

ENVIRONMENTAL MANAGEMENT FOR HOTELS

THE INDUSTRY GUIDE TO SUSTAINABLE OPERATION

8 HAZARDOUS MATERIALS

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This manual was published in 2014 when Sustainable Hospitality Alliance was known as International Tourism Partnership (ITP), part of Business in the Community (BITC).



Any substance that can cause injury, impairment to health or death to living organisms or which can damage the environment is **hazardous** and must be used, stored and disposed of in a responsible manner



HAZARDOUS MATERIALS

A number of substances found within the fabric of hotel buildings or that are used as part of the hotel operation pose potential hazards to human health, biodiversity and the environment. They must be handled, stored and disposed of carefully and replaced with less hazardous alternatives where possible. This approach should include phasing out the use of man-made chemicals that do not naturally degrade in nature and thus systematically increase in concentration over time.

This section examines the issues associated with various materials and substances and the practices you should put in place to manage the risks they present.



8.1 DEFINING HAZARDOUS MATERIALS

A hazardous material is any substance that can cause injury, impairment to health or death to living organisms, or which can damage the environment through, for example being toxic, flammable, explosive, corrosive or infectious.

In most countries there are legal requirements governing the responsible use, storage and disposal of hazardous materials. There are also international agreements covering the use of substances that pose a hazard to health and the environment. These include the **Stockholm Convention**, a global treaty to protect human health and the environment from persistent organic pollutants (POPs). POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife. The European Union has passed numerous directives and regulations to avoid the dissemination and restrict the use of hazardous substances, the best known being the **Restriction of Hazardous Substances Directive** and the **Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)** directive which came into force in June 2007. To complement REACH, the United Nations has proposed a new regulation, the **Globally Harmonised System of Classification and Labelling of Chemicals (GHS)**, which will require enterprises to use standardised symbols and phrases on packaging and on Safety Data Sheets (SDS) to inform users about hazardous chemicals.

In the UK, several pieces of legislation apply such as the **Control of Substances Hazardous to Health Regulations 2002 (COSHH)**, **The Health and Safety at Work Act 1974**, **The Food and Environment Protection Act** and **The Control of Pesticides Regulations 1986**.

See **FIGURE 8.1** for a list of definitions used for hazardous materials most commonly encountered in hotels, together with their identification symbols.

8.2 FUEL OIL AND OTHER OIL PRODUCTS

Fuel oil is the term used for any liquid petroleum product that is burned (in a furnace or boiler) in order to generate heat or used (in an engine) to generate power. Other oils derived from hydrocarbons are used for lubrication, to prevent corrosion, as a hydraulic medium or as solvents. These include lubricating oils and automatic transmission fluid.

8.2.1 The issues

There are a number of safety and environmental hazards associated with the storage, handling and use of oil, gas and oil products. In liquid form they pose a fire risk and if they escape as vapour or in gaseous form they can cause an explosion.

You should never allow any fuel to be emptied into drains leading to the public sewerage system or to your waste water treatment plant. Many drains lead directly to rivers, streams or lakes and fuel oil emptied into drains will have a similar effect to pouring it directly into the watercourse. If fuel oil is released into the ground, it coats the soil with which it comes into contact and seeps down to the water table. Because it is lighter than water it sits on top of the groundwater and

FIGURE
8.1

Hazard symbols

BELOW ARE THE DEFINITIONS USED FOR HAZARDOUS MATERIALS MOST COMMONLY ENCOUNTERED IN HOTELS, TOGETHER WITH THEIR IDENTIFICATION SYMBOLS.

These symbols are derived from the United Nations (UN) system of identifying dangerous goods. Not all countries use exactly the same graphics in their national regulations. Some use graphic symbols, but without English wording or with similar wording in their national language. You should refer to the Dangerous Goods Transportation Regulations that apply to your country as this is the most widely applied regulatory scheme.

**CORROSIVE**

A corrosive material may be defined as something that destroys other materials by chemical reaction. When in contact with human tissue, these substances may burn and destroy. At greatest risk are skin, eyes, the lungs and stomach. Oven and toilet cleaners are usually corrosive.

**IRRITANT**

A non-corrosive substance which can cause inflammation through immediate, prolonged or repeated contact with the skin or mucous membranes. Certain acid cleaners can be irritants.

**ENVIRONMENTAL HAZARD**

A substance that can pollute nature, according to directive 67/548/EWG by the European Chemicals Bureau.

**OXIDISING**

An oxidising substance destroys organic matter by breaking down the cell walls. An example is hydrogen peroxide.

**EXPLOSIVE**

An explosive substance is capable of producing gas at such a temperature, pressure and speed as to cause damage to the surroundings.

**POISONOUS**

A substance that is toxic to humans. Can cause damage to health, physical or mental impairment or even death when inhaled, ingested or absorbed. Examples include some pesticides and herbicides.

**FLAMMABLE**

A substance that can be easily ignited by sparks or flames to cause fire, or which can spontaneously combust or which can react violently with water. Of particular concern are those liquids with low flashpoints, such as solvents and certain fuels.

**RADIOACTIVE**

A substance or a combination of substances which emit ionizing radiation.

**HARMFUL**

A substance which if inhaled, ingested or penetrates the skin may incur limited health risks.

**TOXIC**

A substance that is liable to cause death or serious injury to human health if inhaled, swallowed or absorbed through the skin. Examples include potassium cyanide, mercuric chloride and certain pesticides.

**INFECTIOUS**

Substances that are 'biohazardous' such as virus cultures, pathology specimens and used intravenous needles.

tends to move with it, often over great distances. This can have serious implications especially where groundwater is the source of domestic water supply or is used for animals. One litre of oil can contaminate a million litres of water. Equally plants cannot survive in ground affected by fuel oil, as nutrients cannot move freely through the soil.

Because of these hazards, there are many regulations associated with the handling, transport, storage and use of fuels, for example in England if you store oil in containers with a capacity of more than 200 litres, the **Oil Storage Regulations** may apply. Generally In Europe, the USA and Canada the controls are very tight, but in some developing countries they may be negligible.



8.2.2 Fuel oil and your hotel

Hotels rely on fuel and other oils for a variety of applications such as:

- **oil** to fire boilers to provide heating, cooling, steam and hot water
- **diesel oil** to power emergency generators
- **fuel** to power lawn-mowers and other garden maintenance equipment such as saws and trimmers
- **diesel** or **petrol** for vehicles
- **lubricating oils**
- **transmission fluids**
- **oils** used as solvents such as paraffin (kerosene).

Many establishments store fuel on site in tanks either above or below ground. The tanks range in size from small day tanks with a capacity of 200 litres to large and multiple tanks of up to 50,000 litres each. The risk of fuel spillage and escape can occur at a number of points as outlined below. As a rule, primary containers (whether tanks, intermediate bulk containers, mobile bowsters or drums) should not be situated outside a building within 50 metres of any borehole or 10 metres of any inland freshwaters and coastal waters that any leaking oil could enter.

a RISKS IN HANDLING:

- spillage due to **overfilling**
- **lack of precautionary measures** when carrying out maintenance or repairs on equipment carrying fuel
- **misuse of fuel** for other purposes
- **mistakes** when cleaning out tanks
- **improper disposal** into the sewerage system.

b RISKS IN STORAGE:

- **internal or external corrosion** or rust perforation of the tank – the older the tank, the greater the likelihood
- **mechanical faults**
- **installation faults** in tanks, piping or pumps
- **disused tanks** that have not been properly decommissioned.

8.2.3 Good management practices

Good practice in fuel handling and storage should aim to:

- **Minimise the risk of fire and explosions.**
- Ensure that there is **no environmental contamination** resulting from current practice.
- Ensure that **future operations** do not cause contamination.
- Ensure that all storage facilities are **appropriately licensed** and **conform** to local regulations.
- Prevent financial losses from **product leakage** and the cost of **cleaning up** contaminated land and water.



8.2.4 The action plan

It may be necessary to engage external professional help in order to sort out any fuel storage problems you may have. Make sure any outside operators you contract are qualified and licensed to do the work through being registered with any applicable agencies. These criteria apply to consultants, contractors, vendors and suppliers of any fuel. Similarly, any equipment you purchase should be from reputable suppliers, and installed by qualified personnel to the manufacturer's exact specifications and in accordance with the appropriate codes and regulations.

a FIND OUT THE REGULATIONS THAT APPLY TO YOU:

Identify all the national, regional and local fire and environmental regulatory requirements as well as any company standards that are applicable for fuel storage, handling and use. Regulations vary greatly around the world. In the UK for example, businesses are subject to the **Control of Pollution (Oil Storage) (England) Regulations 2001** which apply to oil stored in tanks, intermediate bulk containers, oil drums and mobile bowsters.

b CARRY OUT A FUEL-STORAGE INVENTORY:

TANKS AND DISTRIBUTION SYSTEM

Collect and keep in one place information on the infrastructure as follows:

- ✓ **age** of the tank, **date of installation**, **supplier** and **installer**, any **warranties** or **guarantees**
- ✓ **material** from which the tank is made (this is usually steel, plastic or fibreglass)
- ✓ **corrosion protection** (cathode protection for example), coating, interior lining
- ✓ any **cleaning**, **repairs** or **modifications** that have been conducted in the past with the dates
- ✓ **condition** of the **tank**, **piping** and **pumps**
- ✓ **condition** of the **tank interior** (amount of water, deposits)
- ✓ any **history** of **leaks** or **spills**
- ✓ **geologic**, **hydrologic** and **soil characteristics** of the area surrounding the tank
- ✓ any **settlement** of the soil that has occurred that could have caused the tank to change position
- ✓ any **pressure exerted** on the tank from the top, sides or from below (by plant roots for example)
- ✓ the **height** of the **water table** in relation to the tank
- ✓ whether the tank is **positioned** in such a way that leakage could pose a threat to the water supply.

MAINTENANCE AND OPERATIONS

Gather operational information including:

- ✓ **daily/monthly/yearly throughput**
- ✓ **inventory records** (both via metering and manually logged records)
- ✓ **spill and leakage monitoring** both within and outside any secondary containment
- ✓ **operating procedures**
- ✓ procedures for **preventive maintenance**
- ✓ **records of inspections** and tests by relevant authorities
- ✓ **any additives** which may have been used to disperse sludge or prevent corrosion (what and when).

LEAK DETECTION / SPILL PREVENTION

Collate information on what is in place to prevent leaks and spills such as:

- ✓ **leak detectors**
- ✓ **secondary containment**
- ✓ **automatic tank gauging**
- ✓ **overspill protection** (and equipment for recovery and disposal of fuel spilled during filling)
- ✓ **interstitial monitoring** (monitors the space between the inner and the outer walls of tanks or piping systems, at least once every month, including sumps and any vertical pipes)
- ✓ **visual and electronic monitoring** of wells for underground storage (visual and electronic checks)
- ✓ **bunding** for above ground storage (and recovery and disposal of fuel collected in bunding)
- ✓ if you are only storing a small quantity of oil in a drum, then the drip tray should have a capacity of not less than 25 per cent of the drum.

c ASSESS WHETHER YOU ARE MEETING THE STANDARDS YOU HAVE IDENTIFIED:

If you are not meeting the standards outlined in 8.2.4.a you will need to take swift corrective action. You need to assess how far you are from meeting the standards and to plan how you are going to achieve compliance.

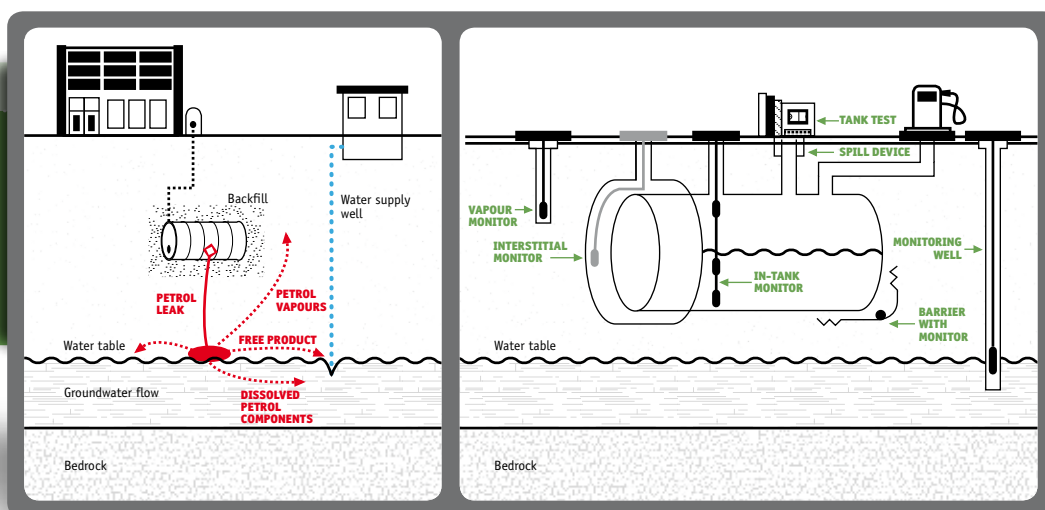
● IDENTIFY LEAKS AND SPILLS

If there is no immediate visual or other evidence (such as an odour), you should check to make sure there are no leaks through unexplained losses in inventory (such as discrepancies in deliveries which are due to changes in temperature, a sales error, or pilfering on a frequent or cumulative basis). If they are not already fitted, you should install meters to measure filling and consumption quantities). Leaks can occur if the tank is more than 10 years old or if there is visible structural damage on the surface or settlement. In addition to looking on the ground or in the drains (for above ground tanks), in monitor wells or extraction wells (for underground tanks), look in the soil downstream of the tank. Dying vegetation is often symptomatic of fuel spill, as are fuel odours in the basement or ground floor of buildings. **SEE FIGURE 8.2**

FIGURE 8.2

left:
Leaking fuel
and petrol
underground
flow

right:
Leak detection
alternatives



If your site investigation or fuel inventory suggests there may be a leak, the tank and supply lines need to be tested. Common techniques include pressure testing (with air or other gas) or hydrostatic pressure testing (using fluid). Hydrostatic testing requires the system to be emptied, filled with test fluid and then refilled with fuel, all of which is expensive and time-consuming, and reveals only major leaks. Neither pressure or hydrostatic testing is recommended as it may cause fuel oil to leak into the ground.

A precision test using the fuel that is being stored will account for all variables, such as volume change, pressure, temperature, tank deflection, etc. affecting the product and tank system. Such a test should include the complete underground storage and handling system. All devices and techniques used during the test should be able to detect leaks as small as 0.2 litres per hour. Since generally at least two tanks are installed, the standby tank should be filled up and also subjected to this test. Test results are valid for the time of the test only and offer no continuing surveillance and protection and monitoring systems should be installed for continuous control.

If a leak or spill is confirmed, you should notify the local fire department, the local regulatory authority and the company that owns the equipment (if applicable). Take all possible steps to contain the leak, and if vapours are present, ventilate the area. The tank will have to be emptied and cleaned internally. If any personnel have to enter the tank, you must ensure they have an adequate air supply and take full safety precautions, including having someone nearby at all times.



Assess the extent of the leak and take remedial action. Any spilt fuel will have to be removed and the contamination may require that the soil or groundwater be biologically reclaimed. This may involve excavation. Underground leaks can require extensive and long-term corrective action, especially where they have existed for some time before detection and the spill has spread. Surface spills or leaks from piping are usually detected quickly and their spread can generally be limited through prompt response.

- **REPLACE INSTALLATIONS**

If you need to replace a tank or piping, the new installation should meet the latest regulations. Tanks should have double walls of either steel or reinforced fibreglass. Metal installations should have corrosion protection, with plastic cladding or cathodic protection with the installation of sacrificial anodes. Unless piping is made of material that will not corrode (such as plastic), it must meet the requirements for cathodic protection. Existing piping should be coated with a corrosion-resistant coating.

- **PROVIDE LEAK DETECTION DEVICES**

Automatic tank gauging, monitoring for vapours in the soil, interstitial monitoring and monitoring for liquids on groundwater can all be done continuously by detection devices. **SEE FIGURE 8.2**

- **DECOMMISSION OBSOLETE TANKS**

Disused tanks should be emptied, cleaned and filled with a non-corrosive substance (such as clean sand) until they are dismantled by a licensed contractor. Similarly, all obsolete piping should be removed, capped or filled.

8.3 LIQUEFIED PETROLEUM GAS (LPG)

Liquefied petroleum gas (LPG), in the form of propane and butane, is used by hotels principally for heating and cooking. It is also found in camping-style lamps and in pressurised lines transferring beverages such as beer from the cellar to the bar. LPG is either stored in large tanks or in more portable cylinders.

8.3.1 The issues

THE MAIN HAZARDS WITH LPG^[1]

- impact from a **gas cylinder explosion** or the **rapid release of compressed gas**
- **impact from parts of gas cylinders or valves that fail**, or from any flying debris
- **contact with the released gas**
- **fire** resulting from the escape of LPG
- impact from **falling cylinders**
- **manual handling injuries**.

THE MAIN CAUSES OF ACCIDENTS

- **inadequate training and supervision**
- **poor installation** of the equipment
- **inadequate examination and maintenance**
- **faulty equipment** and/or **design** (e.g. badly fitted valves and regulators)
- **poor handling**
- **poor storage**
- **inadequate ventilation**
- **incorrect filling procedures**
- **unseen damage** to the cylinder.

