Olfbar

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Introduction

An olfbar is a place where different qualities of air may be perceived. It was first established at the Healthy Buildings conference in Stockholm to demonstrate that air polluted by materials or components in buildings may often not be acceptable for human beings. These materials and components, ignored in ventilation standards all over the world, pollute the indoor air and make the air stale, stuffy and irritating.

Chemical and physical investigations have frequently not been able to identify reasons for complaints on bad indoor air quality. In many cases the human senses are superior to chemical analysis in assessing air quality. The judgements of human beings can be used besides chemical analysis to evaluate air quality.

The quality of the air served in this olfbar was measured in decipol by a selected, trained panel of judges.

The Human Nose

The striking factor of the human nose is its extreme sensitivity to low concentrations of chemical substances in comparison with the performance of many physical instruments.

To be perceived, a molecule must be volatilized from its source and inhaled into the nasal cavity. In the nose two senses are situated (fig.1), the olfactory sense, which is sensitive to odorants and the common chemical sense, which is sensitive to irritants in the air. The perceived air quality is a combination of odorants and irritants sensed in the air.

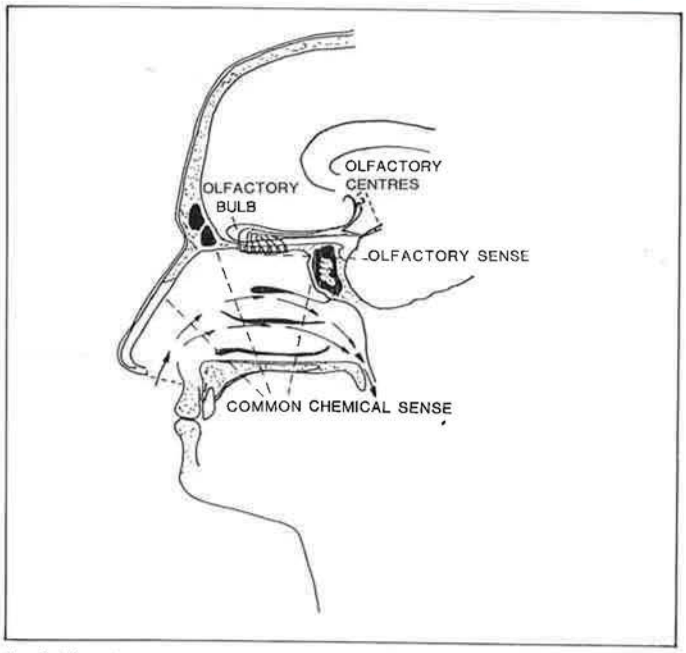

fig.1 The human nose

OLF and DECIPOL

Two units, olf and decipol, were recently introduced by Fanger(1), to quantify air pollution sources and air pollution perceived by humans indoors and outdoors.

One olf is defined as the emission rate of air pollutants (bioeffluents) from a standard person (the standard person referred to is the average sedentary occupant who participated in two studies of human bioeffluents (2.3). Any other pollution source is then expressed as the number of olfs required to cause the same dissatisfaction to a visitor as the actual pollution source.

One decipol is the pollution caused by one standard person (one olf) ventilated by 10 l/s of unpolluted air.

Reference Gas

The quality of the air served in the olfbar was measured using a selected, trained panel of judges. They assessed the air quality in decipol by comparison to four known decipol levels established by a reference gas.

Air
Infiltration
Review

Editor : Janet Blacknell

Air Infiltration Review has a quarterly circulation of 3,500 copies and is currently distributed to organisations in 39 countries. Short articles or correspondence of a general technical nature related to the subject of air infiltration and ventilation are welcome for possible inclusion in AIR. Articles intended for publication must be written in English and should not exceed 1,000 words in length. If you wish to contribute to AIR, please contact Janet Blacknell at the Air Infiltration and Ventilation Centre.

Conclusions and opinions expressed in contributions to Air Infiltration Review represent the author(s)' own views, and not necessarily those of the Air Infiltration and Ventilation Centre.

Air Infiltration Review

IMPORTANT
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enclosed

a quarterly newsletter from the IEA Air Infiltration and Ventilation Centre

International Energy Agency — AIVC

Vol. 10, No. 2, February 1989

New People at the Centre

Mark Limb

Mark Limb joined the Air Infiltration and Ventilation Centre shortly after the New Year, as a new member of the technical staff at the Centre. He recently graduated from the Wolverhampton Polytechnic, having gained a BSc Hons degree in Applied Science, majoring in Environmental Science. While in his final year he undertook research relating to the thermal environment of the main Polytechnic Library, with special reference to the comfort and performance of both students and staff at the Polytechnic.

Mark is currently working on a review of the work that has been done in energy conservation, efficiency and ventilation in relation to air quality and comfort. He will also contribute to the Technical Information Service, while developing his expertise in infiltration and ventilation topics, including indoor comfort and air quality studies.

Helen Sutcliffe

Helen Sutcliffe is visiting the Centre from Coventry Polytechnic where she is a Research Assistant in the second year of study for a Ph.D, involved with infiltration and air change studies in large single cell buildings. Whilst at the Centre, Helen will be working on a study of recent research into air change and ventilation efficiency.

Clare Donovan

Clare Donovan joined the AIVC as a part time employee at the beginning of the year. She lives locally and will be assisting AIVC staff with the Technical Information Service.

Inside this issue:

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AIVC

Head of AIVC: Martin W. Liddament,
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Barclays Venture Centre
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Great Britain

2nd fold (Flap A)

Forthcoming Conferences

1. Excellence in Housing '89
   2-4 March, 1989
   Fort Garry Place
   Winnipeg, Manitoba
   Canada

   Further details from:

   Manitoba Energy and Mines
   Tom Akastream
   555-330 Graham Avenue
   Winnipeg, Manitoba
   Canada, R3C 4E3

2. Measurement of Toxic and Related
   Air Pollutants
   EPA/APCA International Symposium
   2-5 May 1989
   Raleigh, North Carolina
   USA

   Further details from:

   Seymour Hocheiser
   Environmental Monitoring Systems Laboratory
   U.S. Environmental Protection Agency
   Research Triangle Park
   NC 27711
   USA

3. Renewables a Clear Energy Solution
   15th Annual Conference of the Solar
   Energy Society of Canada
   19-21 June 1989
   Penicton, B.C. Canada

   Further details from:

   Natalie Gallimore
   Solar Energy Society of Canada Inc.
   Suite 3, 15 York Street
   Ottawa, Ontario
   Canada K1N 5S7

