



Agenda

1. Biological Exposures and their Health Effects
2. Biological Agents Regulations
3. Analytical Methodologies
4. Recommended Limit Levels



Biological exposures

- A Biological agent is a micro-organism, cell culture, or human endoparasite, whether or not genetically modified, which may cause infection, allergy, toxicity or otherwise create a hazard to human health
- They include bacteria, viruses, fungi (yeasts and moulds) and parasites



Legislation

- The Safety, Health and Welfare at Work (Biological Agents) Regulations 1994 as amended in 1998 (S.I. No.146 of 1994 and S.I. 248 of 1998) set down the minimum requirements for the protection of workers from the health risks associated with biological agents in the workplace.
- There are two modes of exposure at work to biological agents:
 - (1) they are intentionally worked with, as in a microbiological laboratory, or
 - (2) incidental exposure which may occur as a result of the kind of work done.....

What work activities might involve exposure to biological agents?

- Work in food production plants
- Work in agriculture
- Work activities where there is contact with animals or products of animal origin (or both)
- Work in health care, including isolation and post mortem units
- Work in clinical, veterinary and diagnostic laboratories
- Work in refuse disposal plants
- Work in sewage purification installations
- Work in composting handling units





Biological exposures

- In line with the Safety, Health and Welfare at Work (Biological Agents) Regulations 1994 (S.I. No. 146 of 1994), the Safety, Health and Welfare at Work (Biological Agents) (Amendment) Regulations 1998 (S.I. No. 248 of 1998), companies should complete a biological risk assessment to assess any risk to the health and safety of the workplace resulting from exposure to biological agents.
- The outcome of the risk assessment will dictate what testing, hygiene measures, training, health surveillance, notification, emergency plans, vaccination and individual protection measures should be taken.



What measures should be put in place if it is not technically possible to prevent exposure to biological agents?

- Keep the number of employees exposed or likely to be exposed to a biological agent as low as possible.
- Work processes and engineering control measures should be designed so as to avoid or minimise the release of a biological agent into the place of work.
- Use both collective protection measures and individual protection measures where exposure cannot be avoided by other means.
- Ensure that there is an adequate awareness to the potential risks to staff.
- Use hygiene measures compatible with the aim of preventing or reducing the accidental transfer or release.

What measures should be put in place if it is not technically possible to prevent exposure to biological agents?



- Use the bio-hazard sign and other relevant warning signs.
- Draw up plans to deal with accidents involving a biological agent.
- Test, where it is necessary and technically possible, for the presence, outside the primary physical confinement, of a biological agent used at work.
- Use means for safe collection, storage and disposal of waste by employees, including the use of secure and identifiable containers, after suitable treatment where appropriate.



Legislation

- It is our experience that while there is awareness (some!) of biological exposure risks in these environments

there is little awareness of the general effect that exposure to high levels of mould, bacteria and allergens have on health in settings such as the office .



Biological Exposures

- Biological agents such as bacteria, viruses, moulds and dust mites and their metabolic products can be a common factor in office air pollution.
- Repeated exposure to organic materials of bacterial or fungal origin are relevant to health issues such as asthma, rhinitis and mucosal complaints. Such increased exposure is also likely to result in a greater incidence of sickness absence due to colds and flu.
- Inadequate office cleaning practice and poor personal hygiene can lead to high levels of microorganisms in offices.
- Excess levels of indoor moisture (water damage, inadequate ventilation) can be a major contributory factor.
- Office microbiological testing has found hundreds of thousands of bacteria on hot spots like printer buttons, desktops, keyboards and other surfaces. These tiny organisms can then become airborne unseen to the naked eye. They may be inhaled, either alone or attached to particles of dust.



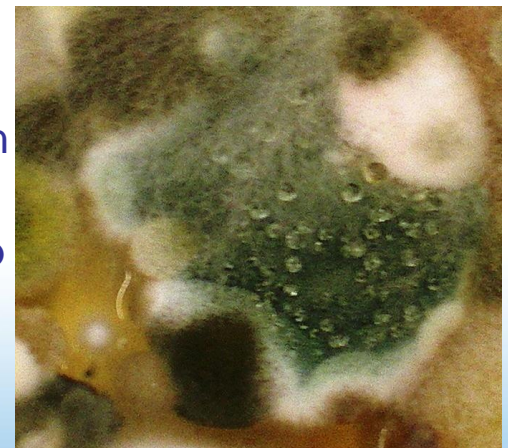
Mould Exposure & HVAC Exposure Risks

- Mould can grow on any surface within the building where moisture and nutrients are present.
- Moist plant soils and dehumidifier trays can provide ideal breeding ground for mould. Carpets and other fabrics are prone to mould growth should they become damp.
- A primary source of indoor air contamination can be the bacterial and fungal colonisation of air filters, natural ventilation points, heat transfer coils and ductwork within the system. A large number of studies worldwide have shown that high levels of microbial contamination in air samples taken inside a building can be associated with microbial growth in the air distribution ducts.
- Dust particles trapped by filters in the system provide a source of nutrients which can lead to rapid fungal colonisation. These fungal colonies produce spores and volatile organic compounds.
- Therefore it is accepted that hygienic maintenance of air distribution ductwork in respect of microbial cleanliness can affect the air supplied to building spaces.

