

# Picking up the scent

Healthy Buildings '88 focused on the solutions and requirements for a healthy indoor climate. Building services engineers now have a new design tool, the sniff factor. *Bill Holdsworth* explains.

**A**t the Healthy Buildings '88 Conference in Stockholm, in September, the human nose dominated the proceedings. In hushed tones we were informed that the World Health Organisation had accepted the human nose as the criterion for judging indoor air quality.

I said I understood, thinking of the time when I had been asked to investigate the smell of academy cabbage - a stale smell that gently wafted from the sub-basement kitchen at the Royal Academy of Music in London, up the majestic staircase. It was found to be caused by grease-clogged ductwork and the vanished fan.

Whether the smell of cooked cabbage has affected the quality of both classical and pop music these last 15 years would be hard to determine, but all could change with the introduction of the olf and the decipol, two units which quantify air pollution perceived by humans.

We breathe air for life. We smell the air and when we are at the seaside or walking across hill land we take in great gasps of it, saying how good it is to get out of our lungs the contaminated air of our cities and towns. We have built up a large history of knowledge on the injurious effects of external air polluted by car exhausts, factory discharges, radioactive seepage and the cocktail described as smog.

Our knowledge in dealing with indoor air, however, is not so extensive. As engineers we believe that we have created a well tempered environment. Filters are used more often to stop the heater battery from getting clogged. We may also wash, heat and cool the outside air. Then we mix it in the interests of conserving energy and that seems to be the end of the matter.

Yet for all our cleverness we are discovering more and more that the buildings we are building are proving to be not so healthy to live in.

Modern techniques of analysis can detect many hundreds of pollutants in indoor air which are hazardous to health and cause sickness in many people. Drops of liquid chemicals, fungal spores, organic and inorganic solid particles have all been found to trigger headaches, nausea, depression, muscle spasms and much worse. Excessive contact with Lindane and Dioxine, biocides found in many wood preservatives can lead to toxic induced personality changes.

Recent studies of builders and diy enthusiasts at the Burger Hospital in Stuttgart have proved that toxic agents in both spray and brush products attack the nervous system. The germination period is between 10 and 12 years. Exposure to formaldehyde in domestic and office environments has produced similar syndromes. Medical institutions throughout the world have yet to find a proven method of therapy for this environmental disease, apart from avoidance of the toxic agents. A drug called Nootrope is giving some patients a degree of hope.

Although our sense of smell is not always reliable, it does serve as a warning for both known and unknown dangers in the air. In quantifying air pollution sources and to provide a basis for identification Prof Franger, at the Laboratory of Heating and Air Conditioning, Technical University of Denmark, decided that human senses are usually superior to a chemical analysis of the air. The mucous membrane of the nose determines whether air is stuffy or fresh and whether it is a source of irritation.

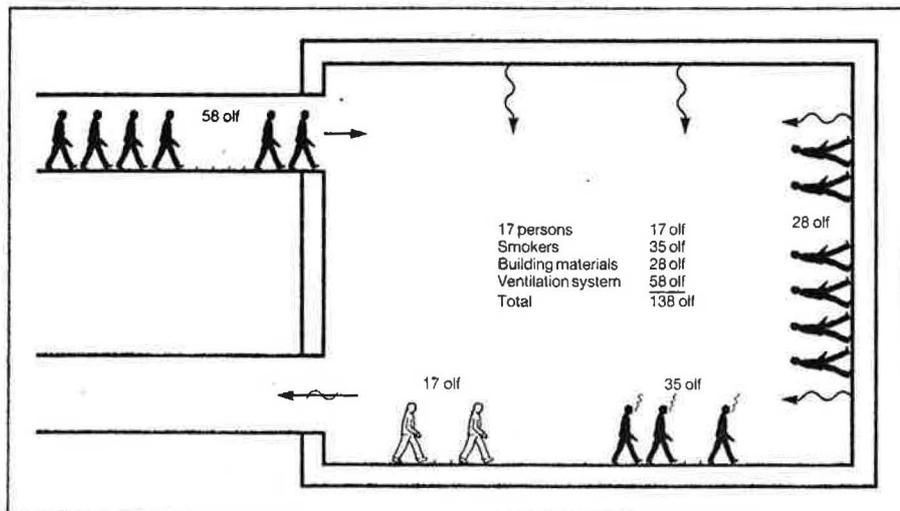
From a study of the bioeffluents of people, the unit olf was derived as being the air pollution from one standard person, ie an adult sitting in thermal comfort with a standard hygiene of 0.7 baths/day. The decipol has also been introduced to quantify air pollution perceived by humans. 1 decipol is the pollution caused by one standard person 1 olf ventilated by 10 litres/s of unpolluted (a slight misdemeanour) air. The olf unit is analogous to lumen and Watt. The decipol is analogous to lux and decibel sound ratings.

