Methods to evaluate gas phase air-cleaning technologies: Perceived Air Quality

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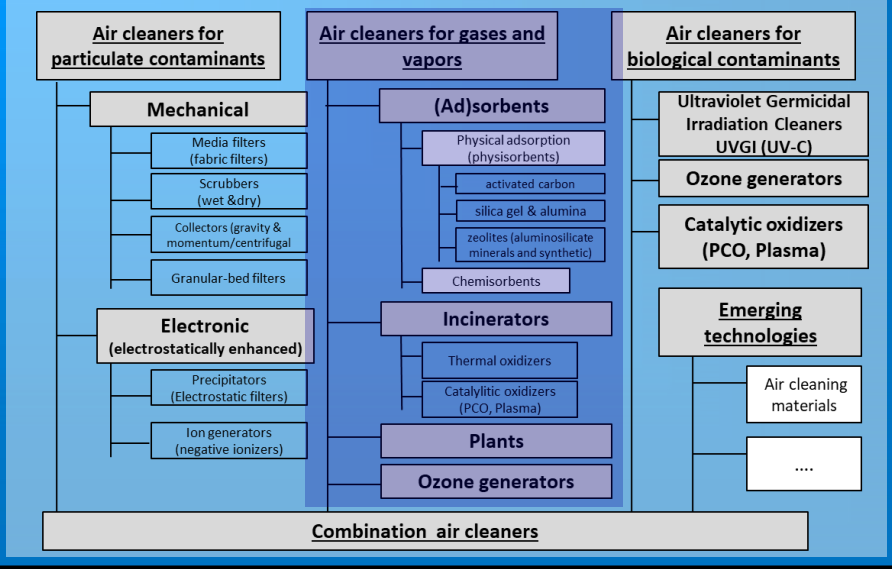
Classifications of air cleaners



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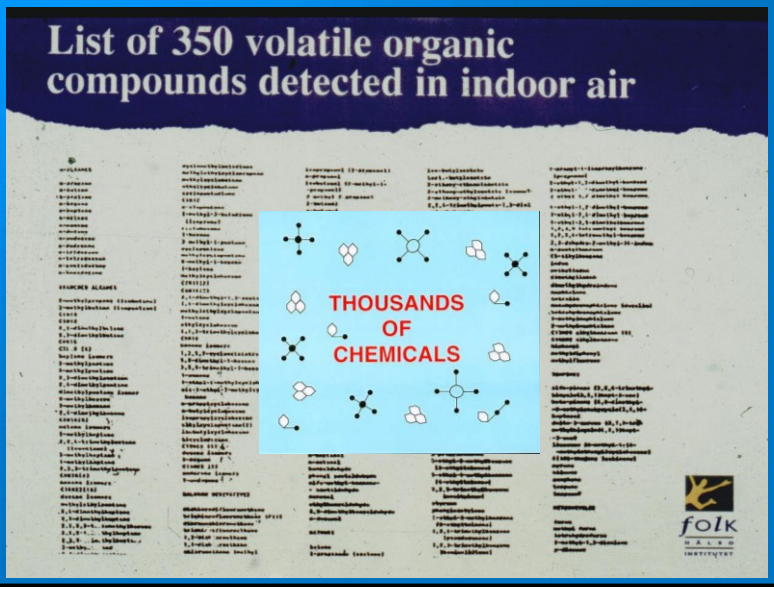
Organic Chemicals in Indoor Air



Chemical measurements

Gas Chromatography/Mass Spectrometry (GC/MS)

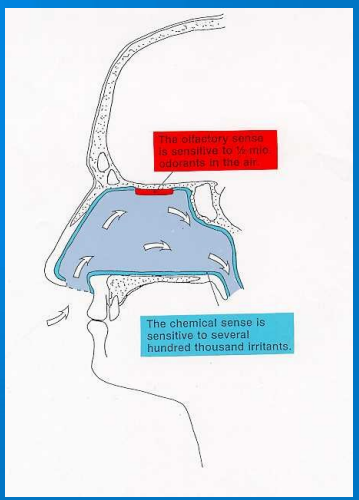
Proton-Transfer-Reaction Mass Spectrometry (PTR-MS)

