Towards Healthy Air in Dwellings in Europe (THADE) –

Remedial measures and building technology to improve indoor climate

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Towards Healthy Air in Dwellings in Europe (THADE)

Co-ordinator:

European Federation of Allergy and Airways Diseases Patients Associations (EFA) by Mariadelaide Franchi

Franchi et al. 2006. Allergy 61(7), 864-868

Whole report 97 pages available at:

http://www.efanet.org/activities/publications_allergy.html

Partners:

- Department of Occupational Health, University of Milan, Italy
- Commission of the European Union, Institute for Health and Consumer Protection, Ispra, Italy
- ER Health Consultancy, Slenaken, The Netherlands
- Federation of European Heating and Air-conditioning Associations (REHVA)
- Technishe Universiteit and TNO-Bouw, Eindhoven, The Netherlands
- Pulmonary Environmental Epidemiology Unit, CNR Institute of Clinical Physiology
- European Respiratory Society (ERS), Lausanne, Switzerland.
- Scientific Communication, Naples, Italy

THADE health determinants in indoor environment

- Environmental tobacco smoke (ETS)
- Dust mites
- Mould
- Pollen
- NO_x
- Formaldehyde
- Volatile organic compounds (VOC)
- Particulate matter
- Man made mineral fibres (MMMF)
- Cockroaches
- Pets
- Carbon monoxide
- Carbon dioxide - ventilation

Environmental tobacco smoke

- one cigarette per hour
- nicotine level 1 micro g/m^3

  = risk level 10^{-5}
- ventilation rate > 300 L/s in mixing ventilation vs. normal 10-20 L/s per person

Source control the only feasible way to control ETS over long term exposure

Control of environmental tobacco smoke

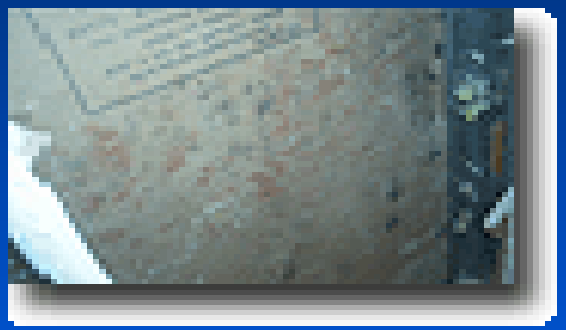
- Legislation
  - Ban smoking indoors
  - Limiting smoking in public places seems to affect in general the number of smokers
- Transfer of experience between European countries
- Education, information campaigns – effect?
- Improved control technology of ETS
  - Smoking rooms
  - Ventilation technology
  - Air cleaning

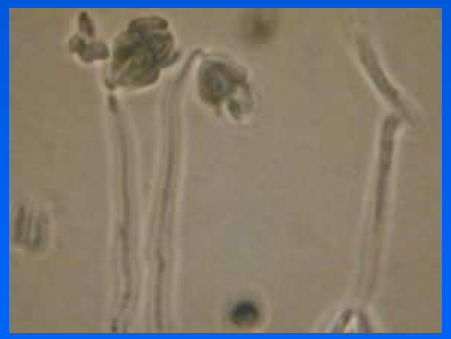
Control of dust mites
= control of indoor relative humidity

- Limit values of relative humidity
  - 45% for dust mites
- Indoor relative humidity is affected by:
  - Moisture generation, temperature, outdoor moisture, temperature (air and surfaces)

