



Occupational Hygiene Society of Ireland 22nd Annual Conference

Exposure to Indoor Air Contaminants in the Office Environment

21st February 2013





Agenda

- Introduction
- Indoor Air
- Legislation
- Exposures
- Indoor Air Pollution and Health
- HFA Findings
- Questions





About Us

airmid healthgroup ltd is an Irish organisation established by a group of clinicians in 2007

Our multidisciplinary team includes

- Clinicians
- Mycologists
- Microbiologists
- Occupational hygienists
- Virologists
- Allergy and Immunologists

We have made it our mission to prevent ill health caused by exposure to indoor air pollutants

health friendly air™ is our goal – independent verification of the quality of indoor air

About Us contd..

Advanced Environmental Laboratory Capabilities

Allergen

- Routine and bespoke allergen detection
- ISO/IEC 17025:2005 INAB accredited testing laboratory Reg. no. 284T for House Dust Mite and Cat Allergen analysis.

– Microbiology

- Identification and enumeration of:
 - Bacteria
 - Fungi
 - Viruses



- Culture and molecular capabilities (PCR/Real time PCR)

About Us contd..

- Our scientific testing services are engaged by a wide range of product manufacturers to provide independent verification of claims regarding clearance of allergens, bacteria, viruses and moulds

Allergen and Microbiological Claim Verification:

- Real Time Allergen Infestation
- Advanced Environmental Chamber Services that simulate real life use of consumer products such as:
 - Air Conditioners
 - Air Cleaners
 - Dehumidifiers
 - Flooring
 - Paint
 - Vacuum Cleaners
- Allergen Barrier Testing





About Us contd..

Health Friendly Air

- Audits and monitors those parameters most likely to adversely impact human health and wellbeing
- Advanced capacity to monitor for surface and airborne biological (mould, bacteria and allergens) contamination
- Ability to interpret results in the context of possible adverse health effects.

Introduction to Indoor Air Quality

IAQ v's IEQ

Indoor Air Quality (IAQ) refers to the totality of attributes of indoor air that affect a person's health, well being and comfort.

Indoor Environmental Quality (IEQ) is a generic term used to describe the physical and perceptual attributes of the indoor space. These include the thermal, acoustic and visual properties of the environment as well as the indoor air quality.



Indoor Air

- The World Health Organization (WHO) estimates that greater than one building in four has indoor air quality problems
- 90% of our time is spent indoors.
- Indoor air is more polluted than outdoor air (5 to 100 times).
- 20-60% of building occupants suffer from symptoms associated with unhealthy indoor air

Applicable Legislation

- The Safety, Health and Welfare at Work 2005

Employers (including self-employed persons) are responsible for creating and maintaining a safe and healthy workplace.

- Safety, Health and Welfare at Work (General Application) Regulations 2007

Applicable Legislation contd..

- The Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001 and the 2011 Code of Practice

- The Safety, Health and Welfare at Work (Biological Agents) Regulations 1994 as amended in 1998

Set down the minimum requirements for the protection of workers from the health risks associated with biological agents in the workplace.

Risk of Exposure

- **Biological Agents**
- **Chemical Exposures**
- **Thermal comfort**
- **Contamination from Outside Sources**



Risk of Exposure contd..

Biological Agents

- **Bacteria, Viruses, Moulds, Dust Mites and their toxins**

Sources in office: hot spots like printer buttons, desktops, keyboards and other surfaces due to inadequate office cleaning practice can then become airborne and inhaled, either alone or attached to particles of dust.



Risk of Exposure contd..

Biological Agents contd..

- Studies have shown that a frequent source of indoor air contamination may be the **bacterial and fungal colonisation of air filters, heat transfer coils and ductwork** within a air handling system.
- Because of the climate in Ireland, **dust mite levels** are higher than in some other countries, emphasising the importance of this allergen here. High allergen levels can be found in carpets, furniture and soft upholstery.



