INVESTIGATION OF INDOOR AIR QUALITY COMPLAINTS

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1. ABSTRACT

There are a large number of contaminants that may be present in the indoor environment. The levels at which these may impact upon the building occupants' comfort and well-being is often significantly below workplace exposure standards. There are also physical factors which may impact on the comfort and well-being of building occupants.

For this reason, recognition of the cause of indoor air quality complaints is often complex. The assessment strategy is dependant upon the type and consistency of occupant complaints. A broad range of tests are used to identify potential problems when complaints are general and non-specific. If complaints are specific then inspection of the site combined with specific confirmatory tests is a more effective technique. Two case studies illustrate these assessment approaches.

2. INTRODUCTION

The quality of indoor air has been directly affected by the ever increasing desire to minimise costs associated with the operation of ventilation systems. As a result outdoor air ventilation rates have tended to be minimised and buildings have been made "tighter" to reduce costs associated with heating and cooling (Perhac 1985, Weschler et al 1989).

The advent of alternative building materials such as pressed wood products and plastics have introduced more potential pollutants into buildings (Mage et al 1985).

The quality of indoor air and potential health risks are of major concern to building occupants and in particular to office workers who often have limited control over their work environment. The time spent indoors at work for many people has been estimated to be approximately 20% of their time, with a further 60 to 70 % being spent indoors at home and other locations (Harris et al). This emphasises the importance of the quality of indoor air with regard to the comfort and well being of indoor workers.

As a result of occupant complaints occupational hygienists are often called upon to investigate the status of air quality of occupied buildings.

3. DISCUSSION

In investigation of indoor air quality problems the first consideration, after clarification of the issues, should be the choice of an investigation technique or a methodology. Another point for consideration is relevant standards, i.e.'what are the results of any testing going to be compared with'.

3.1 Methodology:

The methodology used to investigate indoor air quality is related to the type of problem being experienced by building occupants. Indoor air quality problems can be classified by the types of occupant

complaints, these can be classified into two types:

Specific Complaints eg. an odour or sore eyes.

Non-specific Complaints eg. stuffy, too hot and headaches.

The sampling/assessment methodology should be tailored to match the occupant complaint type.

For specific complaints the primary assessment tools are inspection of the site and interviewing of occupants. In addition to the building occupants support staff or associated persons sometimes need to be interviewed, eg real estate agents. Specific monitoring may be done to test or support hypotheses.

Where complaints are general a broad range of screening tests that target the major causes of problems in buildings (Gorman et al 1989, Wakelam et al 1994) can be useful. A range of tests that can be utilised in screening for the potential causes of indoor air quality complaints are:

- *Temperature*: indicative of thermal comfort
- *Relative Humidity*: associated with thermal comfort. Also low humidity can be associated with complaints of dry, irritated throats and eyes, and it may aggravate persons predisposed to sinus problems.
- *Air Supply Rate-Direct*: A flow meter can be used to measure the outdoor air supply rate per occupant.
- *Air Supply Rate-by CO_2 measurement*: this is a measure of the outdoor air supply rate per person (Spengler et al 1991) as well as a measure of the local distribution of outdoor air vs stale air.
- *Inspirable dust*: can be indicative of performance of HVAC filter performance or integrity, or may be indicative of dust sources within a building.
- *Bioaerosol testing*: Increased bacterial levels can be indicative of overcrowding within an enclosure. Increased bacterial, yeast or mould levels may be indicative of microbial colonisation of building environs.
- *Other Tests*: Carbon monoxide, ozone, lighting and noise.

As a matter of course during the testing, the site is inspected and the personnel are interviewed. An informal manner is often useful in eliciting information from building occupants. The air conditioning system should be inspected to ascertain its layout and performance. Building engineers or managers, where present, are a useful source of information and can often provide a summary of the systems form and function. One of the main points of inspection should be the outdoor air intake/s. The location of these relative to potential contaminant sources should be checked.

This type of screening can also be useful prior to refurbishment of airconditioning systems to establish baseline indicators.