Chemical analysis of indoor air

- Detailed compound-by-compound analysis of indoor air is unable to predict how indoor air will be perceived by humans

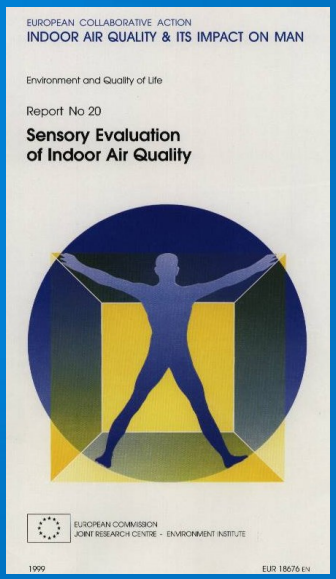
Using man as a meter

- The air quality as rated by humans in subjective evaluations (Glossary of the Indoor Air Sciences, 2006)
- Quality: the extent to which human requirements are met



Sensory evaluations of air quality

- Sensory evaluations of air quality have been used routinely in indoor air research for the past 25 years.
- Perceived air quality has been used to define ventilation rates prescribed in the majority of present standards (eg. 16798, ASHRAE 62.1)
- Perceived air quality has been used to examine emissions from building materials, it is included as a part of testing in few labelling schemes for building and furniture materials (Finnish M1 Label; Danish Indoor Climate Label, and German AgBB Scheme) and the standard describing sensory testing in connection with emission testing (ISO 16000-30)
- Perceived air quality has been used extensively in the past in field studies as a measure of air quality in rooms and buildings (eg. Wargocki et al., 2004)
- Can be considered as an exposure metric



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Supplementing Ventilation with Gas-phase Air Cleaning
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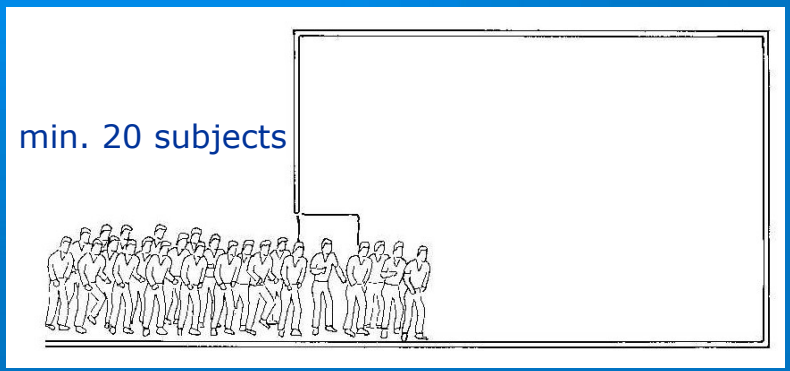
Measurements of perceived air quality