Risk of Exposure contd..

Chemical Exposures

-TVOC's, CO₂, CO, NO₂, O₃, SO₂, CH₂O

Sources in office

- cleaning fluids
- paint
- cleaning products
- improperly ventilated combustion appliances
- vapours off-gas from building materials (e.g. carpets, particleboard, fabrics)
- flooring
- furniture



Risk of Exposure contd..

Thermal comfort

- Temperature, Relative Humidity

When ambient indoor air temperature is too warm can result in fatigue and lethargy.

Low **relative humidity** levels can result in irritation and discomfort and heightens the overall perception.

High humidity levels can result in condensation within the building structure and on interior or exterior surfaces and the subsequent development of **moulds and fungi** and encourages **dust mite** growth.

Health Symptoms

- Moisture and Microorganisms in buildings can cause infections, allergic or hypersensitivity reactions and irritant reactions.
- Increased incidence in infection
- Increased incidence of coughing, asthma and respiratory problems



Health Symptoms contd..

- Headaches, eye, nose, throat irritation
- Difficulty in concentrating and fatigue
- Dizziness and nausea
- Complaints of unpleasant odours and stuffiness



HFA Findings



HFA Findings in Irish Buildings

- Almost one third of the buildings monitored had inadequate levels of ventilation which caused a build up of contaminants in the air.
- Of those buildings with Heating, Ventilation and Air Conditioning (HVAC) systems were complaints were of headaches, dry eyes and skin. Monitoring identified that relative humidity was below best recommended practise
- The results also showed that in 1 case the primary source of indoor air contamination appeared to be biological contamination of the HVAC system.

Chemical Parameter	Result	Natural Ventilation	HVAC
Carbon dioxide	Above Guidelines	39%	20%
	Within Guidelines	61%	80%
<p>Recommended limit: < 1000 ppm (< 1440 mg/m³) - Hong Kong - A Guide On Indoor Air Quality Certification Scheme for Offices and Public Places 2003 - KPMG & Middlesex University (2007) Carbon Dioxide Concentrations</p>			
TVOC	Above Guidelines	65%	12%
	Within Guidelines	35%	88%
<p>Recommended limits: < 261 ppb (600 µg/m³) with isobutylene (2-methylpropene) used as the reference calibration gas. - Hong Kong - A Guide On Indoor Air Quality Certification Scheme for Offices and Public Places 2003 - Finnish Society of Indoor Air Quality and Climate. Finnish Classification of Indoor Climate 2000: Revised Target Values.</p>			

Chemical Parameter	Result	Natural Ventilation	HVAC
Relative Humidity	Above Guidelines	23%	20%
	Within Guidelines	61%	80%
<p>Recommended: 40 – 65% -Hong Kong - A Guide On Indoor Air Quality Certification Scheme for Offices and Public Places 2003 -Wolkoff P, Soren K, Kjaergaard 2007. 'The dichotomy of relative humidity on indoor air quality'.</p>			
Nitrogen Dioxide	Above Guidelines	32%	64%
	Within Guidelines	68%	36%
<p>Recommended limits: < 0.105 ppm (200 µg/m³ / 0.2 mg/m³) - Air Quality Standards Regulations 2011 (SI No. 180 of 2011)</p>			

Chemical Parameter	Result	Natural Ventilation	HVAC
Ozone	Above Guidelines	6%	16%
	Within Guidelines	94%	84%
<p>Recommended limits: < 0.08 ppm - 2011 Code of Practice for the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 (Moderate work)</p>			
Temperature	Above Guidelines	6%	4%
	Within Guidelines	71%	88%
	Occupant Satisfied	23%	8%
<p>Recommended: 21 - 24°C - O. Seppänen, W. J. Fisk and Q.H. Lei 2006. 'Room Temperature and Productivity in Office Work'</p>			