3.2 Standards:

When results of the tests are available these should be compared with relevant guidance levels and the symptoms/complaints of the building occupants. Unfortunately there are no internationally accepted standards for defining acceptable indoor air quality. Standards and guidelines have been developed by many different groups and organisations across the world (Spengler et al 1991). Thus there are a wide range of choices available to compare with test results. Some of the more widely used guidelines in Australia are from the following groups: National Health and Medical Research Council, Standards Association of Australia, the American Society of Heating, Refrigerating and Air conditioning Engineers, and the International Standards Organisation.

3.3 Presentation of Results

Reporting of indoor air quality assessments is similar to reporting of other occupational hygiene assessments. However more detailed explanations are generally required due to the variety of standards and guidelines available and the scarcity of toxicological data which other hygiene standards are usually based upon. The question of health effects versus comfort criteria must also be considered.

3.4 Case Studies:

3.4.1 *SPECIFIC COMPLAINTS*:

A chemical odour reminescent of an organic solvent was reported to be present in the ground floor of a 7 storey inner city building. The building had a central lift shaft, a lower basement carpark and a lower basement area where services were housed. There had been no refurbishment work done within the last six months. On initial appearance of the odour a number of employees working in the area complained of nausea and headaches. As a result this area had been evacuated and locked up. This area was a general access area for members of the public. The area remained unoccupied for the next three days before occupational hygienists were contacted. The question initially posed by the client was "*Can employees safely re-enter this area*", not " *What was the odour*", however this question was important in determining the answer to the clients question. The client in this case had limited funds to commit to the investigation, thus sampling was kept to a minimum with the focus on inspection and interviewing.

On inspection no odour was detectable in the main foyer, but an odour of aromatic hydrocarbons was just detectable in the toilets and appeared to be emanating from the wall cavity. The outdoor air intakes were inspected,and the real estate agent was consulted as to whether any works, eg painting, had been done within the building. Initially the response was negative, on call back it transpired that a part of the basement had been treated with a concrete sealant (Shellac) prior to the problem occurring. This area had a similar odour to that noted in the toilet area and was thought by occupants to be similar to the original odour. It should be noted that the real estate agent had been consulted by the occupants on at least two occasions prior to the hygienists involvement.

Due to the odours being similar in the different areas and the air flow patterns due to lift action etc. it appeared that the source of the odour was the concrete sealant in the basement. Confirmatory sampling would have been useful however the client requested minimal sampling, thus only one sample was taken in the main work area to confirm readiness for reoccupation.

3.4.2 *NON SPECIFIC COMPLAINTS:*

The two storey building was originally an old factory which had been converted into an office complex in the 1970's. The current occupants had, on initial occupation, significantly modified the ventilation for the ground floor cinema area, which was seldom used. However few modifications were made to the ventilation for the upper storey office area where most employees were housed.

There were a range of complaints ranging from thermal discomfort to headaches, stuffiness and complaints of general ill health.
In this case the question asked was "what is wrong with the air in the building"

Due to the non specific nature of the complaints a range of air quality indicators were measured. Lighting levels were also checked as the hygienist percieved the area as "gloomy".

The first problem identified was the lack of planned outdoor air intake into the building. Therefore no direct measurement of the outdoor air supply rate was possible.It was observable that there were a number of areas where outdoor air would be introduced into the return air plenum (the ceiling space). The carbon dioxide levels were between 500 - 700 ppm indicating that the outdoor air entering the building was adequate to prevent carbon dioxide build up (Spengler et al 1991, Standards Australia 1991).

The lighting in a number of interior areas was provided by downlights and this was generally found to be inadequate. The thermal enviroment was at the upper limits, due to capability of the air handling units.

In two of the areas monitored the airborne mould levels were found to be elevated (i.e. above 200 cfu/m^3) indicating possible mould colonisation within the building (Wakelam et al). Further investigation resulted in the identification of two mould colonised areas. Recommendations were made for cleanup and isolation methods. Follow up testing in the same locations gave results below the detectable limits (i.e. less than 3 cfu/m^3).

4. SUMMARY

To streamline the assessment of indoor air quality problems the investigation technique should be matched to the complaint type. For specific complaints a focused investigation technique is often effective with regard to investigation outcomes, time and cost. When complaints are general or non-specific a broad screen of tests can be useful in checking for the major problem types historically identified as being associated with indoor air quality complaints (Gorman et al 1989).

5. REFERENCES

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