Health Effects of Mould Exposure

- The most common symptoms of fungal exposure are runny nose, eye irritation, cough, congestion, and aggravation of asthma
- There are an estimated 100,000 validly described species of fungi with this number growing.
- Moulds may be allergenic or toxic, or they may produce mycotoxins.
- A healthy individual may inhale several thousand spores per day, If the individual is immunocompromised or is allergic then the clinical manifestation is more serious.

Exposure to substantial amounts of mould may contribute to skin, eye and respiratory irritation and can lead to chronic lung infection among the immunosuppressed or those with underlying conditions.



Health Effects of Biological Exposure

- **Bacteria:** The exposure of humans to high levels of airborne or surface contaminating bacteria may result in a variety of adverse health effects including infectious diseases, allergic and irritant responses, respiratory problems and hypersensitivity reactions.
- **Allergens:** Sneezing, coughing, runny nose, sore throat, diarrhoea, vomiting, itching and hives. Exposure to dust mite allergen can inhibit pulmonary immune function. Allergic employees showed a 10% decrease in productivity when poorly controlled.



Air and Surface Testing and Analytical Methods

Bacteriology

Identification by:

1. Microscopic Methods



Mycology

2. Culture Methods



Virology

3. Molecular Methods





Allergen Testing

- Enzyme-Linked Immunosorbent Assay: ELISA
- Utilises the specific interaction of antibodies with proteins
- Interaction is highly specific and can detect minute concentrations of allergen

Routine:

House Dust Mite (Der p1)

Pollen (Timothy Grass)

Cat Allergen (Fel d1)

Standard (ng – 10^{-9})

Amplified (pg – 10^{-12})

Limit Levels

- Despite bodies in a number of jurisdictions attempting to set safe threshold levels for mould or bacterial exposure there is an absence of accepted national or international limits.

Some existing guidelines are:

- CIBSE TM 26; 2000 Hygienic Maintenance of Office Ventilation ductwork was prepared by CIBSE to complement the BSRIA Guidance on ventilation system hygiene, and advice given by HVCA in their guide to Good Practice on ductwork hygiene.
- Best Practice Guidelines (European Collaborative Action Report Number 12, Biological Particles in Indoor Environments)
- Baxter *et al.* J Occup Environ Hygiene, 2005





CIBSE Standard TM26:2000

- CIBSE TM26:2000 proposes protocols for microbial sampling and measurement inside ductwork and the spaces it serves. It recommends annual sampling takes place.

Protocol for sampling air in occupied spaces

- Samples should be taken from at least 2 spaces served by each AHU, one near the beginning and one near the end. Samples should be taken from 2 sampling locations in each space.

Protocol for sampling air in ductwork

- All sampling should be carried out on the inner surface of the ductwork within the AHU downstream from the filter.
- At each location samples for both media should be taken.



Example Limit Levels for Mould and Bacteria

- **European Collaborative Action Report number 12, Biological particles in indoor environment**
 - Category Count; CFU/m³
 - **Bacteria:** Very Low < 50, Low < 100, Intermediate < 500 high < 2000, very high > 2000
 - **Fungi:** Very Low < 25, Low < 100, Intermediate < 500 high < 2000, very high > 2000
- **CIBSE Document TM 26; 2000**
 - Category Count; CFU per 10 cm²
 - Low < 10, Medium >10 but < 20, High > 20



Limit Levels

- Recommended best practice limits: **House dust mite** – Low - < 2µg/g dust
- Best Practice Standard: two-site monoclonal antibody ELISA for the quantification of major *Dermatophagoides spp.* allergens Der p1 and Der f1. Luczynska CM., Arruda LK. *et al.* J. Immunol. Methods 118(1989) 227 235.



To recap....

- Elevated presence of microbial contamination or increased exposure to dust mite allergen is a significant threat to the health occupants.
- The presence of excessive air moisture and availability of key nutrients is central to the development and persistence of harmful levels of indoor microflora.
- Awareness of the medical implications of biological exposure in the office setting is often limited and can pose serious issues for occupant health.
- The monitoring of the health of indoor air must be monitored using the appropriate expertise and technology in order to best advise on remediating possible issues.



Discussion

