

# Managing Indoor Air Quality

Presentation by Simon Tebb, TSI  
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By way of introduction to his topic of Indoor Air Quality (IAQ), Simon explained that for many years, people who were exposed to known health hazards have had numerous kinds of protection available. By contrast, he added, IAQ deals with issues where protection is 'apparently' not needed because the risks are not perceived as overtly aggressive! Nevertheless, there is a tangible risk that has arisen because: -

- A shift from agriculture to manufacturing and services.
- Work in dense urban areas
- More time spent indoors
- Energy savings policies create more air-tight buildings
- More synthetics and composites are used in modern construction
- Older buildings leaked

Simon posed the question "Why does this matter?" and said that if an environment was too hot it could lead to as much as a 25% loss in productivity! Other problems included: -

- Lack of concentration
- Discipline problems
- Increased absenteeism
- Poor infection control
  
- Potential litigation issues
- Increased awareness and concern over air quality and health

The majority of complaints are to do with Thermal Comfort (or lack of it) and Simon reminded us the “People share a good experience with **many** people they know”, whereas “People share a bad experience with **everyone** they know!” The issues are compounded by the fact that, although people in one room experience the same conditions, their responses may be very different.

Thermal comfort is affected by many variables, some of which are: -

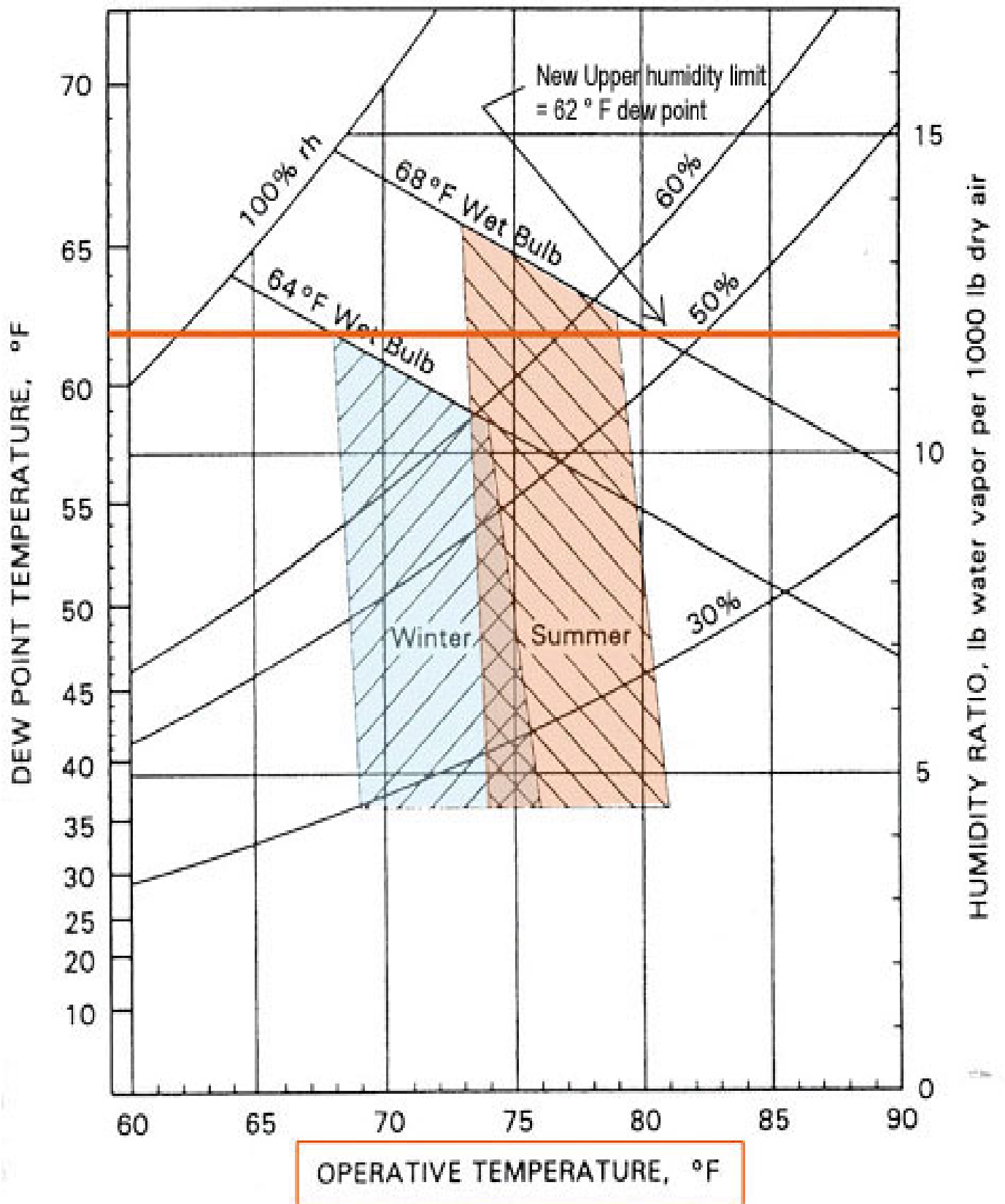
- Air Temperature
- Mean radiant temperature
- Humidity
- Air Speed (Draught)
- Clothing
- Activity