8.3.2 How to reduce the risks

See **FIGURE 8.3** overleaf for information on how to reduce the risks associated with LPG usage.

[1] Much of the material in this section draws on the UK Health and Safety Executive (HSE) publication: Safe use of gas cylinders, June 2004.

**FIGURE
8.3**

LIQUEFIED PETROLEUM GAS (LPG)

REDUCING THE RISKS OF LPG USAGE**General guidelines**

- Be aware of the **national and local regulations** covering the filling, use and storage of LPG on your premises.
- Make sure you are purchasing from a **reputable supplier** who is using gas cylinders that are designed and manufactured to an approved standard.
- **Cylinders** need to stand up to everyday use to prevent danger. They must be **inspected** before they are put into service and **examined** at appropriate intervals to ensure that they remain safe while in service.

Training

- Anyone who examines, refurbishes, fills or uses a gas cylinder should be **suitably trained** and have the necessary skills to carry out their job safely. They should understand the risks associated with the gas cylinder and its contents.
- **New employees** should **receive training** and be supervised closely.
- Users should be able to carry out an **external visual inspection** of the gas cylinder and any attachments (such as valves, flashback arresters, and regulators) to determine whether they are damaged. Visible indicators may include dents, bulges, evidence of fire damage (scorch marks) and severe grinding marks etc.
- **Valves** should only be removed by **trained personnel** using procedures that ensure that either the cylinder does not contain any pressure or that the valve is captured during the removal process.
- Cylinders should be **permanently marked** by the appropriate inspection body to show the date of the last periodic examination.

Handling and use

- Use gas cylinders in a **vertical position**, unless they are specifically designed to be used otherwise.
- **Restrain cylinders securely** to prevent them falling over.
- Always double check that the cylinder/gas is the **right one for the intended use**.
- Before connecting a gas cylinder to equipment or pipe-work make sure that the **regulator and pipe-work are suitable** for the type of gas and pressure being used.
- **Wear suitable safety shoes** and other personal **protective equipment** when handling gas cylinders.
- Do not use gas cylinders for any other purpose than **transporting and storing gas**.
- **Do not drop, roll or drag** gas cylinders.
- **Close the cylinder valve** and **replace dust caps**, where provided, when a gas cylinder is not in use.
- Where appropriate, fit cylinders with **residual pressure valves** (non-return valves) to reduce the risk of back flow of water or other materials into the cylinder during use that might corrode it (such as beer forced into an empty gas cylinder during cylinder change-over).
- Ensure that the valve is protected by a **valve cap or collar** or that the valve is designed to withstand impact if the cylinder is dropped.

Filling

- Make sure that your supplier adheres to the **correct filling procedures** as outlined in the relevant legislation. For example anyone filling gas cylinders should wear appropriate protective equipment. This may include safety shoes, protective overalls, gloves, and ear and eye protection.

Lifting

- Gas cylinders can be very **heavy**: use suitable cradles, slings, clamps or other effective means when lifting cylinders with a hoist or crane.
- **Do not use valves, shrouds and caps** for lifting cylinders unless they have been designed and manufactured for this purpose.
- Gas cylinders **should not be raised or lowered on fork lift trucks** unless adequate precautions are taken to prevent them from falling.

Transport

- Fit **suitable protective valve caps and covers** to cylinders, when necessary, before transporting. Caps and covers help prevent moisture and dirt from gathering in the valve of the cylinder, in addition to providing protection during transport.
- **Securely stow** gas cylinders to prevent them from moving or falling. This is normally in the vertical position, unless instructions for transport state otherwise.
- **Disconnect regulators and hoses** from cylinders whenever practicable.
- Ensure gas cylinders are **clearly marked** to show their contents (including their UN Number) and the danger signs associated with their contents.
- The transport of gas cylinders is subject to **carriage requirements**. For example, that the vehicle is:
 - ✓ **suitable for the purpose**
 - ✓ **suitably marked** to show that it is carrying dangerous goods
 - ✓ the **driver is suitably trained**
 - ✓ the driver carries the **appropriate documentation** about the nature of the gases being carried.

Storage

- Gas cylinders should **not be stored for excessive periods of time**. Only purchase sufficient quantities of gas to cover short-term needs.
- **Rotate stocks** of gas cylinders to ensure they are used in the order they have been purchased.
- Store gas cylinders in a **dry, safe place** or on a **flat surface in the open air** or in **well-ventilated housing**. If this is not practicable, store in an adequately ventilated building or part of a building specifically reserved for this purpose.
- **Protect** gas cylinders **from external heat sources** that may adversely affect their mechanical integrity.
- Store them **away from sources of ignition** and other flammable materials.
- **Avoid** storing gas cylinders so that they stand or lie in water.
- Ensure the **valve is kept shut on empty cylinders** to prevent contaminants getting in.
- Make sure gas cylinders are **securely restrained** (for example with a chain), unless they are designed to be freestanding.
- Gas cylinders must be **clearly marked** to show what they contain and the hazards associated with their contents.
- **Store** cylinders where they are **not vulnerable to impact** (such as vehicles in the hotel car park).

Repair

- **Never try to repair a cylinder** on your premises. Any modifications or major repairs should only ever be carried out by qualified personnel from the supply company.



8.4 CLEANING CHEMICALS

8.4.1 The issues

Around 1,500 new chemicals are marketed every year, adding to the 70,000 or more already in existence.^[2] Many people believe that all chemicals are harmful to humans, animals and the environment. Some are known to cause health problems such as dermatitis, cancers, occupational asthma and reproductive problems and there may be much we still have to learn about the long-term effects of others. However, we have also come to rely on chemical products to maintain and improve our quality of life, particularly when it comes to delivering high standards of hygiene.

- Chemical products have **environmental implications throughout their life cycle** – i.e. from their design and development, through the raw materials used in their manufacture and for packaging, in transportation, in use (when the chemical product performs its job), and finally in disposal and recycling. In high concentrations, or if used in combination, some chemical cleaning products are potentially hazardous to human health and/or the environment.
- Many chemicals used for cleaning and other uses eventually **find their way into the environment** either in waste water effluent through drains or with solid waste to landfill or incineration. Some of these chemicals are known to 'bio-accumulate' in plants and animals and pose adverse long term effects. High concentrations of phosphate and nitrate have been the focus of debate about the increase of algal growth in some watercourses.
- Even cleaning products that are based on **natural ingredients** can have direct or indirect environmental implications which need to be considered. For instance, palm oil is a natural and key ingredient of soap, beauty products and foodstuffs. However, growing this lucrative crop in tropical areas such as Malaysia and Indonesia involves clearing natural rain forest to make way for palm oil plantations. This reduces the habitat for many animal and plant species, threatening their survival. Other issues include use of pesticides on the crop, which can poison animals such as the elephants that eat the leaves. Some producers and consumers of palm oil are now working to develop sustainable palm oil production methods.
- The **disposal of containers and packaging** can be problematic especially in resorts or environmentally-sensitive areas.

8.4.2 Benefits of minimising chemical use

- a Significant cost savings** can be achieved by eliminating non-essential products, using products at the correct frequency and concentrations, buying in bulk or in concentrated form and using refillable containers to reduce waste disposal costs. Many hotels use more chemicals than are necessary to meet hygiene requirements. Excessive use of chemicals usually results from:
 - non-existent or poor dosing equipment (which can be due to lack of maintenance)
 - poor staff training
 - technical factors (such as low temperatures or an improper wash pressure).
- b Using less hazardous products or those which prevent or minimise skin contact will minimise the health and safety risks** (and the associated potential liability) of your operation.
- c Reducing chemical use and selecting cleaning products with a lower environmental impact^[3] will help protect the quality of the aquatic environment** such as lakes and streams. Choose products that are not hazardous to the environment and optimise chemical use by using chemicals only when needed and in the correct doses.

[2] United Nations Environment Programme, May 2004: Stockholm Convention on Persistent Organic Pollutants Coming into Force. See www.unep.org/Documents.Multilingual/Default.asp?DocumentID=398&ArticleID=4487&I=en

[3] Note that in practice, it takes considerable competence to fully interpret the environmental impact of individual substances, and in many cases not even the scientists are categorically sure. For example, it is not easy to decide whether a highly acute aquatic toxic substance is more hazardous than one that is not, but is bio-accumulative, or non-biodegradable. If unsure, consult the MSDS (materials safety data sheets) and your supplier.



- d Using products with minimal packaging can help to **reduce pressure on landfill sites** and reduce any chemical run-off that can occur from such sites. Where possible, select products with minimal packaging that has been (or can be) recycled and is not hazardous to the environment.
- e Some chemical cleaning products will also kill the bacteria that are essential for breaking down and treating waste water effectively, which is an important consideration for **hotels that operate their own waste water treatment plant**. Used correctly, the small amounts released are insignificant, however large spillages can compromise local treatment plants.

8.4.3 Cleaning products commonly used in hotels and their impacts

Chemical cleaning products are most likely to be used by the housekeeping, kitchen, laundry and engineering departments. They are essential in hotel kitchens and outlets where food is being prepared, where hygiene is crucial and systematic operation and control methods are required in order to prevent food poisoning.

Chemicals are available in solid, liquid, powder, granules, tabs and gel forms. They include:

- a **laundry and dishwashing detergents** (which may contain some/any of the following: alkalis, bleaching agents, sequestering agents, surfactants, solubilisers and acids)
- b **toilet and bath cleaners** (acids, alkalis)
- c **bleaches** (may include hydrogen peroxide, sodium hypochlorite, sodium chlorite and sodium perborate)
- d **surface and floor cleaners** (alkalis, surfactants, solvents)
- e **disinfectants** (quaternary ammonium compound, chlorine, acids, alcohols, peroxygen)
- f **degreasers and oven cleaners** (alkalis, surfactants, solvents)
- g **descalers or delimers** (acids, such as hydrochloric acid)
- h **glass cleaners** (solvents, surfactants)
- i **metal cleaners** (solvents)
- j **dry-cleaning chemicals** (organic solvents such as perchloroethylene, a chlorinated hydrocarbon)
- k **swimming pool chemicals** such as chlorine and bromine **SEE SECTION 3.3.4.**

More information on the raw materials used to make cleaning products together with their impacts can be found in **APPENDIX 4**.

8.4.4 Effective management of chemicals

a OBJECTIVES:

The key to using any chemical product is **careful and informed selection, efficient use and safe disposal**. Basically, if you use 20 per cent more product than you need, you are adding 20 per cent to every other impact in the life cycle and 20 per cent to your costs. In order to use chemical cleaning products in the most environmentally responsible way you should ensure that:

- the product is **necessary and the right one for the job**
- it causes **minimal adverse environmental impacts**
- the **optimum doses** are used
- the products are **stored, labelled, used, handled and disposed of** in accordance with local and **international standards and regulations**.

**b THE ACTION PLAN:**

Identify and record where hazardous materials are being used, what they are being used for and the reasons for their use.

- **Assess the hazards associated with the product's use.** You may need to examine the product information sheet for each product and ensure that staff are using the appropriate concentration (this will vary according to local conditions such as the hardness of the water and soil conditions). **Materials Safety Data Sheets (MSDS)**, referred to in some countries as **Safety Data Sheets (SDS)**, are standardised documents that describe the known hazards associated with a material, indicating the safe handling procedures and recommended responses to accidents. The information is set out under 16 sections **SEE APPENDIX 1**. The sheets are prepared by the chemical supplier and in many countries they are required by law to send you an MSDS if you buy a chemical. They should also send one on request even if you are only considering purchase. If you already have the chemical but the MSDS is lost or the material is so old that none came with it, most manufacturers are happy to email or fax a relevant MSDS on request and should even make compilations of their data sheets available free of charge. When assessing an MSDS it is important not to confuse the risk statements associated with the raw materials and those of the final formulation, which may be a minute amount. (Sections 3 and 15 in the MSDS give the final classification of the product but people often give more attention to the raw material details in sections 2 and 16).
- Make sure you **understand the full package of requirements and support from your supplier** – e.g. technical advice, training, equipment and support materials. Some suppliers will conduct a complete review of your chemical usage and identify options for improvement.
- Identify opportunities for **reducing the number of different chemical cleaning products and replacing them** with simpler, cheaper and environmentally-preferable alternatives where possible.
- Review **handling, storage, labelling and disposal procedures**.
- Compile a **hazardous materials manual**.

c THE HAZARDOUS MATERIALS MANUAL

In some cases it may not be possible to use a less hazardous substance so it is important to ensure that the effects of its continued usage and disposal are minimised. One way to achieve this is to compile a hazardous materials manual, covering the use, handling, storage and disposal of hazardous chemicals and other hazardous substances used in your hotel. The manual needs to be in a format that can be readily and regularly updated.

- **Ask manufacturers and suppliers to provide details** for every substance that they supply to you. This information can be compiled into a manual for use by staff. Make sure that it is continually updated with new pages if new chemicals/hazardous materials are purchased. **APPENDIX 2** shows how you might set out your own hazardous materials sheets.
- It is particularly important that you **follow the correct disposal method**. Too often, chemicals are given the respect they deserve when they are being handled and used, but are then thoughtlessly disposed of into the normal waste-water system. It is imperative that the end-user is aware of correct disposal methods, and the implications of failing to follow them.
- Make sure that the necessary **information reaches the end-user** in his or her department.
- You should also ensure that any **hazardous chemicals are stored separately** or 'flagged' with a special method of identification in order to bring their hazardous nature to the attention of the person taking them from the stores.

**d STORAGE**

Storage of chemicals should be:

- In a **cool place**, to avoid chemical reaction through excessive heat or direct sunlight.
- '**Secure**', i.e. on strong shelving, stacked in such a way so the containers will not fall over, and only accessible to those authorised to use them.
- In such a way as to facilitate **stock rotation**.
- So that they **do not block corridors, access or exit points**.
- With all appropriate **emergency equipment readily to hand**, i.e. correct fire-extinguishers, fire blankets, fire hose and a comprehensive first-aid box.
- Aimed at keeping all chemicals **securely isolated** from each other, as mixing products may cause a chemical reaction or even an explosion.
- With particularly **volatile chemicals** (such as chlorine) stored and **secured correctly outside the building**.
- Managed in a way that **avoids over-stocking** and hence waste and disposal problems.
- In **properly-labelled containers**.

e USE

- Always ensure that any new chemical products you purchase meet the basic **health and safety requirements** for your property.
- If possible **avoid products marked 'Danger', 'Poison', or 'Warning'**. When you must use a strong product to get the job done, protect yourself by wearing gloves and goggles, and be sure that your work area is well-ventilated.
- **Wear protective gloves** when using any cleaning products.
- **Never mix** different chemical products, and ensure that staff are trained not to do so under any circumstances. This could pose a serious health and safety risk.
- **Always add chemical products to water** and never water to the product.
- **Natural alternatives** may be appropriate for some cleaning applications (such as using vinegar and water to clean glass), but not where their use may compromise hygiene standards, such as in areas where food is prepared or displayed.



**f LABELLING, ENVIRONMENTAL AND ETHICAL CLAIMS**

- Many cleaning products carry some form of **environmental branding**. However some of the claims made on these labels may be unclear and cannot be verified so read them carefully and, if in doubt, consult the manufacturer.
- Be wary of the term '**natural**' when used to describe cleaning products. Although the chemical ingredients may be extracted from plants or the earth, they are likely to have been chemically converted or 'synthesised' in order to become useful in cleaning products.
- Beware of products that claim to be **biodegradable**. Only substances, not products, can be classified as biodegradable. In fact, over time all substances are biodegradable – it just depends how long it will take. Look for information on the substance's ultimate biodegradability, which involves its complete breakdown into simple salts, water and oxygen, which is the internationally recognised indicator.
- Some cleaning products or their chemical components are still **tested** by their manufacturers (or in some countries the authorities) **on animals**. If you want to source ethical as well as environmentally responsible products, you may wish to select a manufacturer that either does not currently test on animals or has established a date by which all animal testing will cease. Ask your supplier for their policy on this.

g QUANTITIES AND TIMING

- It is generally necessary to use more cleaning chemicals in hard water areas than in soft water areas. This is because chemicals are needed to soften the water for maximum cleaning efficiency. Investment in **water softening plant** will help to reduce the total volume of cleaning chemicals used. Such equipment may be particularly justified if your establishment has a restaurant or busy laundry.
- **Avoid manual dosing** if possible as it is not possible to be as exact on quantities. Many of the larger manufacturers of cleaning products provide **staff training** and **automated dispensers** (which measure out the precise quantity of concentrated products) to ensure that appropriate quantities and concentrations of a product are used. Take care, however, because concentrated chemical products can be more hazardous to handle than their diluted alternatives. In most cases your supplier will fit the equipment and advise you on appropriate handling and storage arrangements.
- It is important to leave the product in contact with what is being cleaned for **the necessary amount of time**. If the recommended contact time is not respected the cleaning result will be poor and a second cleaning will be required, doubling your chemical consumption.

h PACKAGING

- If possible, choose products that are packaged in recyclable containers or can be supplied through **refill systems**.
- The '**recyclability**' of containers will depend on the facilities available in your area. PVC containers (polyvinylchloride) are more difficult to recycle than high and low density polyethylene (HDPE and LDPE), polypropylene (PP), polyethylene (PE) and polyethylene terephthalate (PET).
- **Reuse** chemical containers only where they are to be filled with the same product, as cross-contamination can be dangerous. Thorough cleaning will require higher chemical and water consumption.

i DISPOSAL

- Some chemical products should be treated and disposed of as hazardous waste. When changing to alternative cleaning products consult the MSDS to ensure that **appropriate disposal routes** are chosen.
- If your hotel operates its own waste-water treatment plant or has to comply with discharge consents, **check the likely implications** of changing chemical cleaning products with your chief engineer or local authority prior to making a decision.

