not form an aerosol.

Farmer's lung
Inflammation of the air sacs (alveoli) in the lungs, caused by exposure to micro-organisms present in grain and mouldy hay.

Fungi
A group of micro-organisms (see below) with a more complicated cellular structure than bacteria, in which the hereditary genetic material is retained within an internal membrane, forming a nucleus.

(Singular = fungus)

HACCP
Hazard Analysis and Critical Control Point. A system that identifies, evaluates and controls hazards which are significant for safety.

Hazard
The potential to cause harm.

HSE
Health and Safety Executive. Responsible for enforcing the regulations.

Infection
The invasion by and growth of micro-organisms in body tissues.

Inflammation
A protective response by the body which often results in pain, swelling and redness.

Liquor
Runoff liquid form the composting material or input to the composting process

LOLER
Lifting Operations and Lifting Equipment Regulations 1998

Manual Handling Operations
This means any transporting or supporting of a load (including the lifting, putting down, pushing, and pulling, carrying or moving) by hand or by other bodily force.

Micro-organisms
Microscopic organisms that are capable of living on their own. Often simply called 'microbes'.

Noise
Unwanted sound

Pathogen
A micro-organism that causes a disease through infection.

PPE
Personal protective equipment e.g. safety helmets and gloves.

PUWER
Provision and Use of Work Equipment Regulations 1998

Respiratory sensitiser
A substance that causes an allergic reaction in the lungs and airways following exposure. Once a person has become sensitised to a particular substance, further exposure, even to extremely small amounts, can cause an allergic reaction.

Responsible person
Designated person within the workforce who is competent to carry out the relevant health surveillance procedure and to report the conclusions of the procedure to the employer.

The competent person should preferably be an occupational health professional who has the trust of the workforce and has been appropriately trained to recognise the specific signs (see below) and symptoms (see below) associated with occupational exposure at organic waste treatment facilities.

RIDDOR
Reporting of Injuries, Diseases and Dangerous Occurrences Regulations

Risk
The likelihood of a hazard becoming harmful and the severity of outcome under a certain set of circumstances.

RPE
Respiratory protective equipment e.g. respirators.

Sanitization
The process of biological activities that, together with conditions in the composting mass, give rise to compost where the levels of human, animal and plant pathogens have been reduced to low levels.

Sign
Abnormality in a person's health that can be determined through examination

e.g. bleeding, wheezing, and/or vomiting.

Spore
Context as used in this Guide: A general term describing a bacterial or fungal cell that is in an inactive resistant form.

Symptom
Abnormal sensation a person experiences, which is not obvious through examination. These are described by the patient e.g. headache, nausea.

Total Inhalable Dust
Airborne material which is capable of entering the nose and mouth during breathing and is thereby available for deposition in the respiratory tract.

Toxin poisoning
A disturbance of the normal bodily functions caused by a microbial component

WEL
Workplace Exposure Limits are concentrations of hazardous substances in air, averaged over a specified period of time, referred to as a time Weighted average (TWA). Two time periods are used, long-term (8 Hours) and short-term (15 Minutes).

VOC
Volatile Organic Compounds. Molecules that contain carbon-to-carbon bonds and gases at ambient air temperatures.

Appendix I

Further Reading: Bioaerosols and Risk Assessment

What risk assessment approaches should site operators adopt?

In accordance with the legal framework, there are no fixed rules on how risk assessments should be conducted. The ACOP to the Management of Health and Safety at Work Regulations state that the complexity of these assessments should be commensurate with the risk arising.

In the absence of reliable dose response data for exposure to compost bioaerosols and the absence of WELs for compost bioaerosols, employers may be inclined to adopt simple qualitative approaches or semi-quantitative methods using risk rating methods and risk control banding in meeting their legal obligations. An important consideration is not necessarily the nature of the model chosen but the way these methods are applied and how control measures are implemented and monitored.

It is recommended, where possible, that any assessment of the risks to compost worker's health should be supported in the first instance with personal monitoring data to inform any risk assessment as exposure levels are known to vary greatly depending on the site, the activities and the individual. Whilst it is recommended that employers play an active role in the development and implementation of risk assessments and risk control methods, there may be a need in this instance for site operators to seek specialist advice from competent practitioners.

What monitoring regime should be implemented to inform risk assessment?