Chemical Parameter	Result	Natural Ventilation	HVAC
Carbon Monoxide	Above Guidelines	0%	0%
	Within Guidelines	100%	100%
Recommended: < 9 ppm -ASHRAE 62.1 2010 Ventilation for Acceptable indoor air quality - US EPA			
Sulphur Dioxide	Above Guidelines	0%	0%
	Within Guidelines	100%	100%
Recommended: < 0.0076 ppm (< 20 µg/m³) - WHO, Air Quality and health Fact Sheet No313, 2008			

Biological Parameter	Result	Natural Ventilation	HVAC
Fungi/Mould	Above Guidelines	27%	4%
	Within Guidelines	73%	96%
<p>< 2,500 spores/m³ or inside levels must not exceed outside levels by more than 1,000 spores/m³</p> <ul style="list-style-type: none"> - AIHA Conference 2001 (AIHA & ACGIH) - National Allergy Bureau (NAB) SCALE - Suggested Airborne Acceptance or Rejection Criteria (Southern California) Based on 75th and 25th Percentiles. Journal of Occupational and Environmental Hygiene January 2005 			
Bacteria	Above Guidelines	28%	33%
	Within Guidelines	72%	67%
<p>Cfu/m³: Very Low < 50, Low < 100, Intermediate < 500, High <2000 , Very high > 2000</p> <ul style="list-style-type: none"> - European Collaborative Action Programme Report no. 12, 'Biological particles in indoor environments'. 			
Dust Mites	Above Guidelines	0%	0%
	Within Guidelines	100%	100%
<p>Low: < 2µg.g dust Significant: 2 – 10 µg/g dust High: > 10µg/g dust</p> <ul style="list-style-type: none"> - Platts-Mills TA, Vervloet D, Thomas WR, et al. Indoor allergens and asthma: report of the Third International Workshop. J Allergy Clin. Immunol., 1997;100:S1 – S24 			

Physical Parameter	Result	Natural Ventilation	HVAC
Total Suspended Particulates	Above Guidelines	38%	9%
	Within Guidelines	62%	91%
<p>Recommended : < 20 µg/m³ -Hong Kong - A Guide On Indoor Air Quality Certification Scheme for Offices and Public Places 2003</p>			

HFA Case Studies

Case 1: An open plan 4 storey office
Problem: Headaches, nausea, fatigue.
HFA Approach: Full indoor Air Audit
Result: High levels of Carbon dioxide, TVOC' and bacteria caused by inadequate levels of ventilation
Outcome: Increased levels of ventilation, symptoms resolved.

Case 2: A 5 storey office building.
Problem: Respiratory issues.
HFA Approach: Full Audit with HVAC assessment.
Result: High levels of mould found in AHU.
Outcome: HVAC system cleaned and reinstated. Repeat survey showed low fungal presence.

Case 3: Historic building
Problem: Respiratory/allergic issues.
HFA Approach: Full indoor air audit
Result: High levels of airborne mould in some areas. Visible dry rot fungus found (*Serpula lacrymans*). Removed and air cleaners introduced.
Outcome: Repeat survey showed low fungal presence..

Case 4: A large multi national organisation
Problem: None. Corporate Standard
HFA Approach: Full Audit with HVAC assessment.
Result: All levels were within best practice guidelines.
Outcome: Written documentation of risk assessment.

HFA Case Studies contd..

Case 5: A Private Residence

Problem: Hypersensitive Pneumonitis

HFA Approach: Full Indoor Air Audit (entailed 4 separate surveys)

Result: High levels of *Basidiospore* in air samples. No visible signs of mould found further investigation through surface and bulk took place, helped identify source

Outcome: Approximately 1 month after remediation by builders levels reduced by 99.5%.

Case 6: Old Georgian Building – Naturally Ventilated

Problem: Complaints of headaches and nausea.

HFA Approach: Full Audit .