**j TRAINING**

- All relevant hotel **staff should be trained** in the handling, use, storage and disposal of chemicals. Many chemical companies incorporate a full training programme as part of their supply/maintenance package, and such facilities should be assessed and, where relevant, used as fully as possible.
- Contractors, vendors and suppliers using, handling and disposing of chemicals and other hazardous materials should be subjected to **pre-qualification assessments** to determine whether they can comply with the hotel's requirements. It should be noted that in many countries the hotel is liable for damages if the contractor improperly disposes of the hazardous wastes.

8.5 MERCURY IN CFLs

Mercury (Hg) is a naturally occurring heavy metal and is one of six elements that are liquid at or near room temperature and pressure. It occurs in deposits throughout the world and it is harmless in an insoluble form such as mercuric sulfide, but it is poisonous in soluble forms such as mercuric chloride or methylmercury.

8.5.1 The issues

The largest man-made source of mercury is coal-fired power stations as the mercury that naturally exists in coal is released into the atmosphere when it is burned. Mercury is used in a variety of industrial and scientific applications and in dentistry, although its use is being reduced and phased out where possible due to the negative health effects of mercury exposure. These include tremors, impaired cognitive skills, and sleep disturbance in workers with chronic exposure to mercury vapour even at low concentrations. The **World Health Organization**, the **US Occupational Safety & Health Administration (OSHA)**, and **US National Institute for Occupational Safety and Health (NIOSH)** all treat mercury as an occupational hazard, and have established specific occupational exposure limits.

Environmental releases and disposal of mercury are regulated in the US primarily by the **Environmental Protection Agency**. In the EU, the **Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment** bans mercury from certain electrical and electronic products, and limits the amount in other products to less than 1000 ppm. Its use in new non-electrical measuring devices, such as thermometers and barometers has also been banned since 2007, with certain exemptions for the healthcare sector and a two-year period of grace for manufacturers of barometers.

8.5.2 Mercury in CFLs

Mercury is essential to enabling a compact fluorescent lamp (CFL) to be an energy-efficient light source. CFLs contain a very small amount of mercury (around five milligrams) sealed inside the glass tubing. This is roughly equal to the amount that would cover the tip of a ballpoint pen. Older style thermometers, in comparison, contain about 500 milligrams of mercury, or 100 times more.

Many lighting manufacturers have taken significant steps to reduce mercury used in their fluorescent lighting products and there is no danger when the bulbs are in use. However, being made of glass, the lamps can break if dropped or roughly handled.



8.5.3 Safe handling of CFLs

PRECAUTIONS

- **Take care** when removing the bulb from its packaging, when installing it, or replacing it.
- Always screw and unscrew the lamp **by its base** (not using the glass).
- **Never use force** to twist the CFL into a light socket.

IF A CFL BREAKS

Open a window and vacate the room for 15 minutes or more



Using **disposable gloves**, rather than bare hands, **carefully scoop up the fragments and powder** with stiff paper or cardboard and place them in a **plastic bag**



ON HARD SURFACES:

Do not use a vacuum or broom to clean up the broken bulb. Wipe the area clean with damp paper towels or disposable wet wipes and place them in the plastic bag

ON CARPETS:

Remove all the materials you can without using a vacuum cleaner. Sticky tape (such as duct tape) can be used to pick up small pieces and powder. If vacuuming is needed after all visible materials are removed, vacuum the area where the bulb was broken, remove the vacuum bag (or empty and wipe the canister) and put the bag or vacuum debris into a plastic bag



Place all the materials you have used to clear up the debris in a **second sealed plastic bag**



Either take it to your **local recycling centre** or tell your waste contractor what is in the bag so that it does not go into the waste for general landfill



Wash your hands after disposing of the bag.

DISPOSAL

- If the lamp has failed within its warranty period, the best thing to do is **return it to your supplier** and ask them to confirm it will be disposed of responsibly.
- Most landfill sites now have **separate recycling facilities** for CFL and other fluorescent lamps. Your waste contractor should advise you on how it will collect and dispose of spent CFLs. If there is no segregation in place at your local landfill site, you should **'double seal'** the bulb within two plastic bags in your area for waste collection. CFLs should not be disposed of in an incinerator.





8.6 PESTICIDES, HERBICIDES AND ALTERNATIVE CONTROL MEASURES

8.6.1 The issues

Hotels experience a variety of problems with unwanted pests, bugs and weeds. The specific methods used to combat them will depend on the location of the hotel and the problems being experienced. For example, hotels in the tropics are more likely to have a problem with cockroaches, ants and mosquitoes whereas hotels in urban locations may have trouble with rodents. The parts of the hotel which are most vulnerable are in kitchens, waste storage areas, guest rooms and hotel grounds.

Pesticides, insecticides, herbicides, bactericides and fungicides are terms used to describe the many chemical agents developed to kill unwanted life forms. They are widely used in hotel kitchens, waste storage areas, guest rooms and in hotel grounds.

- **Pesticides, rodenticides and insecticides** are used to control insect and other animal infestations.
- **Herbicides** are used to control 'weeds' and other unwanted plants.
- **Bactericides, sterilants, biocides and fungicides** are used to combat bacteria and moulds.

These substances range from simple to complex compounds, and have a correspondingly large range of environmental hazards associated with them. Some kill only the target organisms, others will kill a range of different life forms if used indiscriminately. Once employed, the chemicals may take considerable time to break down and become inactive. Additionally, they may become more concentrated as they pass up the food chain. Short term exposure to pesticides and herbicides can cause a range of health problems in humans and other animals, including eye, lung, throat and skin irritation, dermatitis and poisoning. They can also have long-term effects, including cancers and birth defects. Because they 'persist', meaning that residues may build up in our food and water supplies for considerable periods, environmental problems and damage to other life forms may occur long after the initial application.

There are many laws governing the use of substances used to control pests. In the UK for example they are subject to the **Control of Substances Hazardous to Health Regulations 2002 (COSHH)**, **The Food and Environment Protection Act** and **The Control of Pesticides Regulations 1986**. Internationally, the **Stockholm Convention on Persistent Organic Pollutants** bans the use of certain pesticides and insecticides. **SEE APPENDIX 3 AND ALSO SECTION 3.4.4**

8.6.2 Your action plan

a OBJECTIVES

Good environmental practice in pest, weed, bacteria and fungal control involves maximising non-chemical methods to minimise the use of pesticides and herbicides. Insects and rodents have to be controlled, but the use of chemicals should be considered as a supplement to basic sanitation and other physical and biological measures aimed at the elimination or control of breeding areas.

In order to safeguard the health of employees and guests, and to protect the general environment, your objective in managing pest control chemicals should be to:

- **control and minimise the use** of pest and bacteriological control substances.
- **replace** hazardous substances with less hazardous (preferably naturally-occurring) alternatives.
- ensure that any substances you do use are **stored securely**.
- **supervise and control the preparation and use** of chemical applications.
- ensure that any residues and/or containers are **disposed of in an environmentally safe manner**.

**b ACTIONS**

This will involve:

- identifying **which pesticides and herbicides are being used** and the exact problems they are intended to resolve. The more that is known about the problem, the less chance there is of making a mistake. The words organic, natural and biodegradable in this context do not guarantee that they are safe
- determining whether their use **complies with local, international and company regulations**
- **assessing other methods of control** and substituting them for hazardous substances
- ensuring that pesticides and herbicides are **stored, used and disposed** of in a manner that protects human health and safeguards the environment
- ensuring that pesticide use **does not annihilate other life forms** that you wish to encourage
- **carrying out specific checks and actions** relating to the storage, preparation, application and disposal of chemicals.

8.6.3 Pesticide and herbicide management

Where the application of chemical pesticides and herbicides is unavoidable, proper management is absolutely essential.

Manufacturers and suppliers should provide full details of the hazards associated with the pesticides and herbicides they supply. They should also supply the appropriate information relating to storage, preparation and application. A review of the chemicals can then be undertaken to assess whether there are safer alternatives. For example, some insect sprays are based on **pyrethrum**, a natural insecticide obtained by extraction from chrysanthemum flowers. Pyrethrum-based insecticides are more readily broken down than some other types of pesticide.

Chrysanthemum cinerariifolium, from which potent natural **pyrethrum** insecticide is made



You can obtain information on available pesticides and on the proper application equipment direct from the manufacturers or general handbooks on current pesticides and herbicides and their use. Details of all pesticides and herbicides that you use should be recorded in a hazardous material sheet as shown in **APPENDIX 2**.

**a HEALTH AND SAFETY OF PERSONNEL AND GUESTS:****• STAFF**

Where staff are employed in pest-management, they need to be properly trained in health and safety measures, in the causes and effects of misapplication of the pesticides and in the protection measures required for safe application. See the checklist in **APPENDIX 2**.

• CONSULTANTS

In many instances it will be necessary to call on outside expertise to advise on pest-management problems, particularly in the creation of integrated pest-management programmes, which may require detailed knowledge of the biology and ecology of a particular species.

• CONTRACTORS

In some instances a pest problem may only be solved by the application of special toxic pesticides. If this is the case, you should use specialised contractors. Ensure that all chemicals used by the contractor are approved by the local and national authorities and that their use is properly documented.

• VENDORS AND SUPPLIERS

Vendors and suppliers should provide current data sheets for all chemicals and materials supplied. They should also either be able to take back unused or surplus pesticides or recommend a suitable agent through which they can be disposed.

• GUESTS

Guests should be informed of any pest-control management systems. When application or spraying is in progress, they should be warned of this activity and kept away from the area in which it is taking place.

**b SPECIFIC CHECKS AND ACTIONS:**

SEE FIGURE 8.4 OVERLEAF

FIGURE
8.4

PESTICIDE AND HERBICIDE MANAGEMENT

SPECIFIC CHECKS AND ACTIONS



Storage

1. **Storage areas** must be dry, frost-free, well-ventilated and secure against theft and vandalism.
2. They should be situated **away from other buildings**, especially residential buildings or areas where food or flammable materials are stored.
3. Stores should be built to **resist foreseeable accidents**, including leakage and spillage, fires and the weather. Ensure there is no risk of any spillage entering the ground and polluting water sources. Floors should be impervious to liquids, anti-slip, chemical-resistant, washable and with a means of diverting spillages. Ideally they should be below surrounding ground level without the risk of flooding. Drainage should be into sumps or tanks large enough to contain any foreseeable leakage. Do not site them near watercourses, ponds, ditches or areas liable to flooding.
4. **Display warning signs** without attracting unwanted attention and in large areas, provide **emergency exits**.
5. **Shelving and stacking** facilities should be appropriate for the size of the containers stored in them. Flammable pesticides should be separated from other pesticides. Consideration should be given to possible reactions between chemicals coming in contact with each other. Proper emergency plans should be drawn up and made available.
6. Make sure all pest control chemicals are **clearly labelled** and that the manufacturer's instructions for use are kept with them.
7. **Effective first-aid provisions** should be available, together with data sheets on all the products in the store and the chemical safety precautions. Details of any statutory requirements and emergency telephone numbers should be available.
8. **Emergency telephone numbers** and other emergency facilities should be checked and if necessary updated at regular intervals. Make sure there is a first aid leaflet to hand and, ideally, display first aid information on the wall.

Preparation and handling

1. **Accurate measurements** should be made during both mixing and application phases. Use the most suitable chemical, in the minimum necessary amount, to achieve the desired results.
2. A **safe area** should be available for mixing pesticides. This should be done on a concrete pad, with a separate sump or tank to contain any leakage.
3. Operators should be provided with, and adequately trained in the use of the **necessary equipment** and **protective clothing**. Sufficient spares should be available.
4. **Proper health surveillance** should be available to all those working with pesticides and herbicides.
5. The **area of application** should be clearly marked, and **unnecessary access prevented** while spraying is in progress.
6. **Neighbours** and others in the area should be warned of the spraying programme.
7. Only the **appropriate quantity** of pesticide and herbicide should be removed from the pesticide store for immediate use.
8. Chemicals (especially pesticides and herbicides) must **never be put into unmarked containers**.
9. **Do not transport** chemicals in vehicles used for carrying people or food.

Application

1. **Time the treatment** to coincide with the presence of the pest.
2. Use a **selective chemical** that has the least effect on non-target species and treat only the area affected.
3. **Equipment** should be **frequently checked** and **properly maintained**, both for health and safety reasons and to minimise spray drift.
4. Spraying **should not be carried out in unsuitable weather**. Anyone operating sprayers should have access to a wind-speed meter and only spray when the wind speed is nil or negligible.
5. **Avoid inhalation of dusts and fumes** and **contact with the skin**. Users should wear protective clothing and headgear, and change clothing and wash thoroughly with soap and water after applying pest control chemicals.
6. **Hours of work** should be controlled so that people are exposed for the minimum time.
7. Ensure that anyone handling toxic chemicals **never works alone** and that the work area is **well-ventilated**. In confined areas, they should wear a safety-approved respirator.
8. **Wear a respirator** for outdoor spraying or dusting of organic phosphorus compounds.
9. Take care to **avoid the contamination of food and drinking water**.
10. **Eating, drinking and smoking** should be **prohibited** when using or handling chemicals.
11. Users should be **familiar with the effects** on the body of the chemicals they are likely to be using, and how the chemicals may enter the body.
12. Users should be **aware of the signs and symptoms** of acute poisoning related to chemicals they are using:
 - They should **stop work** if they are feeling ill.
 - They should **seek medical advice** and report the matter if they experience nausea, excessive sweating, are unusually thirsty or have unusual difficulties with their eyesight.
13. **Sprays should be turned off** before inspecting nozzles. Correct protective clothing should be worn for these inspections, and nozzles of pipes should not be blown through (using air from the lungs) or sucked on in order to clear blockages.
14. When using a 'rucksack' type sprayer, be aware of the following hazards:
 - Liquid should **not be allowed to spill** on to the user's back or clothing.
 - **Shoulder straps** should be suitable and easily adjustable.
 - Sprays should **not be too heavy** to be lifted when full.
 - **Pump seals** should be regularly checked, and replaced as soon as there is any sign of deterioration.
 - **Hand lance triggers** and joints should be checked for seepage.
 - It should be possible to check from the outside how full the sprayer is **to avoid spillage** from overflowing.
15. **Control the re-entry** of people into the treated area.

Disposal of leftover chemicals

As most pesticides and herbicides are extremely toxic, due regard must be paid to **disposal** of unused chemicals. Disposal methods will depend on the:

- **quantity of waste** for disposal
- chemical and biological **degradability** of the active ingredients
- **toxic properties**
- **concentration**
- **physical form** of the waste
- **disposal options** available.

Always follow the **manufacturer's and/or supplier's instructions** even when disposing of empty containers. These details should be kept in the hazardous materials manual **SEE 8.4.4.c**. Landfilling pesticides and herbicides is not generally an environmentally sound option and in most cases incineration is advised, at temperatures in excess of 1000°C and at a residence time of at least two seconds.

The following general guidelines should also be adopted:

- **Never transfer pesticides** to **unlabelled** or **mislabelled** containers. Keep in clearly labelled containers even when disposing of them.
- **Do not reuse** pesticide/herbicide containers.
- **Rinse out containers** before disposal, and use the rinse water for pest and weed control.
- **Puncture containers** after they have been used, to prevent re-use.
- **Segregate pesticide/herbicide wastes** from general hotel wastes.
- Use an **authorised waste-disposal contractor**.
- Use an **authorised disposal site**.