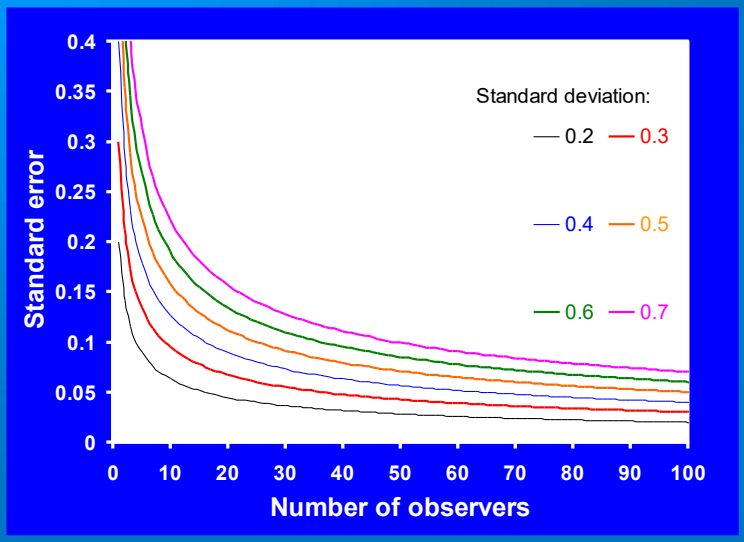
- Subjective evaluations of air quality include ratings of intensity of odour, freshness (stuffiness), acceptability (dissatisfaction)
- Acceptable air quality: air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority of the people exposed do not express dissatisfaction
- Sensory panels of human subjects
  - Untrained panel
  - Trained panel
- Immediate response ("First impression")
- Impartial assessment

Untrained panel

"… a panel of at least 20 untrained observers (…) who render a judgement of acceptability…"



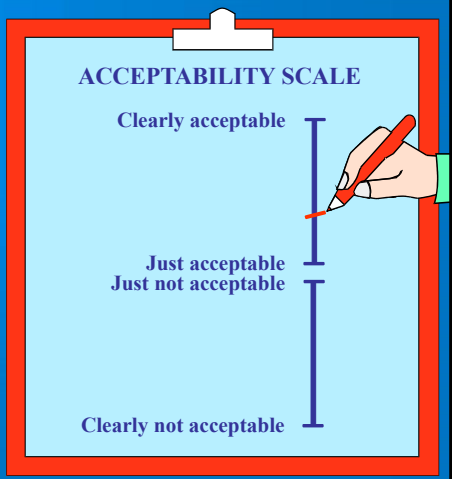
Panel size



Continuous acceptability scale

How do you assess the air quality?

Pay attention to the dichotomy between acceptable and not acceptable.