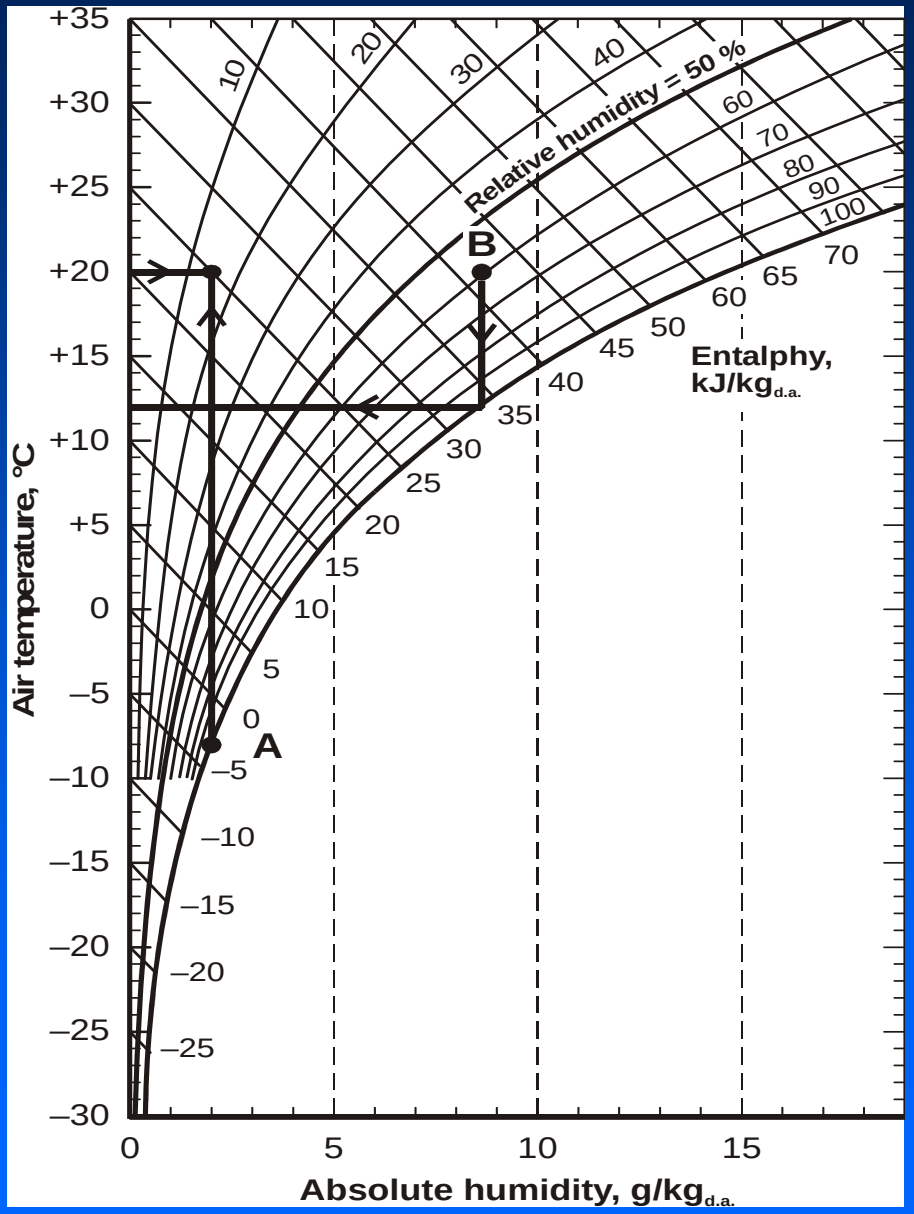
Control of mould growth
= control of moisture in building and condensation

Limit value for the mould growth is 65-75% (depends on time, temperature, species, and material)





