THE PERCEPTION OF INDOOR AIR QUALITY

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In considering the question of indoor air quality, it is necessary to draw a clear distinction between health and comfort effects.

Health or more usually ill health means many things to different people. For the purposes of this paper ill health is defined as the presence of clinically observable adverse effects. As an example a respiratory allergic effect due to moulds in the air is ill health. A feeling of lethargy, frequently cited as a symptom of sick building syndrome, is not regarded as ill health. Therefore from now on this paper will mainly deal with effects on the body which do not produce symptoms of ill health but nevertheless do affect how the occupants of a space perceive the quality of it.

The stimuli to which the body respond are:

1) Sensory

a) Acute stimulation of senses
(Olfactory)
(Chemical)
(Skin - thermal)

b) Inflammatory
(Mucous membrane)

c) Sub-acute stress reactions

(Increase in stress hormone levels)

(Increase in blood pressure)

(Fatigue, lethargy)

(Irritability)

(Decreased productivity)

(Lack of job satisfaction)

(Increased absence)

2) Psychological

(Education programmes)

(Media)

3) Fear of adverse health effects which may be real, unproven or non-existent

(Asthma)

(Impaired lung function)

(Cancer)

(Coronary heart disease)

The main perceptual factors are the acute stimulation of senses and the inflammatory processes.

Within the office situation, the one with which I am most familiar, undoubtedly the major contributor to perception of good or bad conditions is the thermal environment. There are six inter-related factors which combine to give a satisfactory thermal environment. They are:

Air temperature

Rate of air movement

Radiant heat received from or lost to the surroundings

Relative humidity

The metabolic activity of the subject

the heat insulation value of the subjects clothing

Fanger (ref. 1) has produced an equation relating these factors and this can be used to predict the acceptability of any particular thermal environment. It is interesting to note that no particular condition will satisfy a randomly chosen population, The best result that can be obtained is that 5 % will still be dissatisfied. There are other, less precise, indicators of the thermal environment e.g. Corrected Effective Temperature, but Fanger's equation is undoubtedly produces a more reliable result.

Odour is an important factor in the perception of indoor air. This unfortunately is difficult to quantify. The most rigorous approach is that of Fanger (ref. 2)who has used trained panels of 'sniffers' to quantify the acceptability of indoor air from an odour point of view. He has introduced two units -the olf as a unit of source strength strength and the pol (decipol in practical units) as a unit of concentration, Whilst a valuable research tool the concept is difficult to apply as an everyday investigational method. The usual way of controlling odours is firstly their reduction by correct choice of low emission building and furnishing materials. The work of Fanger provides a suitable basis for comparison. Secondly, strong odours such as traffic fumes, cooking odours and tobacco smoke, especially pipe and cigar smoke, can be reduced or prevented from entering the space. Thirdly, sufficient ventilation can be provided to dilute remaining odours to an acceptable level. The ventilation recommendations of the current ASHRAE Standard (ref. 3) are reasonably effective. Some contaminants, notably those due to moulds, fungi and possibly metabolites of these besides producing an odour can also have severe respiratory effects and control, preferably elimination, of these is vital for health rather than comfort reasons.

Some compounds given off by modern building and furnishing materials and the activities of the occupants produce mucous membrane inflammation. Formaldehyde is one such compound and there are a whole range of volatile organic compounds which are present in room air. There is considerable controversy as to the levels which are desirable. From a perceptual point of view, the proposals of Seifert (ref. 3) which proposes limits by class with an overall limit is probably the best. The WHO proposal for formaldehyde of 0.1 mg/m^3 is a good one to follow for this particular chemical.

The psychological aspect is important. Media treatment of such items as sick building syndrome, actually a very rare occurrence, undoubtedly produces a lot of unjustifiable complaints. One interesting psychological aspect is that of expectation. There are two main population groups, those occupationally exposed and the general population. Those occupationally exposed are a selected group characterised by being fit enough to work and of a limited age range which excludes the young and the very old . Additionally their period of exposure to the work environment is probably less than 25% of their total indoor exposure. The general population includes infants, the young, the very old and the chronically sick. There is an increasing tendency, mistaken in my opinion, to regard the office population as different from the industrial population. This is not correct with regard to health effects of air pollutants although expectations may well differ with regard to comfort aspects. In general, the expectations of office workers will be higher than those of industrial workers.

To meet these expectations some form of societal control or guidance is obviously desirable, if only for the promotion of well being. Health aspects are best controlled by legislation embodying exposure limits. This approach has worked well for workplace chemicals and could in theory be applied in a modified form to concentration levels in public buildings, with a suitable adjustment for the different populations involved. Inherent in this is the need for reliable epidemiology at the low levels encountered. To a great extent this reliability does not exist. Therefore guidance rather than legislation is perhaps the way forward combined with indirect control by design and building regulations.

There is an interesting difference between the approaches on radon and environmental tobacco smoke (ETS). Taking the most pessimistic figures

epidemiologically derived for lung cancer due to ETS (a figure some 2 orders of magnitude greater than indicated by dosimetric considerations) the radon risk is some 10 times higher. Despite this most European countries are taking very little action to either educate the public or to deal effectively with the control of radon in the existing building stock, whereas there is considerable action directed towards the control of ETS. Whilst there are many reasons for this differeence, one must undoubtedly be that radon is odourless whereas ETS has an odour.

On a long term basis the indoor contaminant concentration due to outdoor factors must tend to reach a state of equilibrium with the outdoor concentration. These outdoor contaminants are one of the major causes of indoor pollution and it is therefore necessary to control them, Unlike indoor air quality aspects it is practicable to apply legislative controls since the different sources are relatively few in number. In exercising control care must be taken not to replace one risk by another. For instance, lead from automobile exhausts is now very strictly controlled. This has resulted in an increase in benzene levels in the ambient atmosphere. Catalytic converters are necessary to control this, but it will be some years before the entire existing stock of automobiles are replaced

In conclusion, it is considered that the role of direct legislation in laying down contaminant concentrations for the control of air quality is limited. It can be used for the prevention of ill-health both in the control of occupational exposure and for control of the external atmosphere.

Control of factors that the occupant perceives to be important in terms of satisfaction with the indoor environment should not be done by direct legislation but by indirect legislation using design and building regulations backed up by correctly informed societal pressure.

REFERENCES

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