8.6.4 Specific pests and how to deal with them

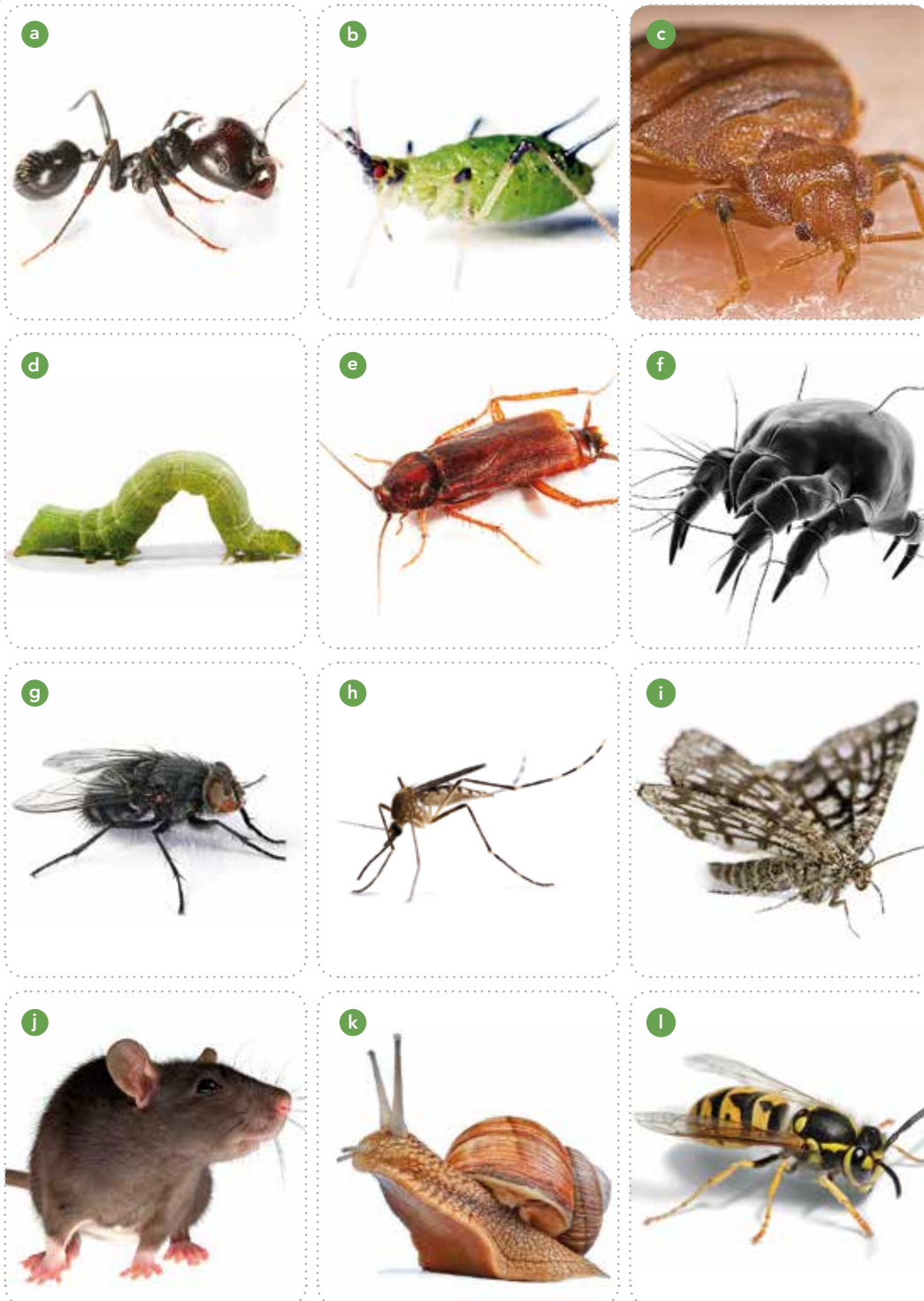
As a general rule, control methods must attack both adults and larvae or young, with the emphasis normally being on controlling the larvae and young in order to break the life cycle.

FIGURE 8.5

Common pests associated with hotels:

- a: ants
- b: aphids
- c: bed bugs
- d: caterpillars
- e: cockroaches
- f: dust mites
- g: flies
- h: mosquitoes
- i: moths
- j: rodents
- k: snails
- l: wasps

See text for full details



NOTE: IMAGES ARE NOT TO SCALE

**a ANTS**

Ants can become a problem during the summer, particularly when food is left on counters or crumbs and debris remain on the floor.

Pavement ants, larger yellow ants, thief ants and carpenter ants are commonly found in hotels.

Ant control requires knowing their habits and where they enter from the outside. The ants establish colonies and send out scouts to find food and water. These scouts leave a scent trail which enables them to find their way back to the colony with news of found resources. Other colony members then follow the scent trails to retrieve the resources. Some ant varieties establish sub-colonies near resources or send out queens to establish new independent colonies.

The first thing to do is to kill any ants you see and to wipe down the area with soapy water in order to prevent major scent trails from being formed and to stop the scouts returning to the colony. If there is already an established trail, wipe backwards from the food source to the entrance of the trail. Then block the entry point to the building – the ants will give up trying to find a way through after a day or two. Temporary blockades can be made using sticky substances such as petroleum jelly or chili powder, cinnamon and boric acid. If you can find the entrance to the nest, pour boiling water into it.

To cut off the supply of food, keep opened foodstuffs in sealed containers or store them in the refrigerator or freezer. Wipe down worktops and sweep floors regularly. Clean out kitchen cabinets, drawers and shelves to remove crumbs and stains. Keep sinks and worktops dry and dry pans and dishes immediately after use.

Baits are best put in the path of an ant trail and then removed after the ant activity stops, before they lure ants from another colony to the area. You may need to try different baits if the first one doesn't work as they use different attractants. Use sticky barriers to stop ants traveling up trees and plants. Prune branches close to the building and remove fences or anything that might create a bridge for the ants to cross.

Low toxicity compounds to control ants include boric acid and diatomaceous earth (DE), a chalk-like powder consisting of the fossilised remains of diatoms, a type of hard-shelled algae. Make certain that any other compounds used in ant control products are safe and ensure that you follow the instructions carefully.

Pharaoh ants are tiny white insects that can come in with the delivery of clean laundry and are therefore not easily spotted. Once established they can spread throughout a building in a very short time. The treatment for infestations can only be administered by a licensed pest control contractor and involves feeding the ants liver dosed with a hormone that acts on the pests' reproductive cycle. This stops them breeding and eventually they die off. Treatment is expensive as it can take up to six months to eradicate an infestation.

b APHIDS

Before toxic insecticides were introduced in the 1940s it was standard practice to use beneficial insects for pest control in agriculture, but the availability of convenient, branded products combined with effective marketing rendered these techniques almost obsolete. Today, many garden pests have developed a tolerance of chemicals whilst the same chemicals are also killing off the beneficial insects that nature intended to control the pests. Cutting out the use of chemicals enables natural predators such as ladybirds (ladybugs) and green lacewings to return. As a result, butterflies and birds also become more plentiful.

Releasing predatory mites, ladybirds and lacewings into the grounds several times over a period of weeks will help to manage sap-sucking pest mites and whitefly. Parasitic wasps can also be used to control scales on trees, shrubs and flowers.

If it is difficult to obtain supplies of beneficial insects for release into the garden, then it is possible to purchase a branded 'lure' that simulates the scent of aphids and lures ladybirds and lacewings to the area.

**c BED BUGS**

Although bed bugs have been traditionally associated with backpackers' hostels and budget accommodation, the rise in international travel means they are on the increase and are particularly prevalent in some areas of Eastern Europe and the Far East. Sadly for some hotel guests, paying for a luxury room in a top hotel does not automatically guarantee immunity from bed bugs. Often they come in with hotel deliveries or in guests' luggage. Kitchens are a

favourite location where they shelter behind wall tiles, equipment or in the crevices in walls and floors – any warm and damp locality near food. They also hide near beds in lampshades, behind fixed headboards and in upholstery. They are attracted to human hosts when they detect an increase in the level of carbon dioxide, exhaled during sleep.

Adult bed bugs are around four to six millimetres long and clearly visible to the naked eye, but colonies can build up without being spotted due to their nocturnal behaviour. However, if a guest has been bitten by a bedbug, they are likely to complain. Sores or bites on the body, often in a line, are fairly conclusive evidence, as are blood spots on sheets, skins that have been cast by bugs as they hatch, excrement that looks like mould on wallpaper, bedheads, fabrics and carpet close to the bed. If there is a serious infestation the room may also have a sweet, sickly smell.

Bedbugs only feed once a week, so they hide in wall cavities, ceilings and central heating ducts and reappear throughout the hotel at different times. Once established it is very difficult to eradicate an infestation as they are prolific breeders with a very short life cycle. Studies have shown that the average time taken for bed bugs to spread to adjacent rooms is seven weeks. For this reason, it is not sufficient merely to treat the room in which they are found as the problem is likely to have spread to other areas of the hotel. The most effective course of action is to enlist professional help so that other rooms can be checked for signs of secondary infestation and treated if necessary.

d CATERPILLARS

Proprietary-branded bacterial insecticides derived from natural ingredients are available to control caterpillars. Check that the insecticide does not remain in the environment for long – some are suitable for use even up to the day of harvest. The insecticide works by paralysing the digestive system of the caterpillars, making them unable to eat.

e COCKROACHES

Cockroaches have been around for more than 400 million years and are believed to share a common ancestor with termites. They contaminate food with their excrement and secrete an unpleasant odour that can permeate the indoor environment. Many individuals also develop allergies to them.

Cockroaches are broad, flattened insects with long antennae and are often confused with beetles. However adult cockroaches have membranous wings and lack the thick, hardened fore-wings of beetles. They are nocturnal and run rapidly when disturbed. Immature cockroaches (nymphs) look like adults, but are smaller and do not have wings. Females can carry an egg case with them for quite some time, dropping it wherever it may fall. Each egg case may contain hundreds of eggs which hatch into nymphs.

Cockroaches require high humidity, warmth, and a food source. They live and breed in moist dark places behind skirting boards, around plumbing, under refrigerators and in cupboards, pantries and kitchens. The holds of aircraft are notorious sources of cockroach infestation and the insects enter the hotel on customers' luggage or other items such as crates of food or drink. Outdoors they are found in piles of debris, rubbish and waste. They will readily feed on carbohydrates, paint, wallpaper paste, and book bindings.



Adult cockroaches can hide in a crack as narrow as 1.6 mm wide, while immature cockroaches tend to stay in even smaller cracks where they are well-protected. They tend to congregate in corners and generally travel along the edges of walls or other surfaces. Use a flashlight at night to inspect cracks, underneath counters, around water heaters, and in other dark locations and look for live and dead cockroaches, cast skins, egg capsules and droppings.

There are five main species and effective control depends on identifying them correctly. Measures to take include effective hygiene and exclusion practices, sticky traps lined with pheromones, boric acid, insect growth regulators and sprays.

Cleanliness should be your prime objective in the elimination of cockroaches. All food-handling areas should be cleaned frequently. In general, cockroach control is best done by a professional on a contract basis, through the application of pesticides to reduce the population to a reasonable level. Control is necessary on a regular basis because of the mobility, reproductivity, longevity and behaviour of these pests. Ensure that you know what pesticides are being used by the professional contractor and do not assume that they are using an environmentally appropriate chemical.

f DUST MITES



Fabrics, bedding (especially mattresses and pillows) and carpets all attract and generate dust – the perfect home for a dust mite. The problem is greater in Northern European countries and in North America where fabrics and carpets form such a major part of the room décor.

Dust mites are only 0.4mm long and so cannot be seen with the naked eye. Unfortunately, they are such a common problem that almost any bed examined under a microscope will be found to have dust mites.

There are several ways to keep dust mites at bay, including regular vacuuming of mattresses and pillows and the use of special mattress and pillow case covers. These need not be made of synthetic or rubber material as specially woven and treated cotton covers are also available that stop the mites getting through from the mattress. Improved ventilation and a low relative humidity will help in reducing numbers.

Thermal treatment of beds and furnishings on a periodic basis is also effective. The bed and furnishings are put into a very large plastic bag which is then sealed and heated up to 100°C, killing off any mites and bed bugs. It also denatures any other irritants that might affect allergy-sensitive guests. Although the process is energy-intensive, it avoids the use of chemicals or pesticides.

g FLIES



Flies of various descriptions, including bluebottles, house flies and fruit flies, are highly efficient carriers of a wide variety of diseases including dysentery, gastroenteritis, typhoid, cholera, meningitis and tuberculosis. For this reason they are highly undesirable visitors to your hotel – particularly the kitchen and restaurant. Once attracted in by food, they can very quickly cross-contaminate food if not dealt with immediately.

Flies reproduce most readily in waste and manure, which is where control should begin. Under warm weather conditions the reproduction cycle – from egg, to larva, to pupa, to adult winged fly – requires approximately one week. For this reason, collection of waste and residues should be carried out at least twice a week. It is also important to keep refuse areas in a clean condition to avoid providing flies with a breeding site. Ensure dustbin lids fit tightly and the interiors of bins are cleaned regularly to keep surfaces free of encrusted food material.

The use of fine mesh window and door screens is a good barrier against entry by any flying insect. Windows and doors can still be opened and, although both light and ventilation will be slightly impaired, it will not dramatically alter the general operating conditions in



the work-place. Ultra-violet (UV) fly killing machines are very effective so long as they are sited correctly and should not just be reserved for kitchens. UV machines disguised as uplighters in dining and lobby areas are discreet and highly effective because they attract and eliminate flies quickly and silently. In food preparation areas they should only be used once all possible precautions have been taken to keep flying insects out. In many catering establishments, poorly-sited fly machines pose a greater food hygiene hazard than having no insect killers at all. This is because when placed next to the food preparation area they draw flies to the food which they are likely to contaminate before being killed. The best position is close to an entry point, at right angles to the nearest competing light source such as a window. If the UV bulb in the machine is working effectively, the insects should fly straight to it, keeping them well away from the food.

Avoid siting UV machines:

- near open doors and windows facing outwards as they will attract flying insects into the building
- where they may be obstructed by a fridge or other large piece of equipment
- near ceiling fans or air conditioning units where they will be prevented from getting to the machine by the air current
- too high up – flies normally fly below 2.5 metres so any higher means the machine will be above the flight path. It will also make it more difficult to service. The UV bulbs should be changed every 12 months to guarantee their effectiveness.

Chemical control of flies calls for treatment of the breeding sites using larvicides or residual sprays which are applied to surfaces where the adult flies land. The use of mist sprays quickly kills flying adults, as do baits containing substances to attract them, mixed with a poison. Some machines automatically spray a metered dose of natural pyrethrum extracted from the *Chrysanthemum cinerariaefolium* plant and can be used in kitchens and restaurants. A potential downside of such machines is that dying flying insects often fall into or on food so staff vigilance is paramount. 'Safe sprays' are available for food preparation areas, but you should check with your supplier to ensure you know exactly what chemical they contain and how they work.

h MOSQUITOES



Mosquitoes pose a real problem in some tourist areas, carrying with them the threat of malaria, yellow fever, dengue fever and encephalitis. Secondary infections can occur when mosquito bites are scratched, even when no disease agent was transmitted. Some mosquito strains have evolved immunity to several of the known safe preventative medicines.

Most types of mosquito lay their eggs in stagnant water, forming 'rafts' of eggs that are around a quarter of an inch long and an eighth of an inch wide. The best control method is to eradicate their habitat and make their environment an unfavourable one.

- Because they like moisture and lay their eggs in standing water, it is important not to leave flower pot saucers, buckets, plastic sheeting or other open containers outside collecting water. Ensure that any water butts you use for collecting rainwater for irrigation are fitted with a lid.
- Clear debris from gutters and drains to ensure that there is no standing water after rain and drain unused pools or fountains so that the water cannot become stagnant.
- Eliminate depressions, mud flats and other areas that might hold water by draining or filling them.
- Repair leaking taps and air-conditioning units so that puddles cannot form and ensure that septic tanks, cesspools and sewage systems are properly maintained and in good working order.



- Avoid over-irrigating lawns and gardens, and keep weeds and grass (where the insects rest) well clipped.
- If you have a pond or lake in the hotel grounds or golf course, fill it with mosquito-eating fish such as top-feeding minnows or goldfish – they will eat the floating rafts before they mature into mosquitos.
- Keep water shorelines clear of vegetation that is likely to harbour larvae, and if possible allow water levels to fluctuate to reduce the production of larvae.
- Some hotels have successfully reduced the number of mosquitoes and other insects by attracting bats to their property. Bats are perfect mosquito catchers as they too are active after dark, and one bat can catch as many as 600–1000 mosquitoes in an hour. Many bats in tropical climates are fruit-eaters so planting banana, fig, date, avocado and mango trees in the hotel gardens will help to encourage them and provide fruit for the restaurant. A simply-built bat house will usually accommodate up to 100 bats.
- To prevent mosquitoes from coming indoors, fit fine-mesh screens to porches, doors and windows. Also, encourage your guests to switch off lights and close their doors and windows before leaving their rooms for cocktails or dinner.

If these measures are insufficient, the use of area repellents such as citronella candles, coils or sprays will repel mosquitoes from porches, patios and other unscreened outdoor areas, although they only work well when the air is still. To kill the mosquito larvae and break the life cycle, mosquito 'dunks' can be placed in still water such as bird baths, water butts, ponds, lakes and other breeding places. In areas with a severe mosquito problem, repellents can be used directly in gardens and on lawns to form an invisible barrier and deter mosquitoes from landing in shrubs and bushes. You may also need to treat areas of water with an insecticide to kill the larvae.

i MOTHS



Moth larvae feed on a wide variety of natural and even synthetic materials. They can be found in kitchens and food storage areas, and clothing, carpets, blankets and upholstery are particularly vulnerable. Holes around the hems of wool blankets are often the first sign of moth attack.

Cleanliness is the key to eradication as the larvae cannot complete their normal life cycle without the necessary nutritional supplement such as food, beverage, sweat or urine stains to provide them with the proteins, mineral salts and vitamin B complex on which they depend. A single egg or caterpillar can start the cycle over again so it is important to be thorough when getting rid of them.

Pantry moths thrive on grain-based foodstuffs in kitchen storage areas. They can be identified by tiny holes in food containers and webs in corners, stickiness in otherwise dry foodstuffs or by an unusual odour. Occasionally the larvae or moths themselves can be seen. The life cycle for these moths is six to eight weeks so it can take some time to eradicate them.

Clean the affected area by vacuuming all surfaces, walls, shelves, cabinets and floors, then scrub hard surfaces rigorously with hot water and detergent, especially in corners and all round the edges of removable shelves. Clean every surface that comes into contact with food. Next rinse the area with white vinegar, either in a spray or by wiping down with a cloth.

Throw away all grain-based food items as well as nuts, raisins, flour, and tea, even if it is in sealed containers. The remaining food items and containers should be thoroughly cleaned with a detergent and water solution and wiped down with a vinegar rinse before being put back. Use air-tight containers made of hard plastic, glass or metal and not plastic bags.