Relation between relative humidity, absolute humidity and temperature



Improved ventilation to control moisture

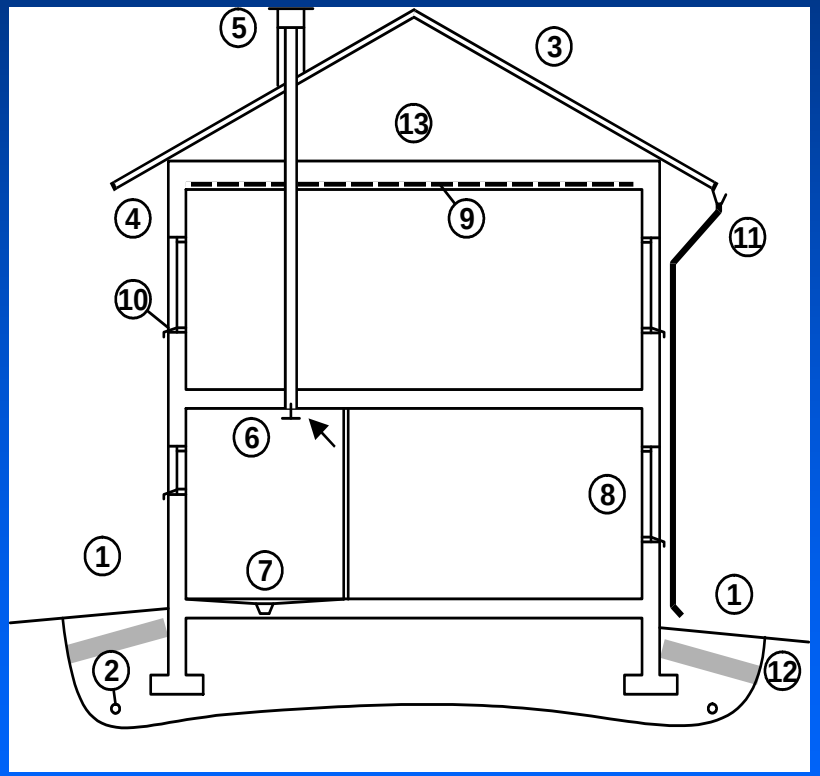
- Adequate ventilation rates for all rooms
  - bathrooms, bed rooms etc.
- Demand controlled ventilation
  - manual, automatic
- Kitchen range hoods (source control)
- Consider application of
  - mechanical exhaust ventilation
  - mechanical supply and exhaust ventilation with heat recovery
- Applicable measures and systems depend on the existing technology

Improved heating for moisture control

- Higher average room temperatures decrease relative humidity
- Avoid intermittent heating which may cause condensation
- Avoid open flame unvented heaters (also a source of moisture)
- Central heating provide usually better control of temperature and lower outdoor air pollution (peat fired fireplaces vs. gas fired district heating)

Improved construction technology to control moisture

- Improve windows to prevent condensation
  - number of panes, and thermal breaks in frames
- Ventilation of structures to prevent condensation
- Use of vapour barriers
- Decrease moisture loads
  - cooking, drying of laundry
- Prevent condensation
  - improve windows, improve thermal insulation
- Water tight building envelope
- Prevent moisture from ground



Consumer behaviour for moisture control

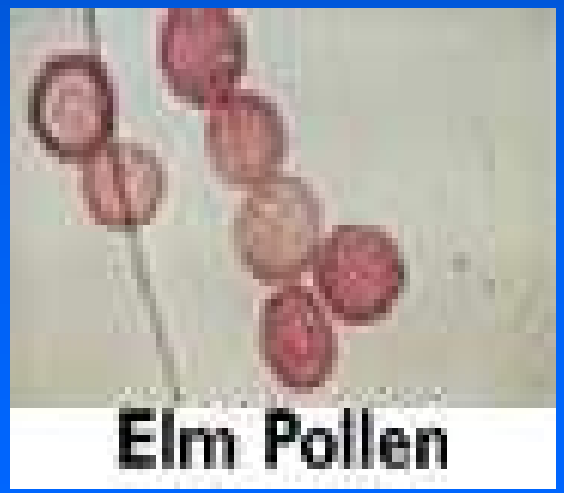
- Information campaigns
  - Cooking
  - Laundry – drying methods
  - Ventilation
  - Limit the use of humidifiers
  - Water beds
- Better appliances
  - Washer and condensing dryer

Pollen

- Relative large particles
- Spiecies depend on location and climate
- Avoid plants with know allergens indoors and in housing areas
- Cleaning of ventilation or indoor air
- Tight building envelope