Result: Total Volatile Organic Compound (TVOC) levels were elevated. Office had been painted 6 weeks previously. A review of the material safety data sheets (MSDS) revealed that both the undercoat and the gloss had a high VOC content.

Outcome: Office occupants relocated for 4 weeks and high levels of ventilation introduced. A repeat survey confirmed TVOC levels had returned to normal. The office was reoccupied.

Case 7: Mechanically Ventilated Office

Problem: Allergic issues

HFA Approach: Full indoor air audit

Result: Very high levels of house dust mite and total suspended particulate. Visible build up of dust throughout the office.

Client Outcome: Improved cleaning programme was introduced to the office.

Case 8: A large 5 storey open plan office

Problem: 1 employee diagnosed with Hypersensitivity Pneumonitis.

HFA Approach: Full indoor Air Audit

Result: All levels were within best practice guidelines.

Outcome: Written documentation that results of Indoor Air Audit do not give cause for concern with regard to building occupant health.



Sustainable Building and Ventilation

Been shown that a myopic focus on energy conservation in buildings can inadvertently lead to poor indoor air quality

Inadequate ventilation means contaminants created by workplace processes are not diluted and are simply re-circulated around the building

An acceptability that tight, insulated buildings with minimal ventilation and low air change rates result in indoor air pollutants building up to sufficiently high levels as to threaten occupant health.

Sustainable Building and Ventilation contd..

A sustainable building is not just energy efficient, it has six fundamental principles:

- Optimise Site Potential
- Optimise Energy Use
- Protect and Conserve Water
- Use Environmentally Preferable Products
- **Enhance Indoor Environmental Quality (IEQ)**
- Optimise Operational and Maintenance practices



Sustainable Building and Ventilation contd..

There is a need when pursuing energy conservation in buildings to take into consideration the quality of the air and its impact on occupants health

Striking a balance between maximising energy conservation and creating a healthy, comfortable and productive indoor environment is crucial for sustainability

Strategies to Ensure Good Indoor Air Quality

Source Control - the most effective way to improve indoor air quality is to eliminate individual sources of pollution or to reduce their emissions

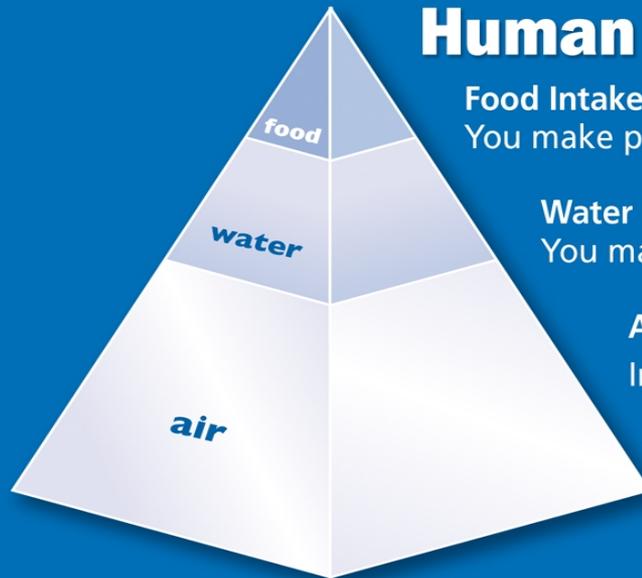
- Building materials & furniture
- Cleaning products
- Isolate emitting equipment
- Control of moisture
- HVAC positioning
- Chemical storage
- HVAC maintenance
- Good housekeeping techniques

Conclusion

- Source/generation of Contaminants
- Ventilation
- Removal of Contaminants/Cleaning

the air we breathe

Human Body Intake



Food Intake

You make positive healthy choices about the food you eat.

Water Intake

You make sure you drink clean filtered water.

Air Intake

Indoor Air pollution is ranked 5th as a cause of ill health worldwide.

You spend 90% of your time indoors.

Is it time your indoor air had a health check?



Thank You