   Tel: (613) 236-4594

4. Building Simulation '89: Technology Improving
   the Energy Use, Comfort, and Economics of Buildings
   Worldwide
   23-24 June 1989
   Vancouver, Canada

   Further details from:

   Dr. Marianne McCarthy Scott
   MCC Systems Canada Inc.
   30 Wellington Street East
   202 Toronto, Ontario
   Canada, M5E I53

   Tel: (416) 368-2959

5. Symposium on Biological Contaminants
   in Indoor Environments
   16-19 July 1989
   Boulder, Colorado
   USA

   Further details from:

   Staff Manager
   Subcommittee D22-05 on Indoor Air
   ASTM, 1916 Race Street
   Philadephia
   PA 19103
   USA

   Tel: (215) 299-5400

6. Progress and Trends in Air Infiltration
   and Ventilation Research
   AIVC 10th Anniversary Conference
   25-28 September 1989
   Hotel Dipoli, Finland

   Further details from:

   Martin Liddament
   Air Infiltration and Ventilation Centre
   University of Warwick Science Park
   Barclays Venture Centre
   Sir William Lyons Road
   Coventry CV4 7EZ
   United Kingdom

   Tel: (0203) 692050

7. Blueprint for a Healthy House Conference
   11-13 October 1989
   Cleveland, Ohio, USA

   Further details from:

   Housing Resource Centre
   1820 W. 49 Street
   Cleveland, Ohio 44102
   USA

   Tel: (216) 281-4663

8. The Sick Building Syndrome
   16-20 October 1989
   Schafergarden, Copenhagen
   Denmark

   Further details from:

   Nordic Institute of Advanced Occupational
   Environment Studies
   C/o Institute of Occupational Health
   Topeliuksenkatu 41a
   ASF-00250 Helsinki
   Finland.

   Tel: 358-0-47471

Healthy buildings

The Building Regulations provide the legislative framework by which basic requirements for the design and construction of healthy buildings are achieved. These are supported by British Standards, Codes of Practice, local bye laws and similar documentation.

Building related illness

The increasing complexity of building services within modern buildings requires careful attention to design, installation, commissioning and ongoing maintenance during use. Lack of attention in any of these areas will lead to operating problems and possible discomfort and illness to occupants. Problems may also be inflicted on members of the public outside the building. The outbreak in summer 1988 of Legionnaires' disease at the BBC building, Portland Place, London, exemplified the extent of such problems.

Provision of heating, ventilation, cooling and lighting in an effective manner are essential for well being.

Sick Building Syndrome

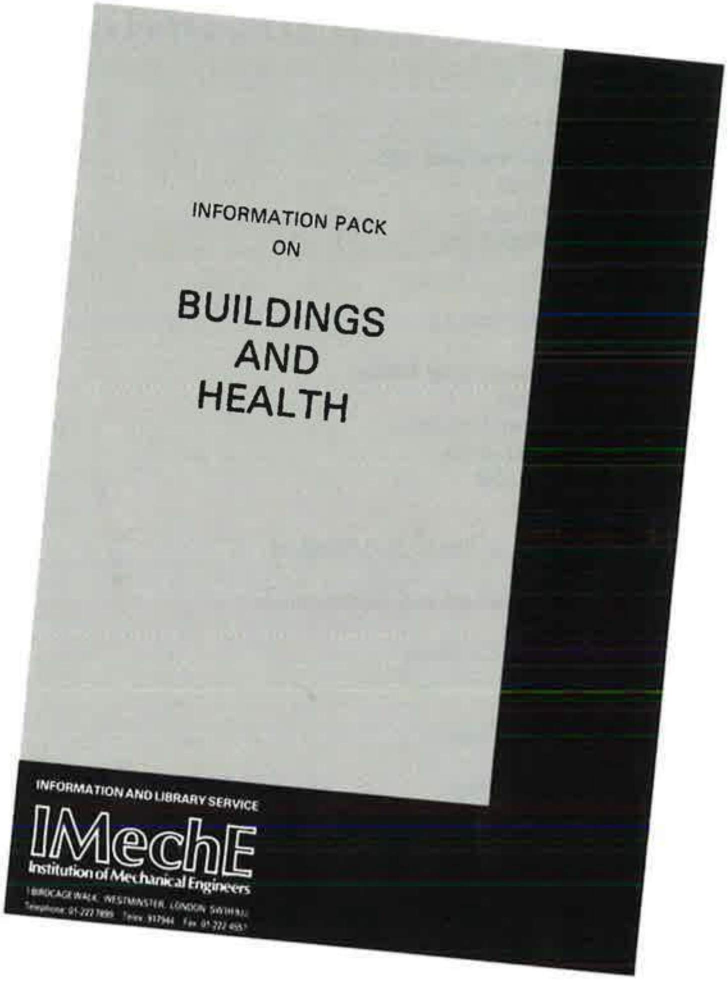
Evidence is rising that even when a carefully controlled environment is provided, levels of illness can be induced. The sick building syndrome questions the basis of the design criteria applied by environmental engineers and casts doubt on the suitability of many modern buildings products and techniques.

Research and development work is progressing, which provides useful data to practising designers and building owners, who are anxious to avoid problems and ensure optimum performance levels from occupants.

Energy Efficiency

Health issues in buildings also affect energy consumption. Reduced fresh air rates save energy but lead to air quality problems. On the other hand, the apparent desire for naturally ventilated buildings reduces the energy use associated with air conditioning systems.

The subject of buildings and health affects us all, whether we be involved in the design, construction or management of buildings or just as occupiers. It is a subject which must be carefully considered if comfort and well being are to be achieved for those who are to live, work and relax in the environment created.



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ON

BUILDINGS
AND
HEALTH

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Book Reviews

BEPAC

December 1988

Papers presented at the BEPAC meeting on June 14, 1988

The second meeting of BEPAC (Building Environmental Performance Analysis Club) was held on June 14, 1988 at the Polytechnic of Central London. The technical presentations made at the meeting led to the establishment of four BEPAC Working Groups, on the subjects of Lighting, Controls, Air Movement and Standards. This publication contains updated written versions of those presentations. It is hoped that this publication will help generate wider interest in the aims and ongoing work of BEPAC. The papers presented are as follows:

The integration of daylighting into building environmental performance analysis.
by Paul Littlefair, BRE Environmental Systems Division.

Prediction of illuminance distributions for uniform and non-uniform lighting.
by Anthony Slater, BRE Environmental Systems Division.

Controls.
by Peter Warburton, Ove Arup and Partners.

Modelling building airflow and related phenomena.
by Geoff Hammond, Cranfield Institute of Technology.