The next step was to use these two new units of measurement. 20 randomly selected offices and assembly halls in Copenhagen were visited three times by 54 judges. To begin with the buildings were unoccupied and unventilated. Next, the buildings were still unoccupied, but ventilated. To determine pollution by both occupancy and smoking, the final visit tested a fully occupied and ventilated building.

Using the sniff technique, severe air pollution sources were quantified by the olf unit. There was a definite olf increase with smoking and further increases were observed when ventilation rates were kept to the minimum recommended for energy conservation.

Slowly the picture built up of injurious compounds used in air filters and in materials for sound, heat and cooling insulation. Outgassing from synthetic building materials, as well as carpets, furnishings and other paraphernalia of living could also be measured. The assumption that our ventilation standards and quality of manufactured components produce clean and relatively unpolluted internal atmospheres is now questioned.

While some people have been sniffing in laboratories in Denmark, others have been sniffing, testing and analysing the sickness that seems to be an unwelcome ingredient of controlled indoor environments. Papers were proffered from Hun-



Addition of olfs for common indoor pollution sources.

Material/Combination	decipol
Chipboard	2.4
Synthetic carpet	3.4
Painted Gypsum	2.1
Sealant	3.0
Lacquer	3.7
Bioeffluents	3.2
Tobacco smoke	14.4
Chipboard + 1/2 syn carpet	2.3
Chipboard + 1/2 painted gypsum	1.6

J Lauridsen, P Jørgensen, et al Lab. Heating and Ventilating Technical University of Denmark.

gary, Finland, Turkey, Japan and the USA. I was particularly impressed with the diligence of Dr Sherry Roger's work from the Northeast Centre for Environmental Medicine, Syracuse, New York State. She found that tighter buildings often had increased fungi spores. Fungi produce some of the most potent toxins, hallucinogens, and antibiotics known to man. They thrive in conditions where no other living organism can. Asthma, migraine, and sinusitis caused by fungi were found to diminish after an improvement in environmental control in 500 locations. The improvements range from a thorough cleaning of all surfaces to the removal of carpeting.

It was found that an increase in ventilation of air filtered with electrostatic precipitators and careful use of building components led to better health, not only from the reduction of fungal deposits but also from the reduction of chemical and other toxic emissions. Thousands of cases have now been documented, and the results are giving all of us in the construction industry some clear pointers.

One example is the case of a 39 year old consulting engineer who moved into a custom-designed, energy efficient new home with carpeting and particleboard subflooring throughout. Six months later he experienced joint pains, headaches, and general sickness.

In spite of treatment, a year and half later his condition had deteriorated. Finally he became a patient of Dr Sherry Rogers. It was found that his blood serum level of formic acid (a metabolite of formaldehyde) was 10 mcg/ml after a weekend at home and 6 mcg/ml after a couple of days away. Other sicknesses were also related to emissions from his ideal home. It was found that the house similar to millions of others, had pollutants that were all above the standards set down by ASHRAE and other agencies.

It would be foolhardy for anyone in the UK to pretend that such conditions do not exist here. They do. Unfortunately our standards of control are far behind those of the USA and the Scandinavian countries. The diagram and attendant table, on the previous page, show where hidden pollutants (olfs) can hide, and the levels found in the first series of materials to be checked. It may bring tears to the eyes of marketing consultants to be told to throw out the carpet, but it does mean that clients and developers whether private or public will find themselves having to ask many more questions of their designers in the future.