Perhaps the primary concern here is what data is required to inform the assessment of risk. The hazards present in compost bioaerosols are fairly well characterised and contain a complex mixture of viable and non-viable bacteria and fungi and their cell components. The main issue here is centred around the findings of the risk assessment, assessing workers personal exposures or assessing work areas may be an effective way developing a set of proportionate risk controls to protect workers health and demonstrate that exposures have reduced 'so far as is reasonable practical'

It is certainly not reasonable or practical at this time to assess employees' personal exposure to all compost organisms. It is recognised that there is a potential risk from exposure to viable organisms present in compost emissions. In particular Aspergillus fumigatus has been commonly assessed. Whilst there is a risk of infective lung disease in immuno-suppressed individuals, the occupational risk has been described as relatively low (Swan et al 2002). The development of extrinsic allergic alveolitis or Farmer's Lung is also well documented following exposure to actinomycete or fungal spores. In the absence of reliable dose-response data for individual compost organisms, it is possible that the estimation of risk to workers could be undertaken from measurements of selective organisms such as total mesophilic organisms, gram negative bacteria and Aspergillus fumigatus (in accordance with the current AfOR guidance (2009), "A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities"). In addition consideration should also be given to measuring thermophilic actinomycetes and total fungi present as these are known to be of have clinical significance and also predominate during the composting process.

For more complex sites or where very high exposures to viable bioaerosols are recorded, there is also a case for estimating the biological load of the dust by assessing indicators of biomass by measuring endotoxin and ß-(1-3) glucan concentrations. This is especially pertinent in light of the fact that assessments undertaken measuring viable organisms alone are known to be an underestimation of the potential risks to employees as non-viable or cell fragments elicit adverse respiratory outcomes in exposed workers.

Furthermore if the intention is to meet legal requirements and reduce employees' exposure 'so far as is reasonably practical' then the scientific determination of risk is not the key consideration but the development of a robust set of evidence-based procedures and control methods is paramount. It could be argued that a more simple approach to estimating workers' risk level could assist in detailing what control measures are required and whether these control measures are deemed to be 'reasonable ' or not.

What activities pose a high risk to employees on composting sites?

Research findings indicate that employees' exposure to dust on composting sites is generally low. Inhalable dust levels below 2mg/m3 are typically encountered (Toivola et al, 2004, Stagg et al, 2010). However despite the relatively low inhalable dust levels, studies have shown employee's exposures to bioaerosols, endotoxin, and to a lesser extent ß-(1-3) glucan, to be consistent with levels that result in adverse health outcomes. Manual sorting of waste has been shown to give rise

to extremely high concentrations of inhalable dust, endotoxin and ß-(1-3) glucan on occasion. (Sykes *et al* 2010, Gladding et al, 2004). It is possible that the physical action undertaken by the workers is resulting in elevated personal exposures due to the re-suspension of particles caused by the movements of the worker, the so called 'personal cloud' effect (Toivola, 2004). Such activities must be considered as potentially high risk and where possible, eliminated by mechanical pre-sorting or separation or by changing the nature of the waste collection so no future sorting is required. If manual sorting is to be conducted, the installation of sorting cabins, with suitable ventilation and local exhaust ventilation for sorting lines is required where practical. Furthermore suitable RPE should be provided for workers undertaking this task (Brun, 2007). This potentially indicates an increased risk for waste collection workers especially in light of the likely increased prevalence of kerb-side collection schemes where workers will be sorting waste at the point of collection from households.

It is suggested however that any activities in which workers are located in the open air (i.e. not within a vehicle cab), whether these be indoors or outdoors, should be effectively controlled. If such activities cannot be avoided then it is recommended that dust suppression to reduce dust generation at source is provided by controlling the moisture and damping down compost piles. In addition, effective means of forced ventilation is required if these activities are conducted within a building and employees should wear appropriate RPE for activities involving the agitation or movement of waste. By way of implementing such control measures, it is recommended that these rules remain in place for a 30m zone around operational areas and that these zones are designated as areas where RPE must be worn unless operatives are within a suitably controlled environment such as a vehicle cab. The selection of a 30m zone is informed from a recent study conducted by Stagg *et al* (2010) who describe that bioaerosol levels typically return to background concentrations within this distance. Such requirements clearly have an impact on site design and layout. In order to achieve this recommendation it is possible that site operators may have to amend working practices and operations and relocate office accommodation and welfare facilities to an area outside of these potentially high exposure zones.

What are the risks to vehicle cab operators and how should they be controlled?