The need for standards in environmental modelling.
by Adam Pinney, BRE Environmental Systems Division.

December 1988

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Membership of BEPAC:
Single £25.00 Sterling
Corporate £100.00 Sterling

Information Pack on Buildings and Health

Compiled by: Annette Watts BSc, ALA

Information and Library Service,

Institution of Mechanical Engineers, September 1988

The information pack contains a selection of material relevant to its subject area. This includes a bibliographical section plus a variety of useful listings, which can range from organisations to standards in the field. This pack contains essential information for the manager, engineer or student who wants an introduction to the problems of buildings and health. It includes organisations, technical literature and standards. Much of the information relates to building services and maintenance, in general, which has a bearing on occupants.

The pack is in two main sections:-

- Buildings and Health Information: lists information sources under a variety of headings.

- Building and Health References: contains over 100 abstracts and details of recently published material.

The document's foreword gives an indication of the subject area covered:

Building and health

Buildings are crucial to our well being. They provide a means by which we shelter from adverse and changeable climatic conditions. In developed countries, buildings provide a great deal more - comfort, security, environmental conditions appropriate to a range of activities.

Clean buildings

Such is the sophistication of developments in technology that buildings can be constructed to achieve extremely stringent operating conditions regardless of external climate. Clean room technology for example is now achieving near perfect sterile conditions at closely controlled temperatures and humidities. This achievement has enabled the production of ever more powerful microchips, and provided the basic building blocks for the development of low cost microcomputer systems.

In medical terms, clean room technology has provided operating theatres with environments so clean that open heart surgery and organ transplant operations can be performed with little risk of infection.

Clean room technology is, however, expensive in terms of both capital cost and running costs.

10. Konferenz des Air Infiltration and Ventilation Centre (AIVC)

25. bis 28. September 1989 in Espoo, Finnland

„Fortschritte und Tendenzen in der Forschung auf den Gebieten von Infiltration und Lüftung“

Die 10. Konferenz des AIVC steht unter dem Thema „Progress and Trends in Air Infiltration and Ventilation Research (Fortschritte und Tendenzen in der Forschung auf den Gebieten von Luftinfiltration und Lüftung)“. Es soll dabei vor allem über neuere Untersuchungen, Ergebnisse und Entwicklungen auf folgenden Gebieten berichtet und diskutiert werden:

Normen und Richtlinien,
Meßtechniken,
numerische Modellsimulation,
Modellsimulation von Raumluftströmungen,
mechanische Lüftung,
Gebäudeauslegung sowie
bedarfsgesteuerte Lüftung.

Die Konferenz wird vom 25. bis 28. September 1989 in Espoo bei Helsinki, Finnland, stattfinden. Dort liegt u. a. die Technische Universität, und Besichtigungen von bekannten finnischen Forschungseinrichtungen sind vorgesehen.

Weitere Informationen und Unterlagen für die Anmeldung von Vorträgen erhalten Sie von der deutschen Kontaktstelle des AIVC

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New AIVC Publications

AIVC-TN-25-89
A subject analysis of the AIVC's bibliographic database - AIRBASE (6th edition)
by Janet Blacknell

The Air Infiltration and Ventilation Centre's bibliographic database, AIRBASE, contains abstracts in English of technical papers covering air infiltration in buildings. The majority of articles are concerned with the prediction, measurement and reduction of air infiltration and leakage rates; also included are selected abstracts of related papers on:

- indoor air quality
- occupant behaviour
- thermal comfort
- ventilation efficiency
- natural and mechanical ventilation
- wind pressure and its influence on infiltration
- energy saving measures
- moisture and condensation

More than 3,000 articles are currently referenced and each can be accessed using a free text retrieval system. Online searches are carried out by the AIVC in response to enquiries on particular topics. As part of this information service, the contents of AIRBASE form the basis of several reports and bulletins published by the Centre. The most important of these is "Recent Additions to AIRBASE", a quarterly bulletin listing all new entries.

This report presents a subject analysis of the entire database and is intended as a reference manual for users wishing to obtain more information on a particular topic. The document also contains a thesaurus of terms which can be used in searching the database.

Copies of this document will soon be available from the AIVC.

AIVC 10th Anniversary Conference

Progress and Trends in Air Infiltration and Ventilation Research

Monday 25th September - Thursday 28th September 1989
Hotel Dipoli, Espoo, Finland

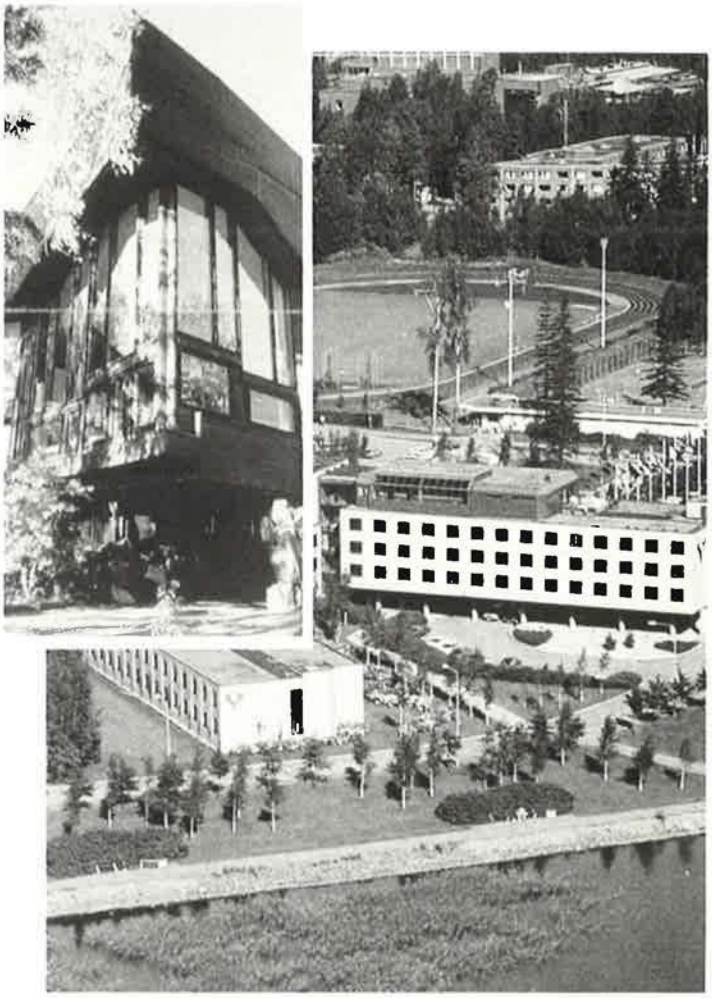
Preliminary Notice

The AIVC's 10th Annual Conference will be devoted to an overview of progress over the last 10 years (poster session) and on new trends and developments (posters and technical sessions).