When trying to answer complaints, Simon emphasised that it was advisable to use the same logical discipline that is used to tackle Health and Safety issues. It was essential, he added, to measure the magnitude of the problem in a systematic way to:

- Include occupied zones
- Be Quantitative
- Be Objective
- Take real-time measurements
- Take comparative measurements in places where occupants are satisfied, as well as where they are complaining
- Ensure that measurements are calibrated. As an example he said that level of CO<sub>2</sub> in the BMI Hall was 850 ppm.

On the matter of thermal comfort, Simon displayed this chart that showed the relationship between temperature and humidity for both Winter and Summer conditions. There is no such thing as ‘one figure’ to define what is acceptable, as there is in the Workplace Regulations where a minimum temperature is stipulated.

These figures from the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) show ‘Target Zones’, based on temperature and humidity, to achieve comfort Summer and Winter.



The goal is to make at least 80% of occupants feel comfortable. Simon quoted one example where half of a computer building had been converted to offices. After complaints, it had been realised that the air was being filtered too much by the original air handling plant, which had been designed for computers.

On the subject of ventilation, Simon went on to say that an essential element was the amount of outdoor air entering an indoor space. This may be achieved by either natural or mechanical means and the standards will vary, according to the type of facility, activities taking place, known contaminants and the number of people.

Activity	ft <sup>3</sup> /min./person (fresh air)	Activity	ft <sup>3</sup> /min./person (fresh air)
Dining Area	20	Classroom	15
Kitchen	15	Laboratory	20
Hotel Room	15	Auditorium	15
Parking Garage	1.5 ft <sup>3</sup> /min/ft <sup>2</sup>	Library	15
Office	20	Patient room	25
Conference room	20	Health facility	15
Public rest room	50	Operating room	30
Smoking area	60	Residential	15
Retail	15	Residential kitchen	25
Gymnasium	20	Residential bath	20

It is also possible that there are potential health issues stemming from exposure to indoor contamination as well as outdoor sources. Typically, these may be from the following groups of contaminants: -

**Bioaerosols**

- Includes plants and animal material
- Bacteria, Viruses, Mould, Pollens and other Allergens. Usually samples are collected and then lab analysed.  
*Moisture management is critical with this group – Legionella!*

**Chemical Contaminants**

- Cleaners, solvents, acids, fuels, emissions from furnishings or decorative treatment, adhesives and a variety of released through reactions or combustion.  
*Proper storage is important with this group – is it near an area where people are unwell?*

**Particle contaminants.**

- Solids or liquids become suspended in the air
- Can be derived from dust, construction, vehicle emissions, smoking, combustion and chemical reactions where vapours condense into particles.

Air filtration is vital to deal with these.

<b>Contaminant Description</b>	<b>Size</b>
<b>Human Hair</b>	$\pm 120 \mu\text{m}$
<b>Visible Dust</b>	$25 \mu\text{m}$
<b>Non-visible Dust</b>	$10 \mu\text{m}$
<b>Common Allergens</b>	$5-10 \mu\text{m}$
<b>Ultrafine Particles</b>	$< 0.1 \mu\text{m}$
<b>Metallic Fumes</b>	$0.3-1 \mu\text{m}$

**Gases and very small particles  
can reach the deepest areas of the lungs**

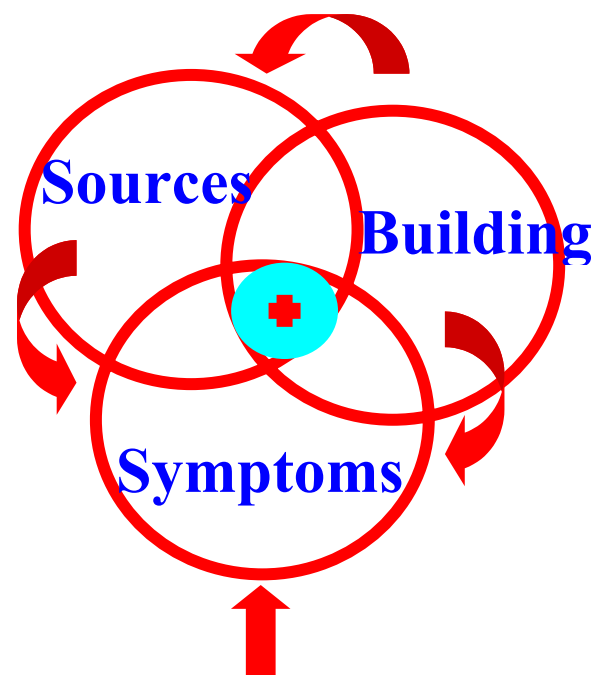
Other routes of entry are through the Skin, which may lead to itching, skin irritation rashes or infection. Another route is Ingestion by swallowing airborne material or eating & drinking substances that have settled on, or been mixed with, food and beverages. Each individual has a different threshold of tolerance to any given substance. Chemical composition, concentration and length of exposure all come into play. Consequently, reactions vary greatly from person to person.