Kill any moths left flying around in the air with a fly swatter or moth traps. There are many commercial traps available.



After a severe infestation, it may be wise to freeze any new grain products you buy in before putting them into store cupboards and consider storing all of your grain based products in this way.

Peppermint gum, bay leaves, peppercorns and cloves are all said to help deter pantry moths.

Moths in clothing or fabrics need to be treated in much the same way – by killing the eggs and larvae to interrupt the life cycle. Fabrics should be washed or dry cleaned and then put in bags and placed in a freezer. When you take them out to thaw, shake them vigorously to remove the dead larvae.

Clean the areas where the fabrics have been stored using a vinegar and water solution as described earlier. If you are storing blankets and bedding away for any length of time, ensure that they are clean. Ideally they should be stored in a chest made from cedarwood. Alternatively, put chips or blocks containing cedarwood oil into the drawers. Lavender sachets are also a useful deterrent. Air rooms well, allow in plenty of sunlight, vacuum regularly and empty vacuum cleaner bags frequently as they can harbour moths, which can eat through the bags.

You will need to follow these control procedures on a continuous basis if your hotel is in an area where moths are a persistent problem. For acute moth problems, re-usable traps are available that can be baited with a controlled-release pheromone system to lure moths into the trap and disrupt their mating cycle.

Mothballs not only have an unpleasant odour, but they are also poisonous so should be avoided if possible. Insect foggers are not recommended as they can pose a health threat and are not always effective.

j RODENTS



Rodents, such as rats and mice, are attracted to hotel and restaurant premises when litter and food are left lying around. They live in close proximity to us and are found in living quarters, kitchens, storage rooms and outbuildings.

In addition to the fact that rats transmit disease, they can cause substantial structural damage and consume and contaminate large amounts of foodstuffs. A rat will consume 8kg (17 lb) of food (including your waste food) yearly and can produce four to five litters a year. Mice often enter a building looking for food and shelter when the weather begins to get colder. Since mice are deterred by the smell of a rat, the problem is often one or the other rather than both together. Mice can squeeze through holes as small as a quarter of an inch in diameter, so eliminating any gaps in masonry where they can gain access from outside is very important.

Rodent control should start with a survey to determine the source of the problem and the conditions that encourage the infestation. This should be followed up with a programme to kill the rodents, removing their sources of food and water, eliminating their place of refuge and making it rodent-proof, and educating and obtaining the co-operation of employees. If the food supply is removed before you kill them, the rodents will migrate to other areas, making elimination more difficult.

The construction of rodent-proof buildings and the elimination of refuges are key preventive measures. Openings in building foundations and walls should be closed or screened with wire mesh that has holes not more than 1.25 cm (0.5 in) wide. Where pipes enter masonry, force heavy hardware cloth or steel wool into the opening, then fill it with concrete. Continual surveillance is necessary, and places where rodents have been gnawing to gain entry to a building should be sealed with metal flashing. Doors are particularly vulnerable to rodent attack so ensure that external doors and windows (especially basement windows and those near ground level) close tightly with no gaps at the bottom. Materials stored in the open, in sheds or in buildings should be stacked at least 30 cm (1 ft) above the ground.



Stringent waste disposal practices should be observed – make sure that any food being collected for disposal is in a secure vermin-proof container with a lid and not just in plastic bags. Wash down dustbin areas regularly. Make sure composting bins are designed so that rodents cannot get in.

Traditional mouse and rat traps, or 'snap' traps, kill instantly. If trapping efforts fail it is usually due to too few traps being used and ideally you should use two traps every two to three feet along the wall. Bait should be sticky to ensure that the mouse triggers the trap mechanism even if it only lightly touches the bait. Mice prefer peanut butter or chocolate to cheese, or you can use bacon, oatmeal or apples as bait. An alternative is a battery-operated trap that generates a high-voltage once the rat or mouse is inside. The design is such that it is relatively safe to use in areas where there may also be children, other wildlife or pets. Because the rat or mouse stays in the trap, there is not the problem of having to locate where the animal has died.

Poison bait should ideally only be used by a specialist contractor. Anti-coagulant poisons are preferred because of their low level of toxicity for human and other life, but some rat populations have become immune. Whilst the hazard to humans varies according to the poison employed, extreme care should still be taken in distributing and placing all poison bait. Every possible precaution should be taken to prevent risk to humans and the contamination of food and water.

k SLUGS AND SNAILS



Slugs and snails can ruin the appearance of the best kept grounds and gardens and are a particular problem for hotels that grow their own organic vegetables. There are various non-chemical solutions including putting salt or sharp shingle around vulnerable plants, drowning them in beer or simply throwing them over a neighbouring fence. Another is the use of an elemental copper band on adhesive tape – the natural electric charge in the copper repels snails and slugs.

l WASPS



Wasps are generally a problem where food and drink is being served outside during warmer months of the year. It is important to control them as some people are allergic to the venom in wasp stings and can develop an allergic reaction, ranging from mild to life-threatening. Each year, around four anaphylaxis deaths caused by severe allergic reactions to bee or wasp stings are reported in the UK alone.

A simple trap can be made by putting beer or a solution of jam or honey with water in a jam jar. If this does not work, there are branded traps available containing specially formulated attractant baits.



8.6.5 Natural control methods for hotel gardens

If you can create a healthy, balanced environment for plants, you will reduce the need to use expensive chemicals in the grounds and gardens. There are many naturally-occurring predators to control pests, and organic solutions to disease, weeds and fungi. Also, if you look after your soil by feeding it with organic compost (including kitchen and garden waste [SEE SECTIONS 4.4.7 AND 4.4.8](#)), leaf mould and other soil improvers such as horse manure, or fish, blood and bone fertiliser, you will minimise the need for synthetic chemicals of all kinds.

a PREVENTATIVE MEASURES

There are several steps that hotels can take to reduce the risk of problems requiring chemical control:

- Plant at the **right time**, in the **right place**. Seedlings should not be planted too early, nor located in unsuitable conditions. Young plants should not be deprived of their peak growing potential – as it is often their best defence against attack. Putting plants which need a lot of water close to buildings will make them more vulnerable to mildew.
- Select **disease-resistant varieties**. It is often possible to find varieties that are resistant to particular pests or diseases, so if you are aware of a particular local problem, choose plants that will be unaffected.
- **Traditional methods** of planting and maintaining grounds can often reduce the need for biocide use. In particular, mixing plants and avoiding 'monocultures' have long proved to be effective in reducing the numbers of certain pests.

b ATTRACTING NATURAL PREDATORS

Birds, insects, worms and other creatures all help to maintain a **natural balance** in the garden, controlling unwanted visitors such as slugs, snails, aphids and unwanted insects. Aim to provide habitats for creatures that prey on pests, such as nesting sites and supplies of food for birds during winter months, or a pond for frogs and toads.

c BIOLOGICAL CONTROL

Biological control is where natural predators or 'competitors' are **introduced** into an environment to control animal or plant infestations. They can include animals, insects, viruses or fungi. Predatory mites, for example, can counter red spider mites; parasitic wasps will resolve whitefly problems, ladybirds will control aphids. *Bacillus thuringiensis* will put an end to pest caterpillars, by giving them a natural bacterial disease. The use of such natural biological control can be very cost-effective, but needs careful planning. Some experiments in introducing species to new environments (such as cane toads in Australia) have been disastrous. Careful and expert review is essential before taking action as a biological introduction may not be applicable to your hotel environment.

d PHYSICAL CONTROL

Physical control refers to the **blocking or trapping** of insects or other animal pests. Examples include using Ultra Violet (UV) light to attract insects to electrical exterminators and using flame guns to control weeds. You can also provide effective protection to seedlings from insects through the use of plastic bottles cut in half and inverted over the seedlings. Basic sanitation measures will also help such as:

- proper **storage, collection and disposal** of refuse, including manure
- eliminating or reducing **breeding areas** by keeping water collection areas clean, clearing out bushes and ensuring hotel buildings and other structures are rodent-proof
- fitting **screens** on doors and windows to stop the ingress of pests
- effective **food safety and hygiene** precautions for all food storage, preparation and service areas
- **pest-control** operations at regular intervals.



e WEEDS AND UNWANTED VEGETATION

Weeds are plants that grow where they are not wanted. Even cultivated plants that grow larger than intended and begin to spread out of control become weeds. They can be very persistent and may grow in cracks in paving and walls, gutters, or in soil where no other plants can compete for example. Many species of weeds are not readily killed by mechanical cutting; they quickly recover and continue to grow. Some weeds grow rapidly during times when desirable plants are dormant, and will spread and shade out the species you want. Other weeds may be toxic to livestock or have noxious properties. All these factors need to be taken into account both when planting and when planning vegetation control.

To reduce or avoid the use of herbicides you should:

- Strive to keep the exterior grounds of the hotel **well-maintained** at all times.
- **Remove plants that are out of control.** Common sense and alertness will help you recognise incipient weed problems.
- Consult with a professional weed expert who is knowledgeable about the proper maintenance of desired vegetation. Having a contract with a reputable firm for certain phases of grounds maintenance (fertilising, chemical weed control, etc.) can be more economical than stop-gap attempts by personnel who have to divide their time between various maintenance jobs.

8.7 ASBESTOS

8.7.1 The issues

Asbestos is a naturally occurring, chemically inert mineral which is immune to rot and bacteriological attack. It is mined in much the same way as copper, iron and lead and the main producers are the US Canada, South Africa and former Soviet Union states.

With its many useful properties, asbestos was a very popular product in the 20th Century until the 1970s. Its primary use was as a construction material because of its high resistance to alkalis, corrosion and high temperatures, its high tensile strength, and its properties as a sound attenuator and electric, heat and cold insulator. However, its one serious drawback is the known adverse effects of asbestos on human health. Although asbestos use is banned in the European Union, the US, Japan, Australia and other countries, it is still used in some countries owing to the lack of equivalent replacement materials for many applications.

Asbestos comprises a group of minerals with a crystalline structure, occurring as parallel bundles of fibres. When disturbed, these bundles separate into smaller individual fibres called 'fibrils'. Once inhaled or ingested, the fibrils are not readily broken down or expelled and remain like needles in the body. Asbestosis is a disease is caused by exposure to high levels of airborne asbestos fibres over a long period of time and Mesothelioma is a rare and virulent form of cancer which occurs in those who have been exposed to asbestos fibres as long as 50 years ago. Mesothelioma affects the lining of the lung, lining of the abdominal cavity or the lining around the heart. Some sufferers were exposed at work and others were exposed secondarily through family members who without their knowledge, brought fibre home on their work clothes or on their hair or skin. Mesothelioma International^[4] estimates that 250,000 workers in Western Europe alone will have died from the disease by 2029.

When used as a component of other materials, it is not always easy to tell if asbestos is present. The only conclusive way to find out is to take a sample and examine it under a microscope by polarised light or by X-ray diffraction, or both. This should be carried out by a competent laboratory.

[4] See www.mesotheliomainternational.org



8.7.2 Types of asbestos and where it is found

There are **three basic types** of asbestos: **Chrysolite** (white asbestos), **Crocidolite** (blue asbestos) and **amosite** (brown asbestos). Other varieties include **anthophyllite**, **actinolite** and **tremolite**. They fall into two groups:

SERPENTINE GROUP

Serpentine minerals have a **sheet or layered structure**. Chrysolite or 'white' asbestos is the only asbestos mineral in the serpentine group and is commonly found in buildings or materials that date from the early 20th century to the mid 1970s. Some of the materials in which it is contained include:

- joint compound
- mud and texture coats
- vinyl floor tiles, sheeting, adhesives
- roofing tars, felts, siding, and shingles
- transite panels, siding, countertops, and pipes
- fireproofing, fire blankets, interior fire doors and fireproof clothing for firefighters
- caulking putties
- gaskets
- brake pads and shoes and clutch plates
- thermal pipe insulation

AMPHIBOLE GROUP

Five types of asbestos are found in the amphibole group: **amosite**, **crocidolite**, **anthophyllite**, **tremolite**, and **actinolite**. Amosite, the second most likely type to be found in buildings, is the 'brown' asbestos.

Amosite and crocidolite were used in many products until the early 1980s. The use of all types of asbestos in the amphibole group was banned (in much of the Western world) by the mid-1980s, and by Japan in 1995. These products were mainly:

- low density insulation board and ceiling tiles
- asbestos-cement sheets and pipes for construction, casing for water and electrical/telecommunication services
- thermal and chemical insulation (such as fire doors, limpet spray, lagging and gaskets)

Asbestos can be found in cement, rubbers, plaster, paint, bitumen, mastic, resins or plastics where the fibres are bound into the mix. When it hardens, the fibres are securely sealed, so that they cannot escape into the atmosphere. The end product, whether it is floor tiles, fire blankets, gloves, roofing sheets, pipes or fire partitions, poses no threat to health as long as it remains intact.

The most widespread use of asbestos is in ceiling, floor and wall coverings. It is sprayed together with cement to form a coating on structural steel members for fire protection. It has been used extensively for insulating boilers and tanks and for pipes carrying steam, condensate and hot water, for ventilation ducts and kitchen exhausts.

Vermiculite is a naturally occurring mineral that may contain asbestos. Vermiculite expands into worm-like accordion shaped pieces when heated. The expanded vermiculite is a light-weight, fire-resistant, absorbent and odourless material. These properties allow vermiculite to be used to make numerous products, including attic insulation, packing material and garden products.

More information on asbestos-containing materials can be found in **APPENDIX 7** of this section.



8.7.3 Hazards of asbestos dust

Today we are aware that breathing in sufficient amounts of asbestos dust for long enough periods can cause serious illness. Legislation concerning air emissions recognises the risk category of asbestos fibres as being of the highest order. However, the mere presence of asbestos-containing materials (ACM) in a building does not automatically constitute a health risk to the occupants.

To pose a risk to health, the ACM must be 'friable' and capable of becoming airborne when disturbed. Friable means that the asbestos can be crumbled or pulverised to a powder by normal hand pressure. It is the airborne particles that are dangerous as only these 'fibrils' can be breathed into the lungs. The effect, in the form of cancer, may not appear until many years later.

Because of its widespread use and application, the atmosphere surrounding us contains asbestos particles – more so in cities than in the countryside. The average particle count for cities is 100–200 per m³ of air. However, near emission sources, concentrations can be up to 1000 particles per m³ of air. Within contaminated buildings they will exceed 1,000,000 particles. If frayed asbestos is present in your building, you are potentially exposed to a considerable health risk.

As more has become known about the hazards that asbestos presents, strict controls have been imposed upon its use and management and its use is being phased out. In the UK, owners and occupiers of non-domestic properties (including hotels) have a duty to manage asbestos, which is contained in regulation 4 of the **Control of Asbestos Regulations (CAR) 2006 – The Duty to Manage Asbestos in Non Domestic Premises**.

8.7.4 Asbestos management

a YOUR RESPONSIBILITIES

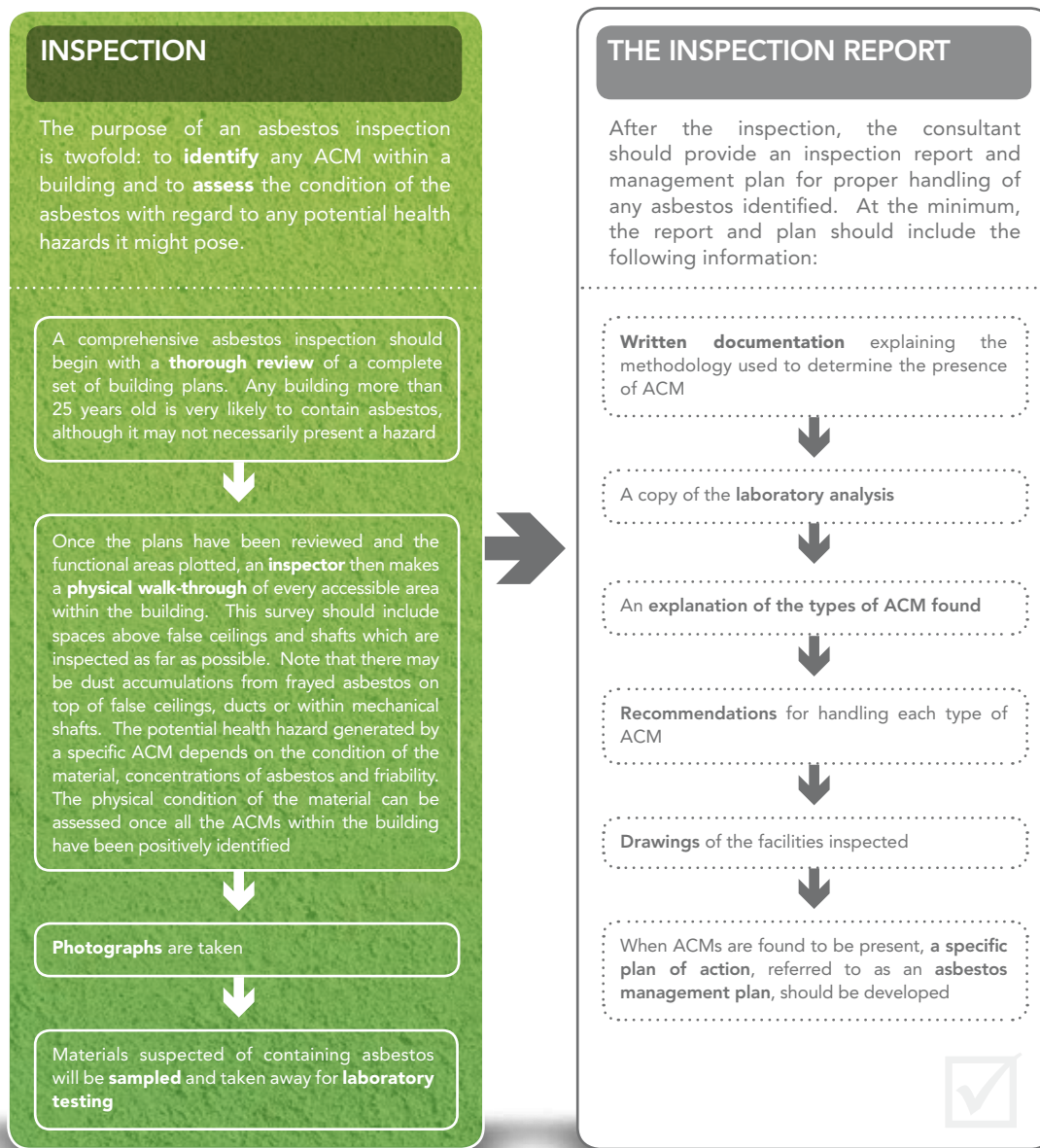
Most asbestos legislation requires the 'dutyholder' (the person or organisation with clear responsibility for the maintenance or repair of non-domestic premises through an explicit agreement such as a tenancy agreement or contract) to:

- **Find out if there are materials containing asbestos** in non-domestic premises, and if so, the amount, where it is and what condition it is in.
- **Presume** that materials contain asbestos **unless there is strong evidence that they do not**.
- **Maintain an up-to-date record** of the location and condition of the ACMs or materials presumed to contain asbestos.
- **Assess the risk** of anyone being exposed to fibres from the materials identified.
- **Prepare a plan** that sets out in detail how the risks from these materials will be managed.
- **Take the necessary steps** to put the plan into action.
- **Periodically review** and monitor the plan and the arrangements to act on it so that the plan remains relevant and up-to-date.
- **Provide information on the location and condition of the materials** to anyone who is liable to work on or disturb them.