The subject coverage is intended to be broad but will include:

- standards
- measurement techniques
- numerical simulation
- air flow simulation
- mechanical ventilation
- building design
- air quality
- demand controlled ventilation

The conference fee will be in the region of £450.00 Sterling, inclusive of full board accommodation from lunch on 25th September to lunch on 28th September inclusive.



Conference Delegates

To give us some idea of the number of likely attendees, please would persons who may be attending return the following form to the AIVC. This application is not binding.

Discount air fares, with considerable savings, may be available for flights from Heathrow, London, if sufficient interest is shown. Those interested should indicate on the form below.

Attention Conference Delegates

I am considering attending the AIVC 10th Annual Conference in Finland, September 1989. Please send me full details when available.

Name:

Address:

Signed:

Date:

I am interested in the discount air fare from Heathrow ☐

Fig. 6 illustrates the sequence of events in the normal case when the VAV system is under both temperature and carbon dioxide control. In this case, the room thermostat setting was also 22 deg C. Although the number of occupants was somewhat higher - 51 persons as compared to 44 in the previous case - the carbon dioxide content did not exceed 820 ppm. This is due to the fact that the air flow through the flow controller increased quickly from the original value of 220 l/s to about 500 l/s when the carbon dioxide content exceeded 600 ppm.

As illustrated by the measurements carried out, it is advisable to combine temperature and carbon dioxide control to meet all of the loading conditions that may occur in an auditorium.

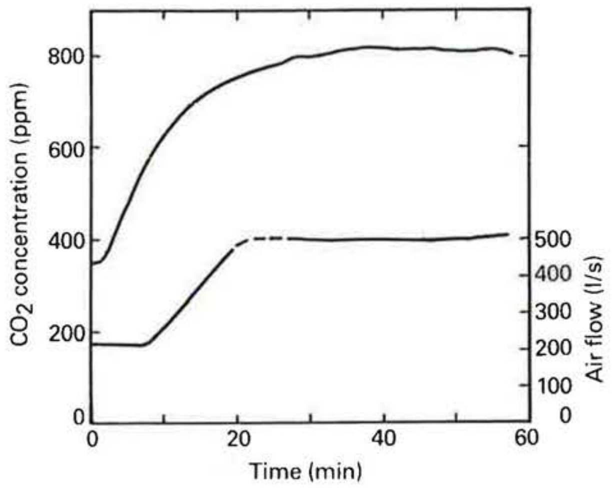


Figure 6. Measured carbon dioxide content and air flow when the ventilation system is under combined temperature and carbon dioxide control and 51 persons occupy the auditorium.

New projects

The measurement programme carried out has demonstrated that demand-controlled ventilation can provide major benefits in premises in which the occupant loading varies more or less unpredictably and in which the activities demand a good indoor climate with good air quality.

In addition to auditoria, these conditions also apply to schools and other educational premises in which strict demands are made on the concentration performance of the occupants, i.e. faculties that are highly dependent on the room temperature and air quality.

The Swedish Council for Building Research is providing support for the planned installation of air-quality controlled VAV systems in schools and similar premises. One such project concerns the modernisation of an existing school. The objective in this case is to control the supply air flow in certain classrooms on the basis of the carbon dioxide content, and to ventilate other classrooms in the conventional way.

Conclusions

In auditoria and other premises in which the occupant loading varies, good air quality can be maintained at minimum energy consumption by adjusting the outdoor air flow to suit the carbon dioxide content of the room air.

VAV ventilation systems which are normally temperature controlled can easily be supplemented with carbon dioxide control.

By continuously monitoring and indicating the carbon dioxide content, information can be gained on whether the rate of air change in a room is satisfactory under various loading conditions. This information should also undoubtedly increase the general conciousness of the importance of the indoor climate.

AIVC 10th Anniversary Conference

Pre-registration

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Control System

A demand-controlled VAV system can very well be employed for both air quality control and temperature control. The VAV system installed in this auditorium is designed in this way. As mentioned earlier, a carbon dioxide sensor is used for monitoring the air quality.

The carbon dioxide sensor and the temperature sensor are both connected to the control unit normally included in the VAV system (see Fig.3). The sensor that controls the outdoor air flow at any given time is dependant on factors such as the occupant loading, outdoor temperature and solar heat loading.

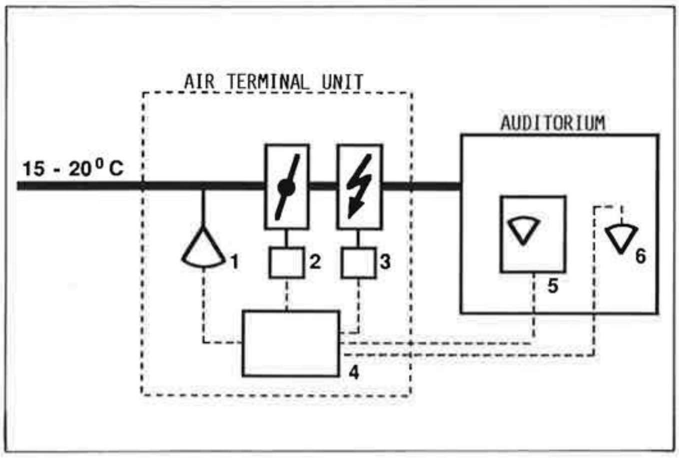


Figure 3. Diagrammatic arrangement of the control system for the auditorium: 1) air flow sensor, 2) damper, 3) electric air heater, 4) control unit, 5) room temperature sensor and set point selector, 6) carbon dioxide sensor.

The carbon dioxide sensor with the associated measuring instrument is the type AROX 425 A of Aritron manufacture. This sensor, which operates on the photo-acoustic principle, is well suited for measuring the carbon dioxide contents occurring in indoor air, i.e. those generally ranging between 300 and 2000 ppm. Moreover, the price of the sensor is justifiable for demand control and monitoring, even for relatively small premises.

The control unit is preset so that the output signal from the carbon dioxide sensor begins to control the air flow when the carbon dioxide content of the room air has risen to more than 600 ppm. If good air quality is to be maintained, such as in an auditorium, it is desirable to restrict the carbon dioxide content to 700 - 900 ppm. Higher carbon dioxide content may affect the attentiveness of the auditorium occupants.