Russian Thistle Plant

Orchard Grass Plant



Elm Pollen

Timothy Grass Flower

Indoor generated nitrogen oxides

- Avoid gas fired cooking appliances
- Do not use unvented gas heaters of space or domestic hot water
- Use always effective range hood in kitchen
- Provide an effective ventilation system to kitchens

Control of formaldehyde and VOCs

- Control of emissions from building materials and furniture – low emitting materials
  - Labelling systems of clean materials (models available from Finland, Denmark, Germany)
- Control of emissions from consumer products
  - Cleaning products (for ex. limonene)
  - Personal hygiene and beauty products

Building materials

Major source of VOCs in buildings

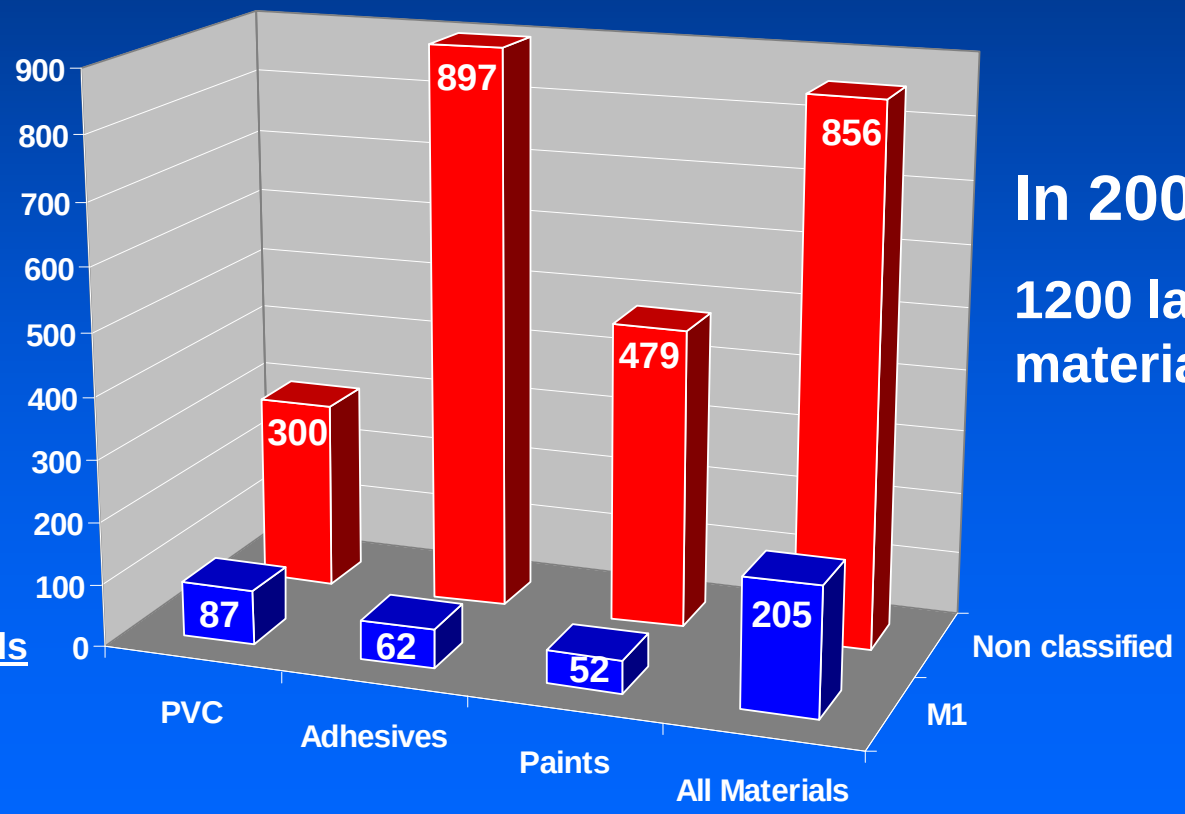
- **large range of emission rates between and within material groups**
- **criteria for low polluting materials is developing**
- **all surfaces absorb and re-emit pollutants**