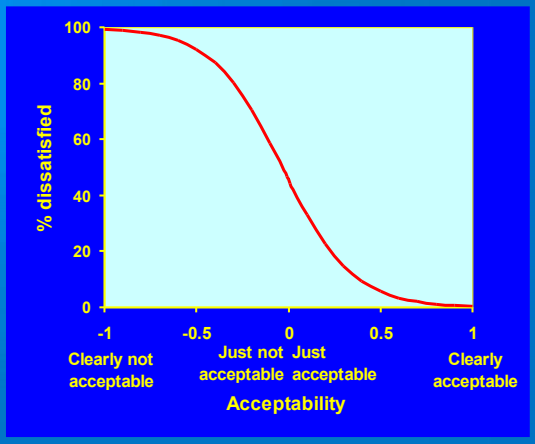


Measuring metric

Acceptability

↓

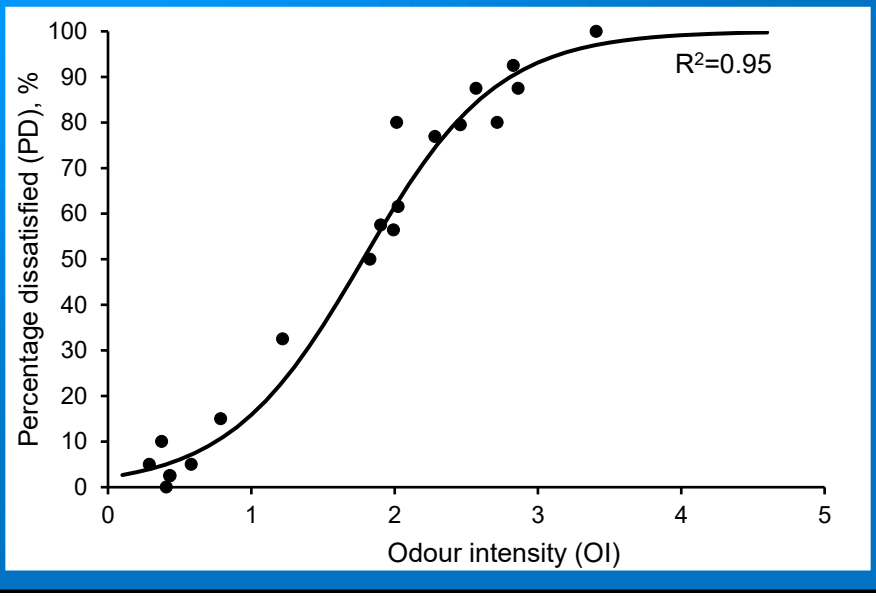
% dissatisfied



Odour intensity: category scale (Yaglou et al. 1936)

- No odour
- Slight odour
- Moderate odour
- Strong odour
- Very strong odour
- Overpowering odour

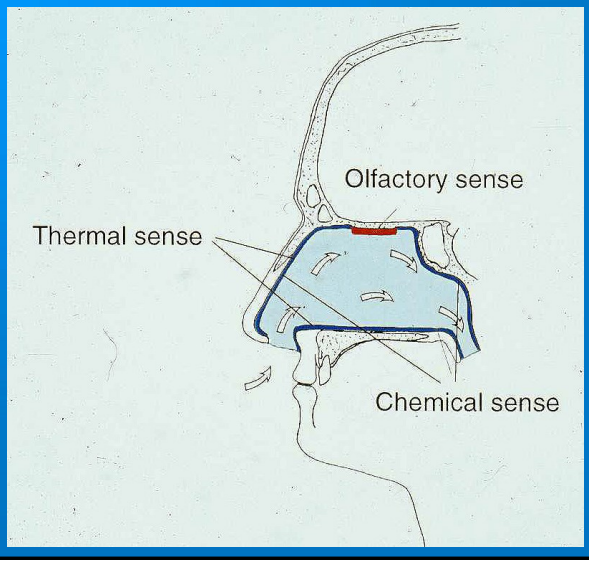
Odour intensity vs % dissatisfied



Main factors influencing sensory measurements

- Temperature and relative humidity
- Adaptation – sensory fatigue

Impact of temperature and humidity on sensory measurements



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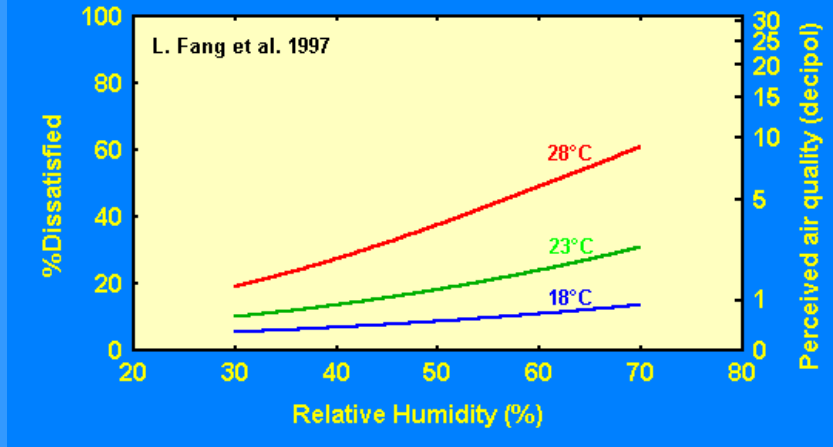
Impact of temperature and humidity on perceived air quality



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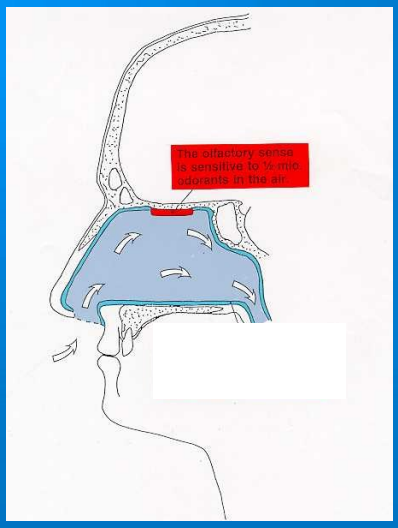
Impact of adaptation: sensory fatigue