Measurements in the auditorium

Numerous readings of carbon dioxide contents, air flows and room temperatures were taken in the auditorium at different occupant loadings and different outdoor conditions. The measured carbon dioxide contents agree very well with the expectations, based on the assumption that an adult person doing sedentary work emits 15 - 20 litres of carbon dioxide per hour. The conclusion is that measurement of the carbon dioxide content in a room provides a quick check of whether or not the correct rate of outdoor air flow is being supplied to the room.

Fig.4 shows an example of the readings taken in the auditorium, which had previously been empty for several hours. The carbon dioxide content and the air flow increase when 30 persons enter the auditorium and remain there for above one hour. When measurements were started, the carbon dioxide content in the room air was about 340 ppm, which agrees very closely with the carbon dioxide content in outdoor air. The air flow through the flow controller was intially 220 l/s, but increased quickly to about 380 l/s when the carbon dioxide content rose to more than 600 ppm. Due to the increased air flow, the carbon dioxide content in the auditorium was restricted to a maximum of 750 ppm.

Fig 4 also illustrates that a VAV system in which temperature and carbon dioxide control are combined can adjust the air flow very quickly to suit the prevailing occupant loading. The advantage of this combined method of control is also illustrated by Fig. 5 and 6 which show the carbon dioxide content when 44 and 51 persons respectively were present in the auditorium for almost one hour.

In the first case, when the VAV system was only temperature-controlled, the carbon dioxide content increased to about 1020 ppm in 50 min (see Fig.5.). During this period, the air flow through the flow controller did not have time to change, and remained at the original value of 220 l/s. On this occasion, the room thermostat setting was 22 deg C.

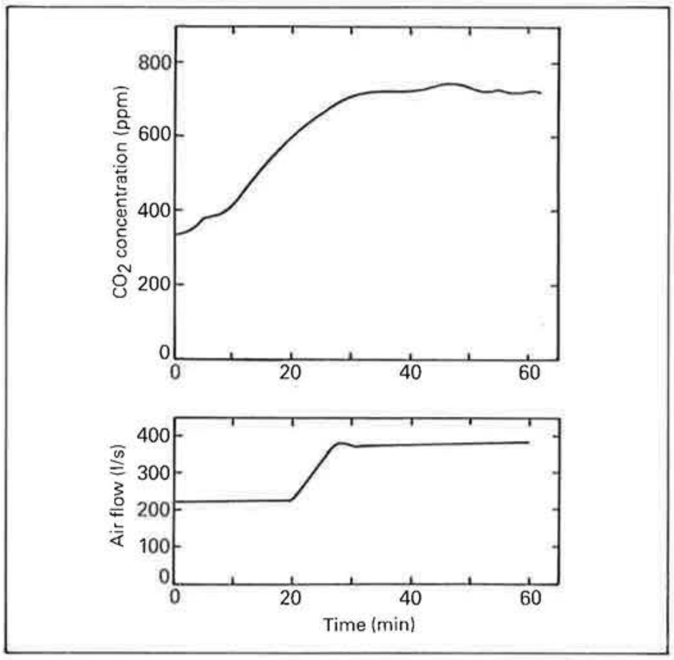


Figure 4. Measured carbon dioxide content and air flow when the ventilation system is under combined temperature and carbon dioxide control and the auditorium is occupied by 30 persons.

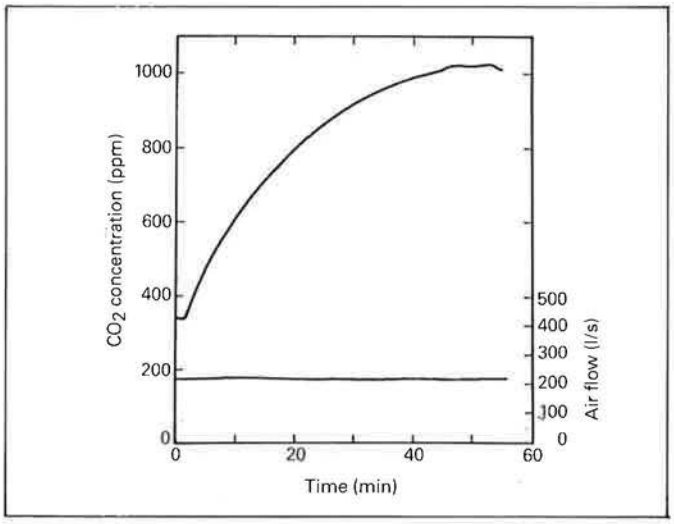


Figure 5. Measured carbon dioxide content and air flow when only temperature control is operative and the auditorium is occupied by 44 persons.

Auditorium with demand-controlled ventilation

Ove Strindehag and Per-Göran Persson
Fläkt Evaporator AB, Jönköping, Sweden.

Introduction

Many of the environmental problems occurring indoors are caused by an inadequate supply of outdoor air to remove the contaminants generated by the pollutant sources in the building. To achieve good indoor air quality, it may therefore be necessary to increase the rate of outdoor air flow, thus also increasing the energy consumption for heating, cooling and distribution of the ventilation air. But good air quality can always be maintained at minimum energy consumption by controlling the outdoor air flow at all times to suit the content of contaminants in the indoor air, i.e. by employing demand-controlled ventilation.

In premises with demand-controlled ventilation, it is usually assumed that the occupants are the principal contaminant source that determines the outdoor air flow rate which should be specified. In such cases, the air quality can be monitored by carbon dioxide sensors.

This article describes a demand-controlled ventilation system in a newly built auditorium at Fläkt Evaporator AB in Jönköping, Sweden.

Particulars and design of the auditorium

The new auditorium which was completed during the spring of 1988 is designed for an occupant loading of 60 persons. The floor area is 100 m^2 and the ceiling height is 3.9 m. The volume of the premises is thus 390 m^3, which corresponds to 6.5 m^3 per person when the auditorium is filled to capacity. The interior of the auditorium is shown in Fig. 1.

Figure 1. The new auditorium at Fläkt Evaporator AB is equipped with an air-quality controlled VAV system.

Air is supplied to the premises at floor level by type DEPB (Fläkt Evalporator AB) low-momentum supply air devices. The exhaust air is extracted through two long slot-type exhaust air devices located in the ceiling adjacent to each long wall. The ventilation system cools the premises, and water radiators are used to supply make-up heat at low outdoor temperatures.

The air quality in the auditorium is monitored by a carbon dioxide sensor located mid-way along one of the long walls, about 3 m above the floor. The carbon dioxide content is indicated on a display unit at the rear wall of the auditorium. The indoor temperature and supply air flow are also shown on this display unit (Fig. 2).

Figure 2. Display unit that shows the room temperature, air flow and carbon dioxide content.