Comparison of material emissions (μg/m² h)

M1 classified vs non-classified building products in Finland *(Saarela, K. VTT. 2002)*

EMISSION CLASS FOR BUILDING MATERIAL
M1

1. **TVOC**< 0.2 mg/m²h
2. **Formaldehyde** < 0.05 mg/m²h
3. **Ammonia** < 0.03 mg/m²h
4. **Carcinogenic compounds** (IARC) < 0.005 mg/m²h
5. Material is not **odorous**



In 2008

1200 labeled materials

Control of indoor generated particulate matter

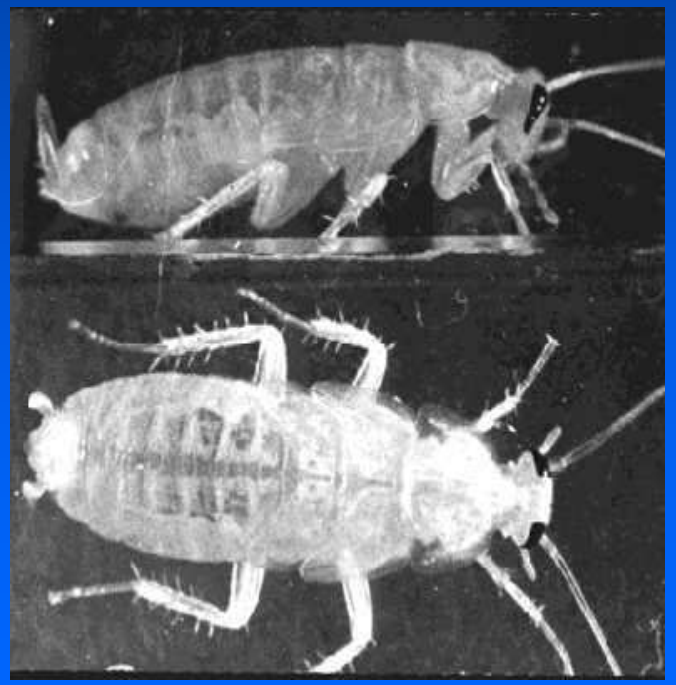
- Cleanability
- Selection of textiles – recommendations
- Easy-to-clean surfaces and furniture (no fitted carpets)
- Improved cleaning methods
  - central vacuum cleaners
  - cleaning of exhaust air of vacuum cleaners
- Control of outdoor pollutants
  - planning – location of housing areas
  - mechanical ventilation and filtering of out door air
- Air cleaning by recirculation air cleaners

Mineral fibres (MMMF)

- Asbestos= carcinogenic
- Other man made mineral fibres are irritants
- Sources: acoustic linings, thermal insulation
- Seal the mineral wool to prevent fibre emissions

Control of cockroaches

- **Information campaigns**
  - **limit the access of pets to avoid the exposure**
- **Improved hygiene**
- **Improved cleaning**



Control of pet allergeens

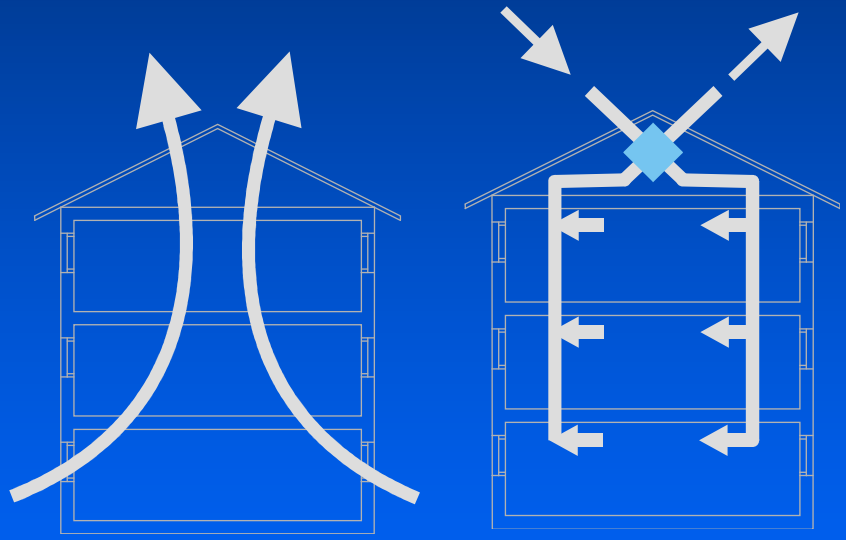
- Well known source of allergens
- Information campaigns
- No pets in public buildings and transportation