Your **staff also have a duty to co-operate** as necessary to allow the dutyholder to comply with the above requirements.

**b IDENTIFICATION**

Both the identification of ACMs and the follow-up required can be extremely complicated and require an expert. Later in this section we focus on how to select expert assistance and what the main steps are that an asbestos consultant will take on your behalf.

**8.7.5 The asbestos management plan**

The consultant's inspection report may offer one or a combination of recommendations for managing ACMs within the building.

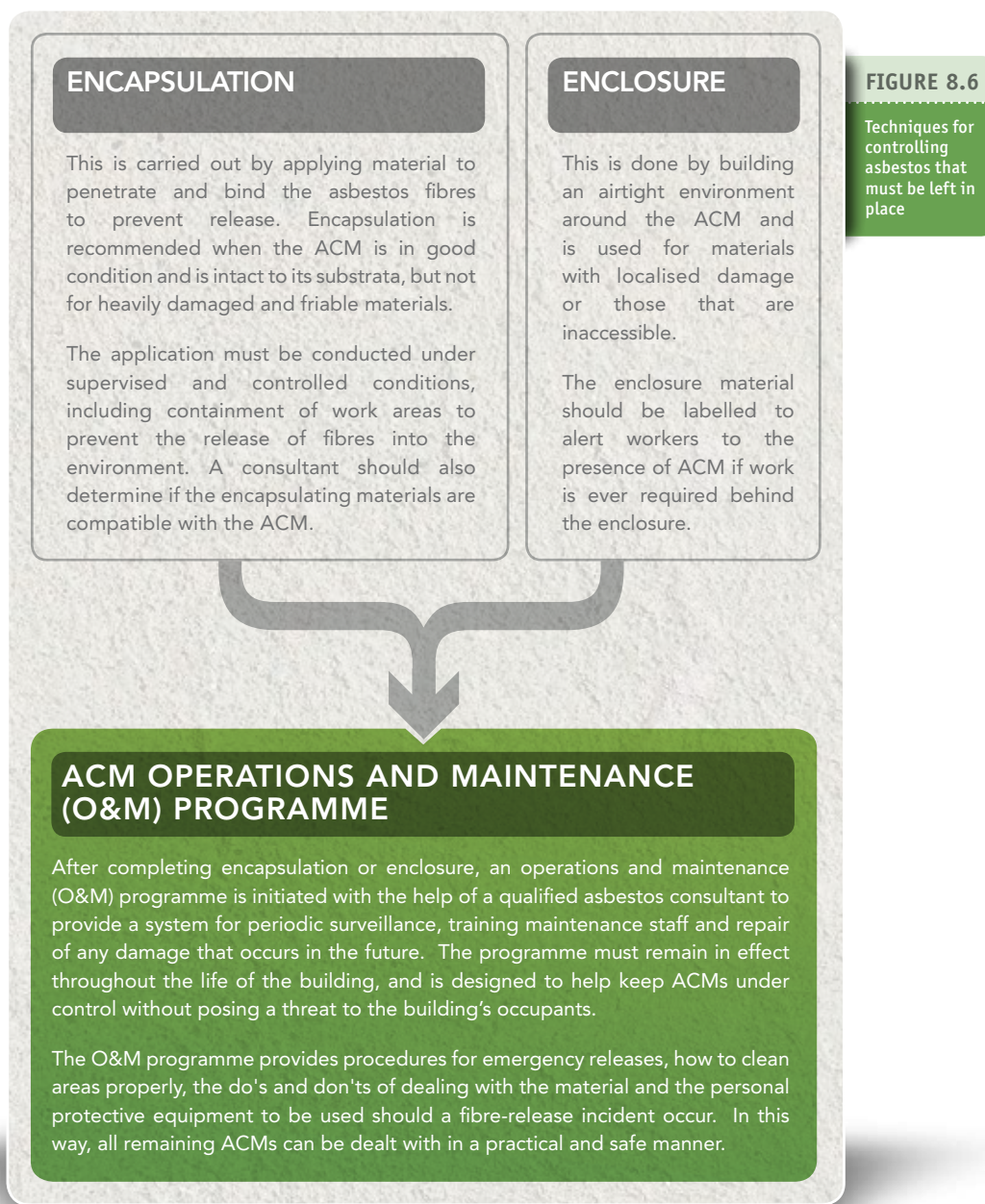
a REMOVAL

This means physically removing the ACM from the building. Removal is usually recommended for severely damaged materials that cannot be repaired, should not bear further weight or which are present in areas of high-occupancy. The procedure is conducted under strict supervision, generally by trained and experienced asbestos-abatement personnel, following a detailed set of specifications. These will be set out in the contract documents. During removal, all occupants are temporarily relocated and the area is isolated and heavily controlled.

**b LEAVING THE ASBESTOS IN PLACE**

This option is no longer permitted if the asbestos is not completely intact unless the risk of removing it is perceived to be a greater risk to health than leaving it in place. Once you have identified ACMs within the building, you will be required to implement a continuous surveillance and maintenance programme throughout the life of the building. Since a limited risk is still there, it may also be difficult to get adequate insurance coverage – if at all. However this needs to be balanced against the fact that removing asbestos that is in good condition is not only creating an unnecessary dust hazard, but also will be expensive.

SEE FIGURE 8.6



**c COSTS ASSOCIATED WITH ASBESTOS REMOVAL**

The asbestos consultant will need to prepare professional cost estimates in order to establish a budget. The following considerations have an influence on the total cost of the project:

- whether the removal is to be conducted when piping systems are hot, which will increase the cost
- inaccessibility due to the height or location of the ACM
- whether removal will restrict or limit the operation of the hotel, resulting in revenue loss
- requirements of asbestos-removal contract specifications with regard to bonding, insurance and licensing, and management of removal operations
- work required by other contractors before, during and after the abatement work
- future abatement regulations mandated by state or local legislation
- other abatement alternatives
- future operations and maintenance (O&M) costs.

Once the decision has been taken as to how to remove the ACM, the abatement process must be planned and an abatement contractor retained. Both actions require detailed planning.

d UNDERSTAND AND DEFINE RESPONSIBILITIES

Specific guidelines and regulations have been established by state and local authorities for the proper removal and disposal of asbestos. The use of a qualified contractor is essential – in the past abatement work in some locations in the US was incorrectly carried out, increasing rather than minimising the dangers. Incompetent abatement creates a considerable financial risk for the building owner and operator including the potential liabilities of exposing building occupants to contamination and improper waste disposal, project delays and other schedule problems that keep facilities out of service, creating loss in revenue and cost overruns.

Define the exact responsibility of your consultant versus that of the contractor. The consultant will generally develop the specifications that identify the correct procedures and requirements necessary to remove the ACM. In addition, they will define any substitute materials that may be necessary. The consultant's advice is also valuable in the selection of the contractor. During the execution process they will monitor all actions undertaken by the contractor to ensure that the specifications are met and exposure of building occupants and possible liability are kept to a minimum. This includes regular measurements of the air, where specified concentration levels of asbestos shall not be exceeded.

When you have appointed a consultant, they will be able to help you to establish the asbestos management plan with your team. If the building is to remain in service, the project will need to be divided into several separate phases, calling for specific logistical considerations such as:

- maintaining access
- sequencing and accessing lifts
- providing uninterrupted access to utility vaults in the basement
- maintaining equipment operation and essential services.



8.7.6 Guidelines for selecting an asbestos removal contractor

The first step is to obtain the services of a qualified consultant or asbestos industry professional to help you seek the right contractor. It is not essential to employ a large firm but it must be a well-qualified firm that can manage, fund and complete your job safely.


How you evaluate contractors will be influenced by the size and complexity of your project. If it is difficult or very large, it will demand more detailed contractor evaluation than if it is small or straightforward.

STEP 1 INITIAL SCREENING

- Establish the **scope of and specifications** for the work that needs to be done
- Draw up a list of **potential candidates** using referrals from the consultant, information from trade associations and from state and local environmental agencies.
- Seek to **answer the following questions**:
 - Does the company have the **necessary accreditation**? In the UK you can check that the organisation is approved by a recognised accreditation body that complies with the International Standard **ISO 17020**. In the case of individual surveyors, he or she should have personnel certification for asbestos surveys from a certification body approved by a recognised accreditation body under **ISO 17024**. You will also need to check which of the three types of survey they are qualified to carry out. Further information can be obtained from the **United Kingdom Accreditation Service (UKAS)**.
 - Individuals undertaking asbestos surveys in the UK should be certified either by the **ABICS (Asbestos Building Inspectors Certification Scheme)** which is operated by the **British Occupational Hygiene Society (BOHS)** or the **National Individual Asbestos Certification Scheme (NIACS)**, a joint venture comprising a specialist division of the **Asbestos Removal Contractors Association (ARCA)** and the **Royal Institute of Chartered Surveyors (RICS)**.
 - Is it a good company in a **sound financial state**, with the necessary **technical competence, experience, responsible practices, good management and responsive administration**?
 - Do they have sufficient **qualified manpower** to carry out the job at the time you want them and to complete it within the specified time frame?
 - Can they respond to and comply with **complex and changing laws** and regulations?
 - Do they have **asbestos-specific insurance** and bonding capability?
 - Can they offer **long-term protection** against claims that may not be filed for 20 years or more?

From this you should be able to draw up a shortlist of two to four bidders. A large bid list may not necessarily produce more price value, but may increase your workload and drive away responsible contractors.

STEP 2 CONTRACTOR EVALUATION

- **Involve** your risk managers, legal advisers, financial experts, engineers and asbestos consultant in the process of understanding and verifying the information received.
- **Check references** from both owners and consultants.
- Review the amount, size and success of contractors' **past abatement projects** and construction management efforts, paying particular attention to projects similar to your own in size, complexity and arrangement.
- **Review the quality and experience** of their project managers, supervisors and workers. Are all the contractor personnel properly trained and licensed and able to handle specific areas of responsibility?
- Can they meet your **scheduled deadline**? 



- Obtain a copy of their **proof of insurance** (a certified copy of the insurance certificate) and bonding capability. Some contractors are insured with occurrence-type policies, under which the insurer pays claims for all covered injuries and property damage occurring during the policy period. The major advantage to the policyholder (and additional persons insured under the policy) is that once the policy is written, claims can be made at any time afterwards. The insurer is responsible for paying claims even after the policy is no longer in force. This is in contrast to a 'claims-made' policy which does not cover claims, injuries or damages filed after the policy has expired, even if the injury or damage took place during the policy period. Extended claims coverages (known as 'tails') can be purchased, but these can be very expensive and are not necessarily available.
- Do the insurance and bonding carriers have the **quality, reserves and financial soundness** to back up the coverage they write? Check how long they have been in business and their financial statements. The insurance and bonding carriers are two very important third-party entities which are also making a critical evaluation of the contractor. The involvement of high-quality firms with sound coverages is a good indicator of contractor performance.
- Does the contractor have comprehensive **employee training, medical, respiratory protection and industrial safety programmes** in place? Do they respond to the latest regulations, specifications and standards of care? Your consultant's assistance will be invaluable here.
- **Review** the documentation and quality assurance programmes that the contractor will provide. The records generated during your job must be maintained for 30 years or longer. Is the contractor reasonably likely to accomplish this?
- **Review the credentials** of the contractors' proposed hygiene, waste-hauling and disposal providers. Since you 'own' your asbestos waste forever, it is essential to be insured that this hazardous material is properly handled and buried in approved disposal facilities.

STEP 3 CONTRACTOR SELECTION

- Is the contractor's proposed work plan and schedule **well thought out** and **realistic**?
- Does it correspond to your **concerns and expectations**?
- Arrange for a **pre-bid meeting** with proposed contractors to answer any questions about the scope of work and to visit the project site.
- Use an **evaluation sheet** to weight the selection criteria and decide which contractor can produce the results most important to you. A full committee review, with all your participating advisers, may be appropriate.
- **Avoid using price as the primary criterion.** Failure to perform adequately on an abatement project can result in widespread asbestos contamination and its associated health hazards and liability implications. Consider negotiating on the price if one firm is clearly the most capable and desirable for your project but is much more expensive.
- Sit down with the contractor's representatives and your advisers to arrive at a **mutually agreeable contract** with fair financial terms.

8.7.7 Safety of personnel

- a Where ACMs are present, ensure that you are complying with relevant **Health and Safety regulations** regarding asbestos in the workplace. Most legislation requires the duty holder to ensure that the hazards relating to asbestos are effectively communicated to anyone likely to come into contact with it.
- b **Under no circumstances** should **hotel employees** be allowed to remove asbestos or carry out any other work associated with it. They should be told about the project and any hazards it presents, the purpose of sealing off the asbestos area and why they must keep out.
- c **Time spent** by the hotel's environmental and/or safety committee discussing plans with the contractor and briefing employees to explain what is to be done will be well worthwhile. The precautions that will be taken during the removal process, in order to protect any building occupant against hazardous dust, should be described. Any hotel employee who will be affected in any way by the asbestos work should attend training sessions and be given written information and guidance as to the do's and don'ts during the removal process.
- d **Tenants, guests and other occupiers** of the building should also be notified in accordance with regulations.



All parties need to understand what will happen during the asbestos removal process in order to prevent the release of hazardous airborne fibres

8.7.8 The removal process

It is important for **everyone to understand** what will happen during the asbestos removal process, both for the preparation and execution of the risk-management plan. This will enable you to prevent hazardous airborne fibre release and possible liability suits and will involve:

a ISOLATION TECHNIQUES

In order to keep the services of the building operating, several **isolating techniques** may be employed:

- **Erecting walls or partitions** which separate the asbestos work area from the public and service areas. Health regulations require the creation of a 'regulated area' to prevent employees adjacent to the abatement work from being exposed to asbestos fibres. Additionally, there are concerns about dust, debris and noise generation from the removal activities. Typical walls are constructed with stud framing and plywood sheathing. Often sound insulation and gypsum board are also used to minimise noise and vibration, or to add a fire barrier to further separate the construction from the occupied areas.

- **Erecting isolation barriers.** Since some demolition activities do not necessarily involve asbestos, the 'regulated' area must be further separated from the general demolition and construction activities. These partitions, again often constructed of wood framing and sheathed, are then covered with one or two layers of impermeable 6 ml thick plastic sheeting.
- **Building tunnels** using construction techniques similar to those described above. Once the active work areas are appropriately partitioned and isolated, each 'regulated area' is fully established by providing a **containment**. Containment is a means of isolating and controlling a work area to affect the behaviour and migration of contaminants and hazardous materials.
- The work area will then be **isolated** to prevent entry by unauthorized personnel by locking all relevant doors in agreement with the operator. Rerouting of emergency exits may be necessary. Locked access to the work area will only be provided for the contractor's personnel and the doors must have 'panic' release systems from the inside.
- **Warning signs** will then be installed at each locked door leading to the work area. Critical doors opening into the work area must be marked in accordance with regulations, along the lines of the examples shown below:



b EQUIPMENT ROOMS

If asbestos is sprayed on the building structure within a **plant room**, another key logistical consideration is the HVAC equipment itself. The chiller, boiler and most of the air-handling equipment stay in operation during the removal activities in the plant-room. Their very presence and location often mean they make accessing the asbestos fireproofing difficult.