The potential risks to vehicle operators on composting sites is poorly understood at this time as there is a lack of data charactering their exposure levels. Anecdotal evidence and personal observations from many site visits suggests that a large number of vehicle operators wear no form of RPE whilst working within a vehicle cab. The potential risks to vehicle operators from poor air quality within the cab has been recognised by Stagg *et al* (2010) who state that vehicles may not provide adequate protection to workers and more information is required regarding the efficacy of the cab air filtration system. This study was specifically designed to address some of the gaps in the current understanding of vehicle operators' exposure levels but also to investigate the impact that cab cleanliness, vehicle filtration system efficacy and operator practices have on workers' personal exposure levels.

Sykes *et al* (2010) highlights that vehicle cab workers are exposed to high levels of inhalable dust, endotoxin and ß-(1-3) glucan which are consistent with adverse respiratory outcomes and that exposure levels are influenced by a number of factors. The findings of this study demonstrate a need for a multi-faceted control strategy if an acceptable working environment is to be provided for vehicle operators and one in which no additional controls, such as RPE, are provided.

Obviously each site specific assessment will have to decide on the most suitable control measures and monitoring data will be needed to evidence that the control measures are satisfactory. This is very important as operatives spend long periods within a vehicle cab and it would be more practical and comfortable if RPE was not required. Such a decision though must be based on a reliable assessment. The key to controlling workers exposure would appear to be in the effective cleaning of the vehicle cab, controlling contamination from the operative's clothes and boots and preventing practices such as the opening of windows and doors and disembarking vehicles in areas where waste is being moved. Once these issues have been effectively managed, further analysis of the vehicle filtration system should be undertaken to determine whether the recommended service period stipulated by the vehicle manufacturer is suitable for the site and the activities that vehicle is undertaking. At present, replacement of the filters on the air handling systems of the vehicles investigated in this study were undertaken as part of the general vehicle service. Further investigation is required to ensure that these

replacement frequencies are sufficient to ensure maximum operating efficiency of the filters.

There is also a need for employers and site managers to **educate and inform** employees of the potential risks from working within a vehicle on composting sites and instruct them of the controls required. All vehicles should have effective cleaning schedules and be inspected to ensure acceptable standards are being maintained. The cleanliness of cabs will be easier to maintain if effective procedures are put in place. Vehicle operators should enter the vehicle cab outside of the 'high exposure zone' and have clean over-clothing and boots. Operators should then remain in the cab with the windows and doors closed whilst in these operational zones. Any necessary communication could be undertaken via in-cab radios to prevent doors and windows being opened. This study reports that the efficacy of vehicle filtration and air handling systems are unlikely to attain the levels of protection reported in experimental studies when applied in field-based studies. This experimental data suggest a peak 100 fold reduction in dust is achievable under controlled conditions. It is prudent to suggest than in order to reduce employees' exposures as far as is reasonably practicable a broad range of control measures are required. This may also involve controlling dust levels at source. Studies have shown extremely high bioaerosol concentrations at composting sites close to areas where waste is being moved. Consequently even if a 100 fold reduction in these levels were achieved the levels experienced within the cab may still be unacceptably high.

Employees should be made fully aware of the procedures and the disciplinary implications of non-compliance and it is imperative that these are seen to be enforced by the management. All vehicle maintenance must be undertaken and recorded in accordance with the vehicle technical specification requirements unless the monitoring data suggest that more frequent service intervals are required. Daily checks of the vehicles air handling system, door seals and cab cleanliness should be conducted and any defects should be reported immediately. Research conducted by Sykes *et al* (2010) has suggested that when vehicle cabs are effectively cleaned and maintained and cab doors and windows are kept closed then it is possible the drivers will not need to wear RPE but this will need to be evidenced on a site by site basis. The key is to reduce dust levels at source and prevent contamination of the cab in the first instance.

What control measures are required to reduce employee exposure levels and how should they be applied?

As compost emissions are known to contain sensitising agents that may cause occupational asthma and, in the absence of any established Workplace Exposure Limits in the UK, workers exposure must be reduced 'so far as is reasonably practical' in accordance with Appendix 3 of the COSHH Regulations. To achieve legal compliance with this requirement poses a great challenge for the composting industry. This study indicates that certain areas or activities resulting from the composting operation could be categorised using fairly simple descriptive expressions of risk and a corresponding set of control measures developed depending on the perceived risk associated with the area or activity. This simple qualitative approach could be considered a reasonable response in light of the current knowledge gaps in our ability to accurately describe source-term emissions, establish agreed monitoring protocols and develop reliable dose-response data. In the absence of such information the potential risk should be managed in a precautionary manner. In order to achieve compliance, employers need to be able to demonstrate that control measures have been developed in accordance with the 'hierarchy of controls' detailed in the Management of Health and Safety at Work Regulations 1999 and the Control of Substances Hazardous to Health Regulations 2002 (as amended).