Carbon monoxide

- Source of carbon monoxide is incomplete combustion
- Control includes product control, system control and consumer information

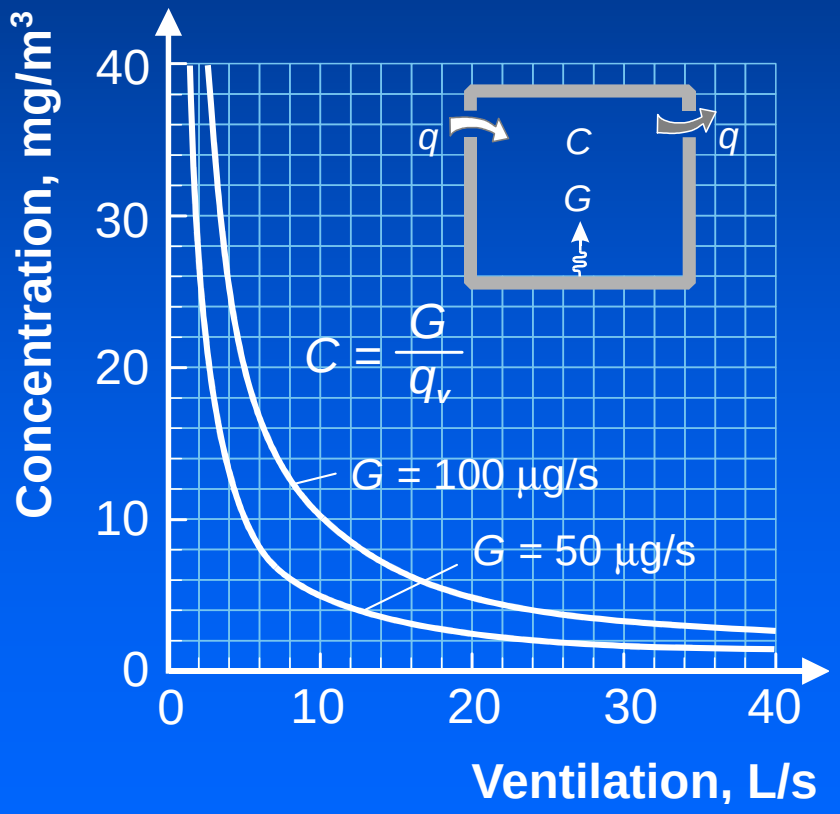
Control of carbondioxide and ventilation

- Control of carbondioxide is controlled by ventilation
- Main indoor sources of carbondioxide are occupants (people and animals)
- Typical CO_2 concentration outdoors is 350 – 400 ppm and indoors 500 – 2500 ppm
- Ventilation controls all pollutants