Variable Air Volume (VAV) ventilation system

The auditorium is equipped with a Variable Air Volume (VAV) ventilation system. In such systems, the air flow is normally varied to maintain the required temperature in the premises. However, a VAV system can very well operate as a demand-controlled ventilation system, and the air flow is then controlled to maintain a certain air quality.

Demand-controlled ventilation systems installed earlier in various types of buildings were usually based on Constant Air Volume (CAV) systems with a variable proportion of recirculated air. However, efforts are now being made in Sweden to avoid air recirculation when installing new ventilation systems. By employing a VAV system, the outdoor air flow rate can be varied without the need for employing air recirculation.

The VAV system installed in the auditorium is the OPTIVENT system (Fläkt Evaporator AB). This ventilation system can deliver supply air to the premises at any rate between 220 and 500 Ω/s. In addition, the system supplies a basic flow of 50 1/s which does not pass through the flow controller in the terminal unit that controls the supply air flow.

The supply air is cooled or heated in a central air handling unit to a temperature of 15 - 20 Deg. C, depending on the outdoor temperature. The air handling unit is equipped with a rotary heat exchanger which, in addition to heat, also transfers moisture. At very low outdoor temperatures, the supply air can also be heated by means of a heater in the terminal unit in the auditorium.

The supply air flow rate is measured in the terminal unit by means of an orifice plate and a differential pressure sensor connected to it. As mentioned earlier, the air flow measured in this way is shown on the display unit in the auditorium. The flow controller in the terminal unit increases the air flow on a rise in room temperature or an increase in the carbon dioxide content. But the air flow supplied to the room is not affected by pressure variations in the duct system of the building.

Noise

Noise from mechanical ventilation plant must not exceed the values given in Appendix 1 of the Standard for the various spaces in different types of buildings. Section C1 "Soundproofing" of the National Building Code of Finland includes regulations concerning the total sound level caused by all HVAC equipment in combination.

Ventilation Requirements

These are dealt with in some detail. It mainly deals with the mechanical ventilation in buildings and gives design guidance for both smoking and non-smoking areas. Energy saving considerations are taken into account by giving guidance on how both mechanical and natural ventilation can be controlled. The rates of fresh outdoor air, and recirculated air are defined and values for the various spaces in buildings are given in Appendix 1 of the Standard. Typical requirements for offices are reproduced in Table 2. Tables are included in the Standard for 14 classifications of buildings. Such design aspects as air distribution, air pressures, outdoor air intake, and exhausts are all covered with guidance given. The discharge of exhaust air is based on five separate classifications with examples given of each. Details are given for the distances separating the location of exhaust openings for the different classifications of exhaust air, and the site of other openings or areas in or around the building that the discharge might affect.

Leakage of the mechanical ventilation system is limited to 6% of the total system flow rate at operating conditions. Three classes of air sealing are given for ventilation ductwork operating at different pressures and in different locations.

Performance

The ventilation system must be fully documented with all relevant information supplied. It must be commissioned and tested with permitted variations from design values given. It shall have been designed so as to facilitate the easy cleaning, maintenance and repair operations. It must be furnished with safety protection devices and suitable surveillance measuring devices, and shall be equipped with full operating instructions for the user.

Table 2. Summary of Office Building Requirements.

Space/Use	Air temp.	Eff. temp.	Draft char.	Outdoor air rate (transfer air = s)		Return air rate	Sound level
	°C	°C		$\frac{dm^3}{s,pers}$	$\frac{dm^3}{s,m^2}$	$\frac{dm^3}{s,unit}$	dB(A)
2.1 Office room	21	20	2	10	1		35
2.2 Open office	21	20	2	10	1.5		35
2.3 Conference Room	21	20	3	10	4		35
2.4 Drafting room	21	20	2	10	1.5		35
2.5 Spaces for public service	21	19	4	6	2		40
2.6 Exhibition space	20	18	4	5	1.5		40
2.7 Data processing rooms							
- processor room	21	19	5	4	0.4		55
- printer room	21	19	4	4	0.4		55
2.8 Archive, storage	20	18 (no work area) (s)				$0.35/m^2$	45
2.9 Cafeteria,rest rm.	20	19	3	10	5		40
2.10 Copying room	20	18			1	$4/m^2$	45
2.11 Office corridor, lobby	20	18	5				40
2.12 Smoking room	20	19	3	10	5	$10/m^2$	40
2.13 Classroom	21	20	3	10	4		35

Appendix 2

Covers the instructions and ventilation of Motor Vehicle Shelters, and applies mainly to car parks. They do not apply to vehicle repair or service shops, bus terminals or other spaces of continuous activity integrated with the car parks.

Air leakage of the building fabric

Whilst air sealing of fabric and windows are considered factors affecting the indoor climate, no values of allowable leakage rates are given in this document.

Obtaining Finnish Standards

Information Centres and Authorities Responsible for Standards and Building Regulations.

National Organisations

1. Ministry of the Environment
   PL 306, SF-00531,
   Helsinki, Finland.
   Tel: 90-1601

   Publications: NTNL Building Codes.

2. The Building Information Institute,
   PL 1004, SF-00101 Helsinki, Finland.
   Tel: 90-6944911

   Publications: Design rules and standard solutions.

3. SFS (Finnish Standards Association)
   PL 205, SF-00121, Helsinki, Finland.
   Tel: 90-661 693

   Publications: Product Standards.

4. RIL (The Finnish Association of Civil Engineering),
   Meritullinkatu 16 A 5, SF-00170, Helsinki, Finland.
   Tel: 90-645601

Distributors of Finnish Standards and Regulations
Useful addresses

1. Building Books Ltd,
   PL 1004, SF-00101, Helsinki, Finland.
   Tel: 90-694911

   Distributes all standards and regulations.

2. Valtin painatuskeskus
   Statens tryckericenstral
   (Finnish Government Printing Centre)
   Hakuninmaantie - 2,
   SF-00430, Helsinki, Finland.
   Tel: 90-56601

   Distributes Government Publications.

National Building Code of Finland Indoor Climate and Ventilation in Buildings

Ken Colthorpe

In this article, Ken Colthorpe - a freelance contributor to the AIVC, reviews one of the most comprehensive sets of regulations to be published covering indoor climate and ventilation in buildings. Ken is currently updating the AIVC's work on building airtightness and ventilation standards.

These regulations are binding and replace those of October 1978. They came into effect on 1st January, 1988 and constitute part of the National Building Code of Finland. They apply to all buildings for which permit had been applied on or after that date. Previous regulations and guidelines however could be applied to buildings for which permit was applied before 1st July, 1988.