Clearly elimination, substitution or minimisation of compost organisms is an impractical control measure as these organisms are essential to the composting process and their proliferation is actively encouraged. The introduction of physical engineering controls or minimisation of the risk by introducing procedural controls, such as safe systems of work, or using personal protective clothing and equipment, require further consideration.

In the first instance, a key factor in controlling employees' exposure is to control dust generation at source which in turn will reduce employee exposure levels. Dust suppression methods that dampen compost piles could be an effective approach during periods when the moisture content of the compost is low, for example in the summer months or following periods of dry weather. Epstein *et al* (2001) reported that damping down compost resulted in a significant reduction in endotoxin concentrations. Clearly this is more applicable to open windrow composting than

enclosed or in-vessel composting methods. The nature of the site activities and the mechanical equipment used may also have an effect on dust generation. Stagg *et al* (2010) identify the turning of windrows as the greatest source of bioaerosol emission especially when this is undertaken by vehicles moving waste using mechanical shovels as opposed to custom-built windrow turning machines where the waste is dropped from a height. Dust control from the movement of vehicles is also recommended and roadways should be properly constructed so that they can be cleaned and vehicle wheel wash systems introduced. The separation of employees from high exposure areas, where practicable, is also required. Areas where waste is being agitated or moved should be designated as potential high exposure zones and where practicable, employees should only work in these areas when inside a vehicle cab or for limited periods of time wearing appropriate RPE. This may have serious implications for site operators as they may have to redesign their site layout and operations to accommodate this. High, medium and low exposure zones could be designated based on exposure levels in these areas and procedures and permitted tasks and decisions regarding the selection and use of RPE could be made accordingly. All employees should be provided with adequate hand-washing and shower facilities and clean over clothing so that 'clean areas' such as inside vehicle cabs, offices and welfare facilities are not contaminated and that no contamination is transported off site to employees homes for example.

Robust control measures, as previously discussed, must be in place for ensuring that vehicle operator's exposures are minimised 'so far as is reasonably practicable' and data presented in this study suggests that vehicle operator's exposures can be significantly reduced from thorough cleaning of vehicles, maintenance and servicing of vehicle air handling systems and controlling operator practices.

A key barrier to implementation of effective control measures is that the control measures rely heavily on the actions of site managers and employees to comply and are not affected by changes in process design and operation. Consequently information, instruction and training for site owners, managers and employees are fundamental to managing these risks effectively.

Is health surveillance needed for compost workers?

The simple answer is yes. Appendix 3 of the ACOP to the COSHH regulations clearly states that

> *'all employees that are exposed or liable to be exposed to agents that may cause occupational asthma should be under health surveillance'*
>
> (HSE, 2005b)

The key issue here though is the level of surveillance required and this ultimately should be determined by the findings of the site-specific risk assessment undertaken, as required by the COSHH Regulations.

In operations where control measures are well documented and adhered to, and employee exposure levels have been assessed and they are low, health surveillance may be as simple as undertaking pre-employment screening that details past asthma or chest illness, information for employees regarding the possible symptoms that could arise from exposure to compost bioaerosols and how any symptoms should be reported. In-employment questionnaires should be completed at least annually to enquire about any developing symptoms. Dependant on the findings of the risk assessment, more detailed health surveillance procedures may be required such as lung function testing and serum testing or skin-prick testing to investigate the development of immunological responses as a result of the exposure. All employees undertaking health surveillance should have a personal health record and the information must be kept for a period of 40 years and the findings of any health surveillance must be communicated to employees and any adverse findings must be investigated further and appropriate controls implemented (HSE, 2005b).

Is respiratory protective equipment required for employees, and what type is suitable?

The findings of the risk assessment should determine whether RPE is required and what would be the most suitable RPE for individual tasks undertaken or what RPE should be worn in particular work areas.

The choice of suitable RPE will depend on the task undertaken, the working environment, the work-rate of the wearer, the length of time the workers will need to wear the RPE and the individual wearer themselves. (See Chapter 8)

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Appendix 2

Useful links

HSE' website: www.hse.gov.uk

HSE's waste and recycling website: www.hse.gov.uk/waste

Further information
For information about health and safety visit www.hse.gov.uk. You can view HSE guidance online or order priced publications from HSE Books at HSE's website. HSE priced publications are also available from bookshops.

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