Effect of ventilation rate on pollutant concentration in one space

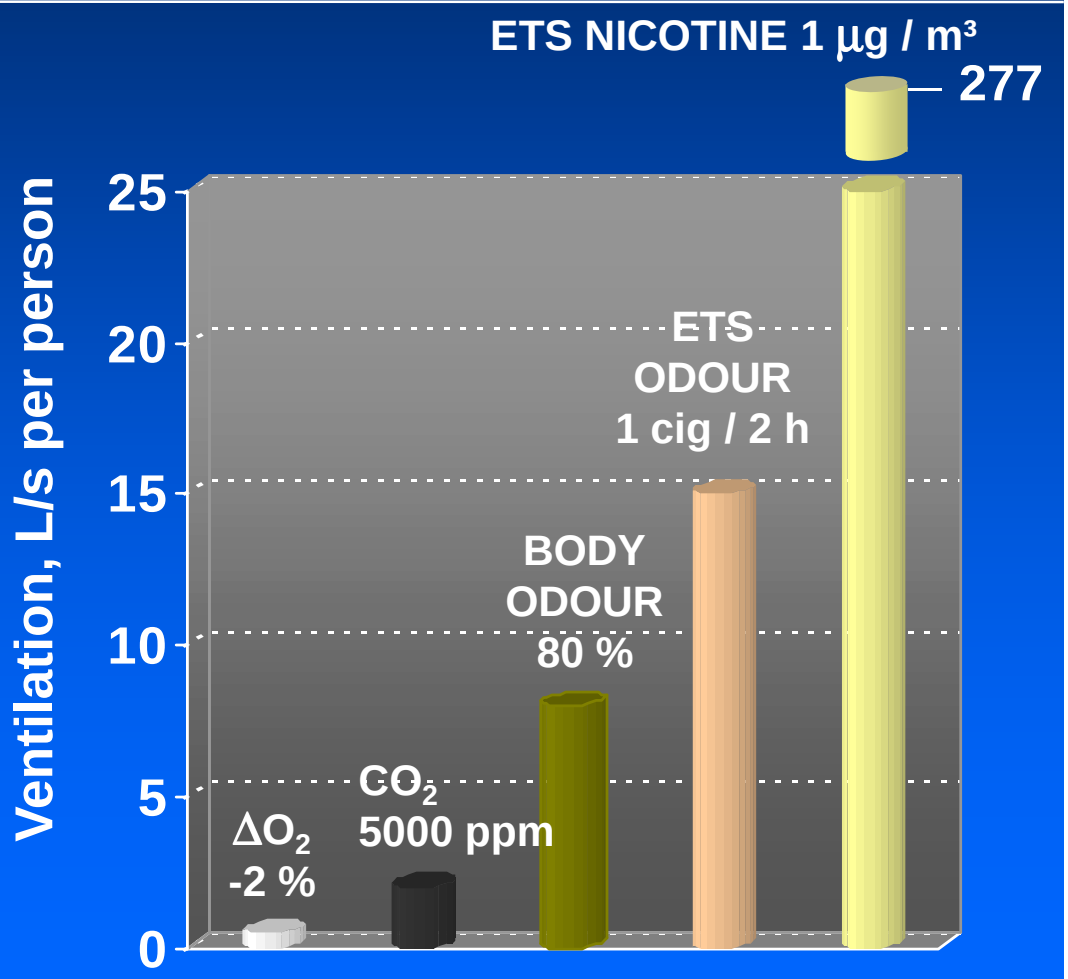
- **The pollutant concentration is proportional to pollution generation and inversely proportional to ventilation rate**



Theoretical needs for ventilation air

Required ventilation rate per person depends on the criteria

- Oxygen is never the critical criteria
- Acceptable long term level of ETS cannot be achieved with ventilation
- **Ban smoking indoors**



THADE indoor air risk factors, their sources and control

Risk factor	Source characterization	Availability of control technology	Control strategy
1. Moisture related bioaerosols	Mould spores, particles, mites, MVOC´s	Available	Building codes and standards
2. ETS	Gases, particles, secondary sources	Available	Legislation, Information, smoking policies
3. Nitrogen oxides	Gas fired cooking and heating applainces, outdoor sources	Available	Alternative methods, source control
4. Pets and cockroaches	Dogs, cats and other furred animals	Available	Avoid furred pets, improve the hygiene and cleanliness
5. VOC´s	Building materials, cleaning products	Developing	Contol of sources (bulding products, consumer products)
6. Non bio-particulates	Textiles, outdoor sources	Partly available, partly developing, difficult	Sourcecontrol (material selection), cleaning, out door pollution, planning

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