To overcome this, a specialised scaffolding company may be called in to erect tube-and-clamp scaffolding around the equipment and overhead to provide access to the material. The scaffolding is arranged so that the framework can be used as a 'reverse containment', i.e. plastic sheeting is applied over the scaffold framing and sealed. Airflow ducts are then used to discharge air via high efficiency particulate air filters into this enclosure to pressurise it positively against inward asbestos leakage and also to ventilate the enclosure to prevent equipment overheating.

Asbestos removal activities can then proceed around the equipment without it being directly in the work area or subjecting it to contamination. This technique is also frequently used with active switchgear, control panels or any stationary items within a work area that cannot be moved, must stay in service or must not be subjected to asbestos contamination.



Asbestos removal may also be required on the HVAC equipment itself, where ACMs have been used. The abatement of this equipment is usually scheduled over a weekend or at a time when the equipment can be shut down. It is important to discuss this scheduling carefully with the contractor to ensure on-time completion. Time must be allowed for decontaminating the area, clearance testing and reapplication of enough insulation materials to permit restarting all the pieces of equipment.

c DECONTAMINATION

Decontamination units must be installed to enable asbestos removal from persons and materials as they leave the work area.

d WET REMOVAL

Asbestos-containing materials are **thoroughly wetted** before stripping and/or tooling to reduce fibre dispersal into the air. Wetting is accomplished by a fine mist spray.

The material is sufficiently saturated to the substrate without causing excess dripping. Material that has been painted over is perforated and clean water injected. Where necessary, the ACM is stripped away while simultaneously spraying water.

e AIR-MONITORING

Air-monitoring should be carried out **continuously and under the supervision of the consultant**, who is independent of the contractor. If there is no appropriate laboratory nearby, portable equipment will be brought and an analytical laboratory set up on site. This permits continuous air-sample analysis, and will identify a high-fibre release incidence so that it can be promptly remedied.

f DISPOSAL

All removed asbestos is **packed into marked disposal bags while still in wet condition**, and not allowed to dry out. Air is removed from the disposal bags with a High Efficiency Particulate Air (HEPA) vacuum cleaner before sealing. All bags are then sealed in leak-tight fibreboard drums. They should not be stored outside the work area.

They are then removed by a **licensed waste haulier** in fully enclosed skips or trucks to an approved site. Receipts and full documentation must be obtained from waste haulier and the final disposal area.

8.8

POLYCHLORINATED BIPHENYLS (PCBs)

8.8.1 The issues

Polychlorinated biphenyls (PCBs) belong to a family of organic chemicals known as chlorinated hydrocarbons.

PCBs are man-made and are stable against heat, excellent insulators, colourless and do not dissolve in water. They are relatively inert, being difficult to break down or to make react with other chemicals. They range in consistency from heavy oily liquids to waxy solids. In cooling applications they are frequently mixed with solvents such as dichlorobenzene to decrease viscosity. These solvents frequently emit a characteristic odour.

PCBs were used from the 1930s until the 1970s as coolants and insulating fluids for transformers and capacitors because they do not readily burn or conduct electricity. They were also used as stabilising additives in flexible PVC coatings of electrical wiring and electronic components, pesticide extenders, cutting oils, flame retardants, hydraulic fluids, sealants, adhesives, paints, de-dusting agents, and in carbonless copy paper.



Two catastrophes, in Japan and Northern Italy revealed the considerable hazard posed by PCBs, and since then governments have phased out their production and use and research has focused on finding replacements. Around the world, PCBs are gradually disappearing from the market and from use.

8.8.2 Hazards of PCBs

PCBs are classified as **persistent organic pollutants (POPs)** (SEE APPENDIX 3) because when they are released into the environment they do not easily biodegrade. As they have a strong tendency to persist and build up in living tissue, they easily make the leap between predator and prey in the food chain. Their half-life value (period of decay to 50 per cent of original strength) is 20–100 years.

Laboratory data show that PCBs cause cancer in animals, and despite the absence of statistical proof that they cause cancer in humans, it is prudent to consider any animal carcinogen a possible human carcinogen.

Animal studies show adverse reproductive and development effects from repeated exposure to PCBs. In addition, it has been shown that PCBs are toxic to fish at very low levels of exposure. Their bioconcentration factor is 85,000–100,000, meaning that very low concentrations in the ocean gradually build up to over 85,000 times this amount in the body of fish up the food chain. The survival rate and the reproductive success of fish can be adversely affected. It is believed that there may be similar cause for concern when humans are exposed to large doses of PCBs.

The 'Yusho' accident in Japan in 1968 affected the health of 1,600 people after they had consumed rice oil contaminated with Kanechlor 400, a 48% chlorinated biphenyl, at 2,000–3,000 mg/kg, which entered the oil through a leak in the heat exchanger. Their complaints ranged from dizziness, nausea, eye irritation, bronchitis and digestive problems to more serious ones such as liver damage and chloracne, a painful disfiguring skin illness and a weakened immune system.

The worst accident occurred in 1976 in Seveso with the accidental release of a highly toxic gas – TCDD. The amount was estimated at only 2–3 kg distributed over an 18 km² area. Nevertheless, a large number of animals died as a result. Humans had the same problems as observed in the Japanese incident, but on a larger scale. The polluted soil had to be disposed of over many years.

TCDD is a gas of the chlorinated dioxin family, frequently referred to simply as dioxin. The same gas can be formed when PCB is exposed to heat. Accidents such as a transformer explosion or fire have made the buildings in which they were housed uninhabitable.

Similar to PCBs, TCDD is non-biodegradable, and therefore finds its way into the food chain. TCDD is considered to be one of the most toxic substances in the world.





8.8.3 Legislation

The **US Environmental Protection Agency** banned PCB production in 1979 and they are subject to the **Toxic Substances Control Act (TSCA)**. A number of countries have set regulations for the use, marking, storage, recording and disposal of PCBs. Both the owning company and operator are legally responsible. The responsibility for investigation, notification and corrective action rests with the hotel.

Because of the millions of items of equipment containing PCBs, complete phase out will take a long time. Disposal has also been handled differently from country to country.

8.8.4 Dealing with PCBs

	START WITH AN INSPECTION	RESPONSES
TRANSFORMERS (OIL-COOLED) AND VOLTAGE REGULATORS	<ul style="list-style-type: none">● Check the nameplate data and technical service manual to verify if your transformers contain PCBs. If verification is not possible, check with the manufacturer or your local electricity company● If a PCB is present, check the transformer and its vault for oil leaks.	<ul style="list-style-type: none">● If PCBs are present, the transformers should be replaced and disposed of by a licensed company at a state-approved disposal plant. The oil is removed there and burnt at temperatures exceeding 1,200°C. Only at this high temperature can PCBs be destroyed as at lower temperatures, highly toxic dioxin gases will form● Replacement transformers should be air-cooled, if adequate ventilation can be provided● Review your future renovation and construction plans to evaluate if a change in capacity is appropriate● If leakage has occurred or is still occurring, proceed as follows:<ul style="list-style-type: none">● Place a pan underneath the leaking equipment● Call in a qualified and licensed consultant to evaluate the extent of leakage and migration● As a first-aid measure, carry out required repairs to the transformer to stop leakage until replacement takes place● Depending on the extent of contamination of the concrete basin, removal and disposal of all affected material to an approved plant must be carried out by a licensed contractor.
CAPACITORS	<p>Capacitors may be installed in different sizes: larger ones are for power factor correction near the main distribution panel or at major equipment such as chillers. Smaller ones are often used as ballasts within fluorescent light fixtures</p> <ul style="list-style-type: none">● Check the nameplate data and service manuals to verify whether the capacitors contain PCBs.	<ul style="list-style-type: none">● Capacitors found to be defective and/or leaking should be treated in the same way as transformers● Capacitors installed in fluorescent tube lights can remain there as long as they are intact. Fluorescent light ballasts manufactured prior to 1980 may contain about 17 millilitres of PCB sealed inside the capacitor of the ballast. The capacitor is wrapped in paper and sealed in asphalt inside the ballast case. High temperatures may cause the asphalt to soften and leak out of the ballast case. Often this leakage of asphalt is mistakenly believed to be PCB. Asphalt, when cooled to room temperature, will re-harden, whereas PCB dielectric from a leaking capacitor would remain as a heavy oil. Sometimes the ballast has the date of manufacture on it, and sometimes it is marked 'No PCBs' by the manufacturer. If the light fixture has no manufacture date and is not marked to say it does not contain PCBs, assume that it does.



8.9 MORE INFORMATION

8.9.1 Contacts

1. **Agency for Toxic Substances and Disease Registry (ATSDR)**
www.atsdr.cdc.gov
2. **American Conference of Governmental Industrial Hygienists (ACGIH)**
www.acgih.org
3. **The Asbestos Institute**
<http://theasbestosinstitute.com>
4. **Asbestos Testing and Consultancy**
www.atac.org.uk
5. **International Association for Soaps, Detergents and Maintenance Products**
www.aise.eu
6. **British Occupational Hygiene Society (BOHS)**
www.bohs.org
7. **Chemical Abstract Service (CAS)**
www.cas.org
8. **European LPG Association**
www.aegpl.com
9. **Royal Institute of Chartered Surveyors (RICS).**
www.rics.org
10. **UK Accreditation Service (UKAS)**
www.ukas.com
11. **UK Department for Environment, Food and Rural Affairs**
www.defra.gov.uk
12. **UK Health and Safety Executive**
www.hse.gov.uk
13. **US Occupational Safety & Health Administration (OSHA)**
www.osha.gov
14. **US Environmental Protection Agency**
www.epa.gov
15. **US National Institute for Occupational Safety and Health (NIOSH)**
www.cdc.gov/niosh
16. **US National Toxicology Program**
<http://ntp.niehs.nih.gov>
17. **US Office of Pollution Prevention and Toxics, TSCA Hotline**
tsc hotline@epa.gov
18. **REACH (the registration, evaluation and authorisation of chemicals)**
www.hse.gov.uk/reach/
19. **World Health Organization**
www.who.org



8.9.2 Resources

1. **Asbestos and Man-Made Mineral Fibres in Buildings: Practical Guidance**
<http://products.ihs.com/Ohsis-SEO/310734.html>
2. **Asbestos Hazard Emergency Response Act (AHERA)**
www2.epa.gov/asbestos/asbestos-laws-and-regulations
3. **Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (Amendment) Regulations 2005**
www.hse.gov.uk/cdg/pressure.htm
4. **Chemicals in Products - Safeguarding the Environment and Human Health**
www.iupac.org/publications/ci/2004/2601/bw3_duffus.html
5. **Control of Asbestos Regulations 2006**
www.opsi.gov.uk/si/si2006/20062739.htm
6. **Control of Pesticides Regulations 1986 (amended 1997)**
www.opsi.gov.uk/si/si1997/19970188.htm
7. **Control of Substances Hazardous to Health Regulations 2002 (COSHH)**
www.hse.gov.uk/coshh/
8. **Easy steps to control health risks from chemicals**
www.coshh-essentials.org.uk
9. **EU Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment**
http://ec.europa.eu/environment/waste/weee/legis_en.htm
10. **Directive 2012/19/EU of the European Parliament on waste electrical and electronic equipment (WEEE)**
http://ec.europa.eu/environment/waste/weee/legis_en.htm
11. **Globally Harmonised System of Classification and Labelling of Chemicals (GHS)**
www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html
12. **Guidance note for the Control of Pollution (Oil Storage) (England) Regulations 2001**
www.gov.uk/government/uploads/system/uploads/attachment_data/file/69255/pb5765-oil-storage-011101.pdf
13. **Guide to Occupational Exposure Values, 2007**
www.acgih.org/Store/ProductDetail.cfm?id=1911
14. **ISO 17024**
www.iso.org/iso/catalogue_detail?csnumber=29342
15. **ISO 17024**
www.iso.org/iso/catalogue_detail?csnumber=29346
16. **Methods for the Determination of Hazardous Substances**
www.hse.gov.uk/pubns/mdhs
17. **NIOSH Asbestos Bibliography**
www.cdc.gov/niosh/docs/97-162/
18. **OSHA Hazard Communication Standard (HCS)**
www.osha.gov/dsg/hazcom/
19. **UK Health and Safety at Work Act (HASAW or HSW)**
www.hse.gov.uk/legislation/hsaw.pdf
20. **Managing Above Ground Storage Tanks to Prevent Contamination of Drinking Water**
www.epa.gov/safewater/sourcewater/pubs/ast.pdf
21. **NetRegs**
www.netregs.gov.uk
22. **Pesticides - Use them Safely**
www.hse.gov.uk/pubns/indg257.pdf
23. **Plant Protection Products Directive (PPPR) (91/414/EEC)**
<https://osha.europa.eu/en/legislation/directives/exposure-to-chemical-agents-and-chemical-safety/osh-related-aspects/council-directive-91-414-eeec>
24. **Restriction of Hazardous Substances Directive (RoHS)**
www.rohs.gov.uk
25. **Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) - EC Regulation 1907/2006**
http://ec.europa.eu/enterprise/reach/index_en.htm
26. **Gas Safety**
www.hse.gov.uk/pubns/gasindex.htm
27. **Stockholm Convention on Persistent Organic Pollutants (POPs)**
www.pops.int/documents/pops/default.htm
28. **Sustainable Cleaning – A guide for users of professional cleaning products**
http://www.ukcpi.org/pdfs/sustainable_cleaning.pdf
29. **UK Health and Safety Executive - Asbestos management**
www.hse.gov.uk/asbestos/campaign/duty.htm
30. **US Environmental Protection Agency (Asbestos)**
www.epa.gov/asbestos



APPENDIX 1

Materials Safety Data Sheets (MSDS)

The **US Occupational Safety & Health Administration's (OSHA) Hazard Communication Standard (HCS)** requires chemical manufacturers and importers to evaluate the hazards of the chemicals they produce or import. This involves the preparation of **labels** and **material safety data sheets (MSDS)** to convey the hazard information to their customers. All employers with hazardous chemicals in their workplace must have labels and MSDSs for their exposed workers and train them to handle the chemicals appropriately. The requirements do not apply to materials packaged for consumer use.

The MSDS should include precautions for normal use, handling, storage, disposal, and spill cleanup for each material. The hazards identified need to be reasonably foreseeable health and toxicity concerns arising from the product's use and the MSDS should not include recommendations for protective measures that are more strict than needed.

CONTENT

Chemical manufacturers and importers must obtain or develop a MSDS for each hazardous chemical they produce or import. Employers must also have a MSDS, in English, in the workplace for each hazardous chemical they use. OSHA's HCS specifies what a MSDS must contain:

1. The product name used on the label, and the chemical and common name(s) of ingredients which have been determined to be health hazards, and which comprise one per cent or more of the composition. Carcinogens shall be listed if the concentrations are 0.1 per cent or greater.
2. The chemical and common name(s) of all ingredients which have been determined to present a physical hazard when present in the mixture.
3. Relevant physical and chemical characteristics of the hazardous chemical (such as vapour pressure, flash point).
4. Relevant physical hazards, including the potential for fire, explosion, and reactivity.
5. Relevant health hazards, including signs and symptoms of exposure, and any medical conditions generally recognised as being aggravated by exposure to the chemical.
6. The primary route(s) of entry into the body.
7. The OSHA permissible exposure limit and **American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV)**. Additional applicable exposure limits may be listed.
8. Whether the hazardous chemical is listed in the **National Toxicology Program (NTP)** Annual Report on Carcinogens (latest edition) or has been found to be a potential carcinogen.
9. Precautions for safe handling and use, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks.
10. Appropriate control measures, such as engineering controls, work practices, or personal protective equipment.
11. Emergency and first aid procedures.
12. The date of preparation of the MSDS or the latest change to it, together with the name, address and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the MSDS, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.
13. If no relevant information is found for any given category, it should be marked to indicate that no applicable information was found.
14. If significant new information becomes available regarding the hazards of a chemical, or ways to protect against the hazards, it must be added to the MSDS within three months.
15. A MSDS must be provided with the initial shipment of a hazardous chemical, and with the first shipment after a MSDS is updated.



APPENDIX 1

.../continued

STANDARDISATION

Since the HCS does not impose a specific format on MSDSs, the information varies widely in presentation and amount, which can range from two to eight or more pages. Some companies have transferred the information on vendor MSDSs into their own format, with the result that they then become the 'responsible party' for the content of the MSDS.

In an effort to improve completeness, accuracy, and consistency, the **Chemical Manufacturers Association (CMA)** developed a 16-part voluntary standard for MSDS preparation, which was published in 1993 as **ANSI Z400.1-1993, American National Standard for Hazardous Industrial Chemicals, Material Safety Data Sheets, Preparation**. Its sections can be summarised as follows:^[5]

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Names the material and relates the MSDS with the label and shipping documents. Must include a mailing address and telephone number for the manufacturer or distributor.

SECTION 2: COMPOSITION, INFORMATION ON INGREDIENTS

Identifies the hazardous components of the material. If non-hazardous ingredients are listed, they should be listed separately. Chemical Abstract Service (CAS) numbers should be included, as well as **OSHA Permissible Exposure Limits** and American Conference of Government Industrial Hygienists (ACGIH) TLVs. If the identity of any ingredient is claimed to be a trade secret, it should be indicated.

SECTION 3: HAZARDS IDENTIFICATION

Describes the material's appearance, odour, and health, physical, and environmental hazards that may be of concern for emergency response personnel.

SECTION 4: FIRST AID MEASURES

Should include emergency and first aid procedures in easy to understand language. Procedures for each potential route of exposure should be included. A 'Notes to Physicians' sub-section should be included if the information is available.