The regulations are to ensure that a satisfactory indoor climate is maintained in all occupied spaces under normal weather conditions and activities in the spaces. They cover the purity of the indoor air, the temperature and humidity which must be kept under control, as well as draught, noise and excessive radiant heat.

Temperatures

Temperature control in summer is referred to and indoor air must generally not exceed +27 deg C. An allowance is given however when outdoor temperatures exceed +22 deg C for a five hour maximum period. Residential buildings are allowed to deviate from these values.

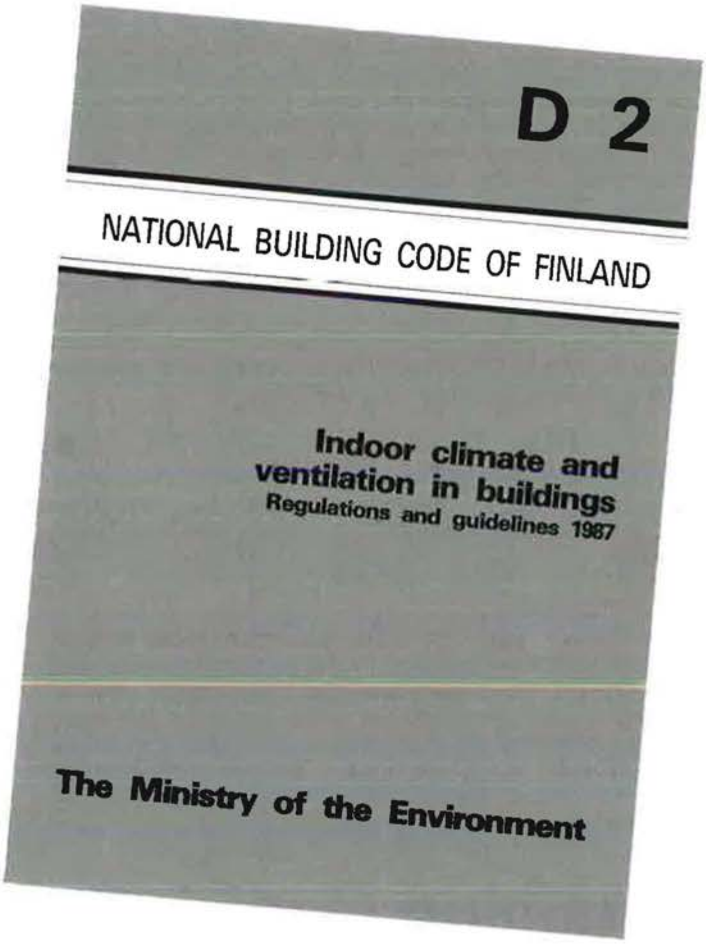
For winter design temperatures, outdoor values are referred to in Section D5 of the National Building Code of Finland "Calculation of performance and energy requirement for heating of buildings", which gives values for various localities. Indoor design temperatures however, are given for different types of buildings in Appendix 1 of its Standard. Effective temperature is also referred to and covers those spaces with large window areas or with radiant heating.

Purity of Air

Impurities in the indoor air must be kept below the guide values given for outdoor air which include sulphur dioxide, nitrogen dioxide, and carbon monoxide. Design indoor values are also given for formaldehyde, radon and carbon dioxide which must not be exceeded. The content of other impurities in non-exceptional spaces shall not exceed 1/10 of the content known harmful in working area air. (Table 1).

Humidity

Humidity levels must be controlled to prevent hazards to both health of the occupants and to the building structure. Some guidance is given on means of control and where humidification may be required.



D 2

NATIONAL BUILDING CODE OF FINLAND

Indoor climate and ventilation in buildings
Regulations and guidelines 1987

The Ministry of the Environment

Table 1. Summary of air quality requirements.

		annual ave.	daily ave.	hourly ave.
Sulfur dioxide	/m³	40	200	500
Nitrogen dioxide	/m³		150	300
Carbon monoxide	mg/m³		10	30
Particles	/m³	60	150	

1) 8 hours

Formaldehyde	new buildings (existing buildings	0.15 mg/m³ 0.30 mg/m³)
Maximum	new buildings existing buildings	200 Bq/m³ 800 Bq/m³
Carbon Dioxide	2500 ppm (of which 1500 ppm is produced by metabolism).	

(If the outdoor air flows are controlled based on the carbon dioxide content of the indoor air, a maximum setpoint of 800 ppm (cm^3/m^3) may be used.)

fig.5a and fig.5b The olfbar in Stockholm

Like in any normal bar, it is also possible to order cocktails, either standard cocktails, pre-mixed or cocktails selected by the customer. Any kind of material or object may be tested in the olfbar. By using the four milestones as a reference you can yourself try to judge the air quality from these objects or materials.

fig.6 Different types of air quality served in the olfbar

The main purpose of the bar is to demonstrate that buildings should be designed to please not only the eyes but also the nose. It is essential to choose low-olf materials, components and furniture in a building.

References

1. P.O. Fanger, Introduction of the olf and the decipol units to quantify air pollution perceived by humans indoors and outdoors, Energy and Buildings, 12(1988), p.1-6;

2. P.O. Fanger and B.Berg-Munch, Ventilation and body odor, Proc. an engineering foundation conference on management of atmospheres in tightly enclosed spaces, Atlanta, ASHRAE, 1983, p.45-50;

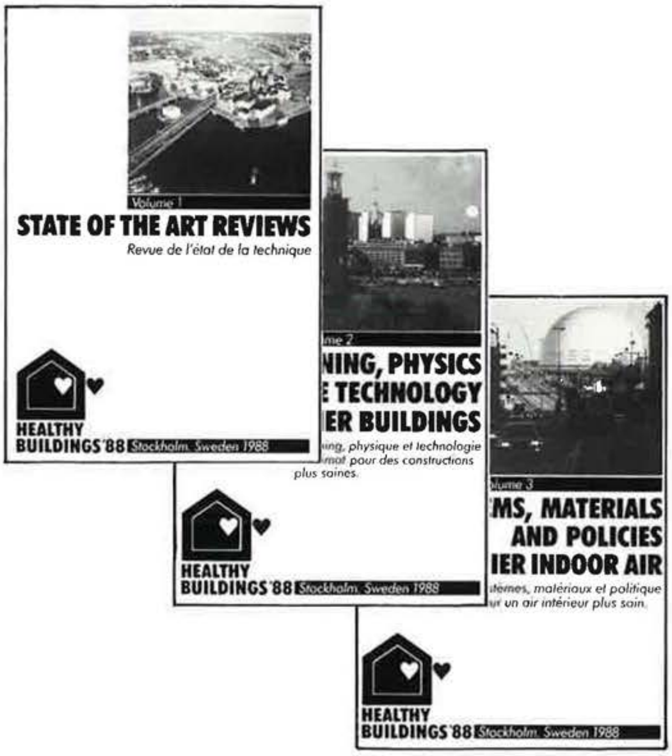
3. B.Berg-Munch, S.Clausen, P.O. Fanger, Ventilation requirements for the control of body odor in spaces occupied by women. Environ.Int.12(1986), p.195-199;