Typical symptoms will, therefore, vary accordingly to individual sensitivities and the other variables to give these reactions: -

- Headaches
- Irritated skin
- Irritated eyes
- Sneezing
- Coughing
- Difficult breathing
- Inability to work

These symptoms should not be swept aside with dismissive treatment based on a couple of aspirins or a sticking plaster. It is essential to find the sources of pollution and control them. But first, you have to find them! Simon commented that this was best done by a systematic process, looking at these three elements.

Simon described one case where fumes were present in the corridor of a large office block and the staff felt unwell. The fumes rose to a peak at 3.00 pm and this area was compared to adjacent spaces where people felt unaffected. Eventually the source was identified as a ventilation grill that pulled in air from the street outside on a road junction that was busy at rush hour.



Any IAQ Investigation should contain these main Elements: -

- Get approval to conduct a walk-through survey
- Interview those affected
- Take measurements outdoors
- Learn how air is conditioned and distributed
- Set Goals for Indoor Levels
- Identify exceptions to expected levels – higher AND lower
- Follow readings to the exact source
- Document and report results

Simon commented that contaminants could be controlled by the use of Differential Pressure, which was a powerful tool in managing IAQ. Contaminants will also go from high to low differential pressure and most problems will be solved by the use of positive pressures.

But first you must understand and control the pressures between indoor spaces to prevent the migration of unwanted contaminants. In this context it is also important to understand the significant effect that strong prevailing winds may have on air entering the building randomly through unintentional openings. These may well compromise air-handling or ventilation systems and opening windows is definitely not a good idea, no matter what the temptation!

Simon went to describe how photocopiers caused many problems because they were a source of particulates. He also described one Foundry office which had a serious problem and this was cured by installing a fan with a particulate filter to maintain a positive pressure inside to keep fumes outside! He went on to describe another office where there was a Carbon Monoxide problem. The source was eventually identified as a car park and the fumes were being sucked in through an electrical conduit and a socket outlet box that had been installed without a grommet around the incoming cable!

He concluded by saying that most problems revolved around Temperature, Relative Humidity or Carbon Dioxide problems!

## Members' Questions

**David Hughes of David Hughes Business Services** asked about dealing with foundry dusts and Simon replied that it was important to take measurements at the Air Handling Unit. He added that it should be fitted with a High Efficiency Particulate Arrestor (HEPA) to take out the Respirable Particles.

**Dalvinder Masaun of Sandwell and West Birmingham Hospitals NHS Trust** asked if extensive training was needed to use the instruments. Simon said that because they were all “Plug-and-play” designs they were easy to use with minimal training. Dalvinder continued with another question about the relative merits of buying instruments or paying for a consultant survey. Simon advised that 80% of problems were temperature related so it may be appropriate to invest in a thermometer! But it depended on what the problem was and how often it might be repeated.

**Peter Evans** commented that a photocopier he had seen recently was placed with its vent against the wall and there was a distinct possibility of O<sub>3</sub> pollution. In addition, the settings on some air-handling units had been altered frequently over the years in an uncontrolled fashion at the whim of the occupants, so that they may now be unbalanced. Another problem was that the O<sub>3</sub> pollution varied in proportion to the copy volume and was difficult to measure. Simon advised that a Data-logging instrument should be used to give real-time readings of the variations in O<sub>3</sub>.

**Chairman Mark Hoare of Birmingham University** commented on the need for consultation over the design of a new building and cited a call centre. Simon replied that there were no absolute standards, it was not regulated and there were no recognised qualifications! His best advice was ‘beware of experts’ and keep things simple!

**Dennis Walley of Homeserve plc** asked about the effect of static electricity on IAQ and what effect Ionisation had on Health. Simon said that he was not certain what effect ionisation really had although he knew that Ultra-violet light was used in ducts to kill bacteria. However, he warned, the air speed of 5 m/sec was too fast for the UV to be effective, so he thought this equipment was overrated! A much better approach was to clean the ducts regularly.

**Jim Hathaway of Beiersdorf UK** asked about the threshold level for Carbon Dioxide. Simon said that the level in the room was about 7.5 ppm greater than outside, which indicated that the BMI hall was not adequately ventilated!

As there were no more questions, the chairman closed the meeting with thanks to Simon for a very informative talk and asked the members to show their appreciation as well.