SECTION 5: FIRE-FIGHTING MEASURES

Should describe fire and explosive properties of the material, the extinguishing media to be used and fire-fighting instructions. It applies to anyone who may be in the area of the fire.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Information needed to prevent or minimise adverse effects on employees, neighbours, property, and the environment, including waterways. It is intended for emergency response personnel.

SECTION 7: HANDLING AND STORAGE

Provides guidelines for minimising any potential hazards from storing the material, information to minimise handling when appropriate, temperature, inert atmosphere, and conditions to avoid.

[5] Source: Reference Data Sheet on Material Safety Data Sheets by Richard Gullickson, CIH, May 1996. See www.msdssearch.com/msdshistory.htm



APPENDIX 1

.../continued

SECTION 8: EXPOSURE CONTROLS, PERSONAL PROTECTION

Discusses the degree of engineering control that may be needed when handling the material, and the personal protective equipment that should be used if there is a potential for exposure above the regulatory or suggested limits. Exposure guidelines should be included.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

These should be included to assist users to determine proper handling and storage. Appearance, odour, physical state (liquid, solid, gas), pH, vapour pressure and density, melting and freezing point, solubility, and specific gravity should be included. Additional properties may be included if they are useful.

SECTION 10: STABILITY AND REACTIVITY

Should describe conditions that may result in a potentially hazardous reaction, such as evolution of hazardous gases, production of heat, or other hazardous conditions.

SECTION 11: TOXICOLOGICAL INFORMATION

Should include any known information resulting from animal testing or human experience on the toxicity of the material, information on its potential for causing cancer and data for acute, sub-chronic, and chronic exposures, if available.

SECTION 12: ECOLOGICAL INFORMATION

Should list impacts to the environment that may occur if the material is released to the environment, or in evaluating waste treatment practices.

SECTION 13: DISPOSAL CONSIDERATIONS

Should provide guidance to environmental and other technical people responsible for waste management for the product.

SECTION 14: TRANSPORT INFORMATION

Information concerning classification for shipping the material. It should include **US Department of Transportation (DOT)** classifications, or an indication that it is not regulated. It may include information for shipment into other countries.

SECTION 15: REGULATORY INFORMATION

Should contain information regarding the regulatory status of the material. It should include OSHA and **EPA** regulations. It may also include other regulatory agencies, and state agencies, if appropriate.

SECTION 16: OTHER INFORMATION

For other material the preparer feels is pertinent, that should not be included in the other 15 sections, such as label information, hazard ratings, revision dates, and references to other related information.



APPENDIX 2

Hazardous materials sheet

NAME(S):

GENERIC NAME / TRADE NAME:

CHEMICAL NAME:

SUPPLIER:

COMPOSITION:

APPEARANCE AND ODOUR:

USAGE:

PHYSICAL PROPERTIES (at 20°C, 1,013 mbar):

Density (kg/m³):

Vapour density (air = 1):

Boiling point (°C):

Vapour pressure (mbar):

Melting point (°C):

Kinematic viscosity (mm²/s):

Flashpoint (°C):

Solubility (kg/m³):

Auto-ignition temp. (°C):

Particle size (micron):

Flammability limits (% v/v):

pH:

IMPORTANT CHARACTERISTICS:

ACIGH Threshold
Limit Value (TLV):

OCCUPATIONAL EXPOSURE LIMIT:

OSHA permissible
exposure limit:

Incompatibilities:

SAFETY HAZARDS:

Fire:

Stability:

PRECAUTIONS:

Fire:

Stability:

FIRE-EXTINGUISHING AGENTS:

FIRE PRECAUTIONS:



APPENDIX 2

.../continued



HEALTH HAZARDS:

Inhalation:

Skin:

Eyes:

Ingestion:

FIRST AID:

Inhalation:

Skin:

Eyes:

Ingestion:

PERSONAL PROTECTION:

ENVIRONMENTAL HAZARDS:

PRECAUTIONS:

SPILLAGE MITIGATION (SEE ALSO PERSONAL PROTECTION):

DISPOSAL OPTIONS:

Preferred:

Acceptable:

NOTE: Disposal should be acceptable within requirements of operative legislation.

STORAGE:

PACKING AND LABELLING:

SUPPLEMENTARY INFORMATION:

na = data not available, n/a = not applicable, ne = not established

DATE OF ISSUE:

DATE REVISED:



APPENDIX 3

The 12 Persistent Organic Pollutants (POPs) listed under the Stockholm Convention^[6]

1. Aldrin

A pesticide applied to soils to kill termites, grasshoppers, corn rootworm, and other insect pests.

2. Chlordane

Used extensively to control termites and as a broad-spectrum insecticide on a range of agricultural crops.

3. DDT

Perhaps the best known of the POPs, DDT was widely used during World War II to protect soldiers and civilians from malaria, typhus, and other diseases spread by insects. It continues to be applied against mosquitoes in several countries to control malaria.

4. Dieldrin

Used principally to control termites and textile pests, dieldrin has also been used to control insect-borne diseases and insects living in agricultural soils.

5. Dioxins

These chemicals are produced unintentionally due to incomplete combustion, as well as during the manufacture of certain pesticides and other chemicals. In addition, certain kinds of metal recycling and pulp and paper bleaching can release dioxins. Dioxins have also been found in automobile exhaust, tobacco smoke and wood and coal smoke.

6. Endrin

This insecticide is sprayed on the leaves of crops such as cotton and grains. It is also used to control mice, voles and other rodents.

7. Furans

These compounds are produced unintentionally from the same processes that release dioxins, and they are also found in commercial mixtures of PCBs.

8. Heptachlor

Primarily employed to kill soil insects and termites, heptachlor has also been used more widely to kill cotton insects, grasshoppers, other crop pests, and malaria-carrying mosquitoes.

9. Hexachlorobenzene (HCB)

HCB kills fungi that affect food crops. It is also released as a byproduct during the manufacture of certain chemicals and as a result of the processes that give rise to dioxins and furans.

10. Mirex

This insecticide is applied mainly to combat fire ants and other types of ants and termites. It has also been used as a fire retardant in plastics, rubber, and electrical goods.

11. Polychlorinated Biphenyls (PCBs)

These compounds are employed in industry as heat exchange fluids, in electric transformers and capacitors, and as additives in paint, carbonless copy paper, sealants and plastics.

12. Toxaphene

This insecticide, also called camphechlor, is applied to cotton, cereal grains, fruits, nuts, and vegetables. It has also been used to control ticks and mites in livestock.

[6] Source: The Stockholm Convention www.pops.int/documents/pops/default.htm



APPENDIX 4

Common ingredients in cleaning products and their impacts

This table provides a guide to some of the raw materials commonly found in cleaning products. The subject is complex and there will always be differences in scientific opinion. It is not possible to be definitive, particularly when it comes to certain chemical categories. Within each chemical family group there are numerous different environmental classifications and great variation in performance for each.

It should be noted that the classification of raw materials is not always the final classification of a finished product. For example, a raw material classified as harmful, when added to a formulation in a very small percentage (e.g. 0.2 per cent), would not make the final formulation harmful.

More detailed information on ingredients, functions and issues relating to professional cleaning products can be found in **Sustainable Cleaning – A guide for users of professional cleaning products** which is listed under Resources in 8.9.2.

Substance	What it does	Examples	Impact on humans	Impact on environment
Abrasive	Insoluble materials that provide a mechanical action to the cleaning function	Calcium carbonate		Non-hazardous
Acid	Used for the removal of mineral soils	Phosphoric acid, citric acid	Corrosive or irritant depending on substance	Non-hazardous
Alcohol	See solvent	Isopropanol	Irritant, highly flammable	Non-hazardous
Alkalis	Help to break down fats, oils, and other organic soils	Sodium hydroxide, sodium carbonate	Corrosive or irritant depending on substance	Non-hazardous
Bacteria	Micro-organisms for drain cleaning are responsible for resolving the fatty deposits and for building a protective film inside the drain system	Bacillus type micro-organisms		Non-hazardous
Chlorine	Can be used either as bleaching agent or disinfectant/sanitiser. Chlorine helps to break down organic soils	Sodium hypochlorite	Corrosive	Hazardous
Enzyme	Complement the detergent activity by digesting certain soil types	Protease	Harmful	Non-hazardous
Perfume	Mask bad odours or provide a pleasant smell to the detergent	Natural (lemon, lavender, pine) Artificial (limonene, musks)		Non-hazardous
Peroxygen	Can be used either as bleaching agent or disinfectant/sanitiser	Hydrogen peroxide	Corrosive, oxidising	Non-hazardous
Phosphate	Provides a source of moderate alkalinity and supports the cleaning process whilst tying up water hardness minerals	Sodium tripolyphosphate		Non-hazardous
Quaternary Ammonium Compound (QAC)	The quaternaries are cationic surfactants with germicidal (disinfectant) properties	QAC	This is a family of substances and both hazardous and non-hazardous types exist	
Sequestering agents	Series of organic chemical compounds that have the ability to tie up water hardness and other metallic salts	NTA, polyacrylate	Can be harmful or non-hazardous depending on substance	Non-hazardous
Solubiliser	Improve the solubility of some constituents of cleaners and disinfectants in an aqueous solution	Sulfonates, glycols	Non-hazardous or irritant depending on the substance	Non-hazardous
Solvent	Used in detergent formulas to complement the cleaning efficiency	Isopropanol	Irritant, highly flammable	Non-hazardous
Surfactant	Reduces the surface tension of water so it can quickly wet a surface to enable dirt to be loosened and removed. Provide foaming and emulsification. Made from petrochemicals or oleochemicals	Anionic, cationic, non-ionic, amphoteric	Depends on which surfactant	Varies greatly

FIGURE 8.7

Common ingredients in cleaning products and their impacts



APPENDIX 5

Hazardous materials: terminology

B**BEI**

Biological Exposure Indices covering more than 80 chemical substances.

BIO-ACCUMULATION

The ecological process through which chemical products accumulate throughout the food chain.

BIODEGRADATION

Biodegradable material is susceptible to degradation, usually by micro-organisms, leading to the release of heat, carbon dioxide, organic residues and methane. This term usually refers to surfactants and most commonly defines a level of biodegradability specified by legislation. This is a complex area but there are basically two forms: **primary biodegradability**, which deals with a first cleavage of the molecule and **ultimate biodegradability**, which involves complete breakdown into simple salts, water and oxygen.

C**CARCINOGENIC**

A substance thought to cause cancer.

CONCENTRATE

A liquid product that contains less than 20 per cent water by weight.

CORROSIVE

Can destroy living tissues such as skin, eyes, the lungs and stomach. Oven cleaners, for example, may be corrosive.

COSHH

The Control of Substances Hazardous to Health Regulations 2002 which require employers to control exposure to hazardous substances to prevent ill health.

D**DIRTY DOZEN**

Twelve of the most toxic chemical substances such as polychlorinated biphenyls (PCBs), outlawed under the Stockholm Convention.

F**FLAMMABLE**

Can be easily ignited by sparks or flames. Of particular concern are liquids with low flashpoints e.g. solvents and fuels.

H**HARMFUL**

A substance which if inhaled, ingested or penetrates the skin may incur limited health risks.

I**IRRITANT**

A non-corrosive substance which can cause inflammation through immediate, prolonged or repeated contact with the skin or mucous membranes.

M**MONTREAL PROTOCOL**

International agreement to which nearly all countries in the world are signatories. Covers the phase-out of ozone depleting substances (ODS) such as halons and certain refrigerants that damage the earth's protective ozone layer. SEE SECTION 5

MSDS

Under an internationally established system, all manufacturers of chemical products have to provide materials safety data sheets (MSDS). Issued by the manufacturer or supplier they contain comprehensive technical information on storage, handling, use and disposal of the product.

O**OLEOCHEMICALS**

Derived from fats and oils from plants or animals.

OXIDISING

Destroys organic matter by breaking down the cell walls.

P**PETROCHEMICALS**

Derived from crude oil or natural gas – often termed synthetic chemicals even though oil and gas are natural resources.

POISONOUS

Toxic to humans and/or hazardous during transportation.

S**STOCKHOLM CONVENTION**

Global treaty ratified in May 2004 to protect human health and the environment from persistent organic pollutants.

SDS

Safety Data Sheets (see MSDS) the more common term for MSDS in Europe.

T**TLV**

Threshold Limit Value for occupational exposure.

TOXIC/TOXICITY

Can cause physical or mental impairment or even death when inhaled, ingested or absorbed in very small, specified concentrations. Classified as either acute or chronic. Tests for **acute toxicity** (typically carried out on three different water-living organisms: fish, *Daphnia* and algae) reveal the diminished survival (lethal) effects, or sub-lethal physiological effects on reproduction, growth etc. The result is expressed as LC50, which means Lethal Concentration (mg/l) at which 50 per cent of the tested organisms died. The higher the figure the higher the toxicity. **Chronic toxicity** testing provides a more comprehensive understanding of the toxicity of the defined substance and encompasses assessments on the organism's entire life cycle to determine its long term effects.

V**VOCS**

Volatile Organic Compounds. Typically emitted from fuels, solvent and aerosol cans, when released to atmosphere they contribute to the formation of photochemical smog which is believed to be a contributory factor in respiratory diseases.



APPENDIX 6

Pest control chemicals: checklist for staff



BEFORE APPLYING

1. What is the pest problem?.....
2. What are the best methods or products to control the pests?.....
3. What is the least toxic and the least persistent pesticide/herbicide available?.....
4. What health surveillance is in place for those mixing and applying pesticides/herbicides?.....
5. Quantity of pesticide to be used:
Area:..... Department:.....
6. Protective clothing to be worn:.....

NOTE: Do you know the symptoms of acute pesticide poisoning related to the chemicals that you are using? If you feel ill, even with a headache or cold-like symptoms, stop work.

DURING THE APPLICATION

7. Equipment being used:.....
8. Has all equipment been checked for the health and safety of the operator?.....
9. Are you using the best and safest equipment available?.....
10. Have you checked that sprayers are not too heavy to be lifted when full?.....
11. Is the correct protective clothing being worn?.....
12. Have you notified others and cordoned off the area?.....
13. Time control:
Time:..... Duration:.....
14. How many persons are working in the spraying area?.....

NOTES:

- Never work alone when handling toxic pesticides.
- Never eat, drink or smoke when applying or mixing pesticides.
- Do not breathe in pesticide spray, dust or fumes.

AFTER APPLICATION

15. Have all unused pesticides/herbicides been returned to the store?
Yes..... No..... Why not?.....
16. Have you ensured that no pest control chemicals are left in sprayers/other containers?.....
17. Have you disposed of the empty containers safely and according to the best possible practice laid down nationally/internationally?.....

NOTE: All recommended protective clothing must be worn and replaced at regular intervals. Soap and water should be used to wash skin and clothing where necessary. Never use empty pesticide containers for the storage of food or water.



APPENDIX 7

Asbestos-containing materials in buildings

FIGURE 8.8

Asbestos-containing materials in buildings

Generic name	% asbestos content	Dates when used
SURFACING MATERIAL		
Sprayed or trowelled on	1–95	1935–1970
PRE-FORMED THERMAL INSULATING MATERIALS		
Batts, blocks, pipe covering:		
85% magnesia	15	1926–1949
Calcium silicate	6–8	1949–1971
TEXTILES (CLOTH)		
blankets (fire)	100	from 1910
felts	90–95	from 1920
blue stripe	80	from 1920
red stripe	90	from 1920
green stripe	95	from 1920
Sheets	50–95	from 1920
Cord/rope/yarn	80–100	from 1920
Tubing	80–85	from 1920
Tape/strip	90	from 1920
Curtains (theatre safety; welding)	60–65	from 1945
CEMENTITIOUS CONCRETE-LIKE PRODUCTS		
Extrusion panels	8	1965–1977
corrugated	20–45	from 1930
flat	40–50	from 1930
flexible	30–50	from 1930
flexible perforated	30–50	from 1930
laminated (outer surface) roof tiles	20–30	from 1930
Clapboard and shingles		
clapboard	12–15	1944–1945
siding shingles	12–14	?–onwards
roofing shingles	20–32	?–onwards
Pipe	15–20	from 1935
PAPER PRODUCTS		
High temperature	90	from 1935
Moderate temperature	35–70	from 1920
Indented	98	from 1935
Millboard	80–85	from 1925
ROOFING FELTS		
Smooth surface	10–15	from 1910
Mineral surface	10–15	from 1910
Shingles	1	from 1971
Pipeline	10	from 1920
ASBESTOS CONTAINING COMPOUNDS		
Caulking putties	30	from 1930
Adhesive (cold applied)	5–25	from 1945
Joint compound roofing asphalt	5	?–onwards
Mastics	5–25	from 1920
Asphalt tile cement	13–25	from 1959
Roof putty	10–25	?–onwards
Plasters/stucco	2–10	?–onwards
Spackles	3–5	1930–1975
Sealants, fire/water	50–55	from 1935
Cement, insulation	20–100	1900–1973
Cement, finishing	55	1920–1973
Cement, magnesia	15	1926–1950
FLOORING TILE AND SHEET GOODS		
Vinyl/asbestos tile	21	from 1950
Asbestos/asbestos tile	26–33	from 1920
Sheet goods/resilient	30	from 1950
WALL COVERING		
Vinyl wallpaper	6–8	?–onwards
PAINTS AND COATINGS		
Roof coating	4–7	from 1900
Air-tight	15	from 1940