4. S.D. Sastry, Biochem.Appl., Mass.spectrum, suppl.vol.1, chpt.34: Volatiles emitted by humans, p.1085-1290.1980.

Healthy Buildings '88 Proceedings

Volume 1: State of the Art Reviews
Volume 2: Planning, Physics and Climate Technology for Healthier Buildings.
Volume 3: Systems, Materials and Policies for Healthier Indoor Air.

Available on loan from AIVC Information Services. See "Recent Additions to AIRBASE" this month for details of contents.



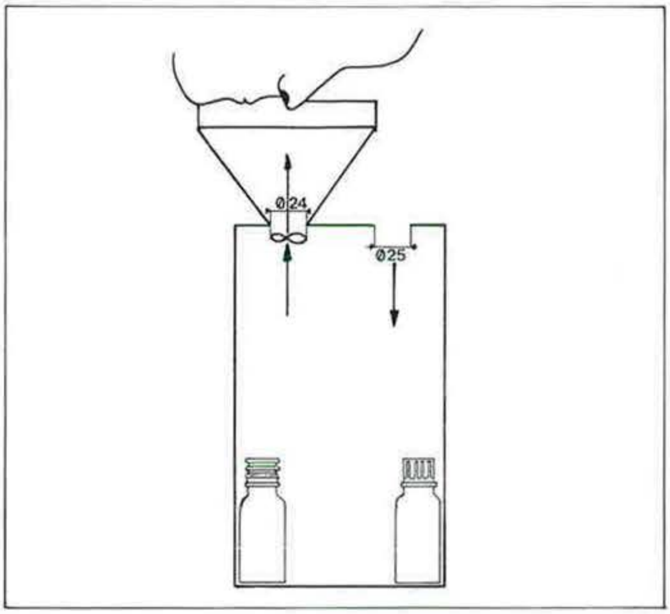


fig.2 Sniffing instrument

Acetone, one of the components of human bioeffluents, was used as the reference for quantifying perceived air pollution. Acetone is a normal urine and blood component resulting from non-enzymatic breakdown of oxoacetic acid, which is a natural part of the tricarboxylic acid cycle for the body metabolism of carbohydrates. A healthy person's breath contains about 1.1 ug acetone per litre (5). Acetone is also found in cigarette smoke and gasoline exhausts and it is used as a solvent for paints, inks, cosmetics, paper coating preparations, pharmaceutical products, and for preparation of vitamin intermediates and for chemical synthesis of a wide range of products. Therefore acetone is a well-known, cheap and available product.

The percentage of dissatisfied as a function of the perceived acetone concentration was determined by a naive panel. This relation was transferred to the relation between decipol and the perceived acetone concentration.

A special instrument to perceive these different acetone levels was developed (fig.2 and fig.3). The instrument consists of a three litre jar made of glass, covered with a plastic cap. This cap has two holes. In one of them an exhaust is placed to suck air out of the jar; The other hole serves as an inlet. On top of the fan, a plastic cone diffuses the exhausted air before it will be perceived. To perceive the outcoming air, one has to place the nostrils in the centre above the diffuser, while the chin is placed on the edge of the diffuser. In the jar, acetone sources are placed with different source strengths, resulting in different acetone vapour concentrations.

Trained Panel

Trained panels have been used for a long time in food science and industry with good results.

The present panel comprised fifteen persons, being selected among 53 persons, to be trained. This selection was based on a general olfactory test and a test for capabilities related to acetone.

The selected persons were trained to judge different acetone levels produced by the earlier described jars, using decipol values. Four jars producing different acetone concentrations (decipol levels 1, 5, 10 and 20), called the "milestones", served as the reference for the panel members during the whole training period.

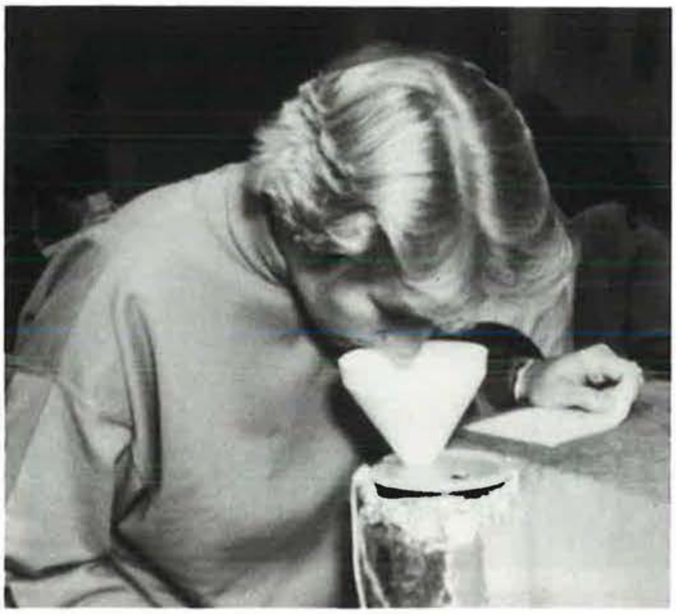


fig.3 One of the judges perceiving the air quality coming out of the sniffing instrument

After the panel was able to give decipol values to any acetone concentration, within an average deviation of 2 decipol, they were given other pollution sources which were put in the same kind of jars as the acetone sources. Again they were asked to estimate the decipol value of the perceived air quality with the four "milestones" as a reference. During the whole training period and the voting period after that, the jars were covered up with aluminium foil (see fig.4).

fig.4 Training of the panel with the covered jars

The Olfbar

The olfbar presents the results of the decipol values given by the trained panel to a broad selection of pollution sources (fig.5a and fig.5b).

In the olfbar different types of air quality are served (fig.6):

- air with pollutants emitted by materials often used in buildings, such as carpets, chipboard, rubber, sealant,...
- air with pollutants emitted by ventilation system components, such as duct, new filter, old filter, humidifier paper,...
- air with emittants from the daily life, which can sometimes be pleasant to perceive, such as newspaper, liquor, fruits,...