As I walked around the poster display stands and listened to some of the many workshop debates I felt that many of us in the building industry had lost our way. We had lost sight of the fact that a building is for people to live in.

We tend to live in enclosed spaces some 80% of our lives, but for reasons of cost cutting or energy efficiency or simply more profit we have reduced the volume of air within living space. Starter

homes have been reduced from 1500 to 685 ft<sup>2</sup> in the last few years. Wall-to-wall carpeting and tight fabric skins have reduced the flow of air further.

I found that a number of scientific papers were telling me what I had learned as an apprentice just after the 1939-45 war: that buildings should have where possible improved natural ventilation; that mechanical systems should have low velocity primary filters to get rid of the grit and that electrostatic precipitators were more beneficial to reduce pollutants. The wheel was being reinvented. The industry was being asked to go back to basics.

An architect from the USA described the controlled environment systems for the new building of the Environmental Protection Agency in Washington DC (the old building being very poorly indeed). He talked of openable windows, openable clerestory lights, air that had been washed and passed over eliminator

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plates, electro-filtered and then again carefully filtered on the return before mixing, then induced from a floor plenum, displaced ventilation, desktop task lighting and desktop personal jet nozzles were all the new thing.

So it is time to put to one side the upmarket catalogues and return to first principles. Our many codes of practise will need to be reviewed, there are no codes for out-gassing and more attention must be paid to the way we design, install, and operate the hvac systems. Manufacturers' data must be critically evaluated which will mean clients paying their advisers for information obtained from sources outside of their normal field, namely the medical profession. Advisers must be given time to investigate in depth. I believe that the introduction of percentage fees leads to the cutting of many corners. Equally, the tendency of architects and design and build contractors to cut out the consultant as if he was some superfluous middleman takes away the very person who is trained to think from first principles.

Another element in the Conference was a sense of a "greening" of architecture and of building services engineering. An ecological change of direction was taking place in the conference hall similar to that on the streets of Stockholm, where indications were that the Green Party could dominate the Government.

Over 40 papers called for a reintroduction of older more traditional ways of construction and habitation.

Intelligent solutions to the creation of separate spaces provide rooms which, by simple adaptation, are cool in summer and warm and comfortable in winter were illustrated from Turkey, Japan, China, Australia. All these countries have extremes of climate but in all the traditional craft of building habitations was to allow them to breathe. There was the deep understanding that a building needs air to freshen it, it needs to be shielded from harsh temperatures, and be able to deflect the wind and exclude harsh sounds.

In the search for healthy buildings some new voices seem to be saying, stop, think again. Let us look at what the ancient civilisations had to offer. It seems that in our rush of the new sciences of European Culture we lost on the way something precious.

There are many equations to answer in the building of buildings which are healthy. They do not have to be expensive. But neither must they be built on the cheap. On return to London I happened to hear Doug Shaw, director of the London Regeneration Consortium, developer for the giant King's Cross site say to a local Housing Association meeting. "Successful developers must not build slums for tomorrow, they must have a social responsibility... that it was essential to use construction techniques and materials that will enable buildings to be erected faster."

In London, we are witnessing the fastest rate of change that any city in the world has ever experienced. Not only can we see massive office buildings rocketing up in the City, but soon the development of the Isle of Dogs will challenge New York's skyscrapers. Legislative controls are thrown out of the window, everything is fast, fast. Fast for profit, fast for regeneration, may result in a collapse of the infrastructure and create even more sick buildings. Throwing writs at architects is not the way to stop the drift into producing indoor urban climates that future generations will find unhealthy to live in.

Social responsibility for every member of a nation's community should be part of our awareness as engineers. After all we have to occupy the buildings we are erecting.

One important and immediate step to ensure a future healthy comfort environment would be for the CIBSE, together with occupational health institutions, trade unions and government agencies to support the introduction of the olf and the decipol. We shall then know what a client means when he asks the building services engineer, "Do you have a nose for it?"

The three volumes *State of the Art Reviews, planning, physics and climate technology for healthier buildings and systems materials and policies* are obtainable from the Swedish Council of Building Research, Stockholm, Sweden.