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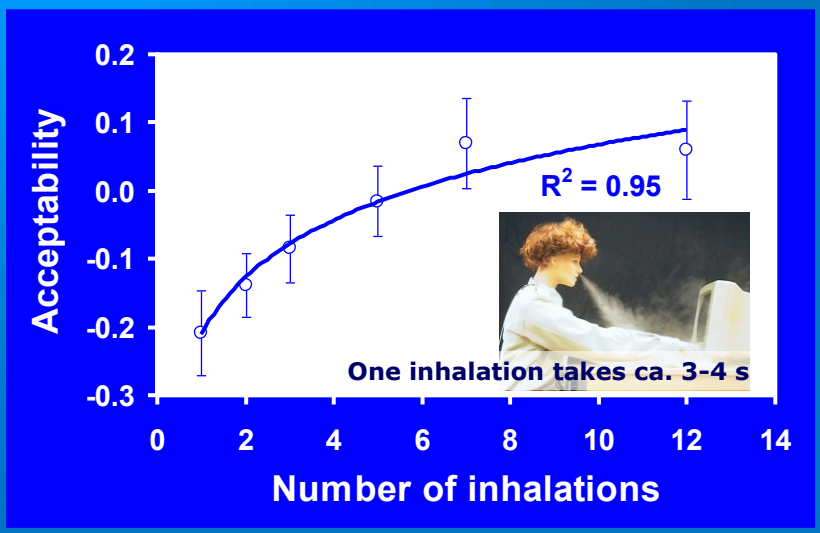
Sensory fatigue



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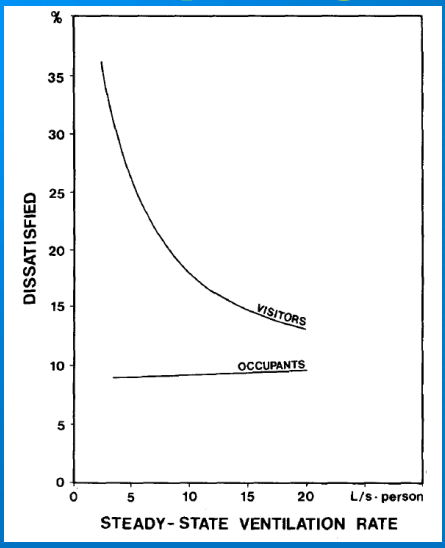
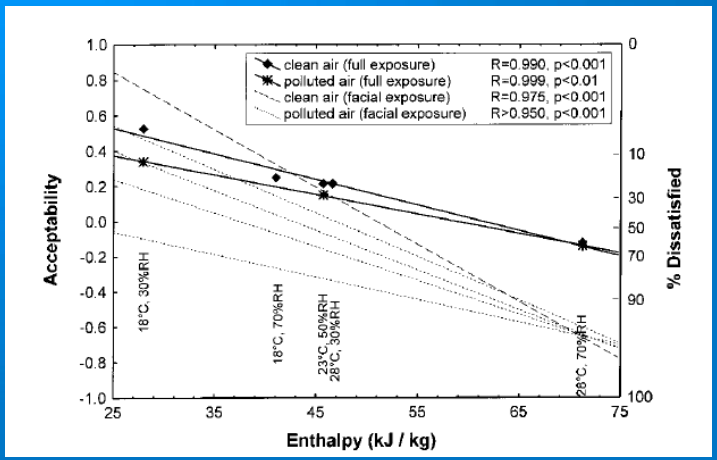
Sensory fatigue



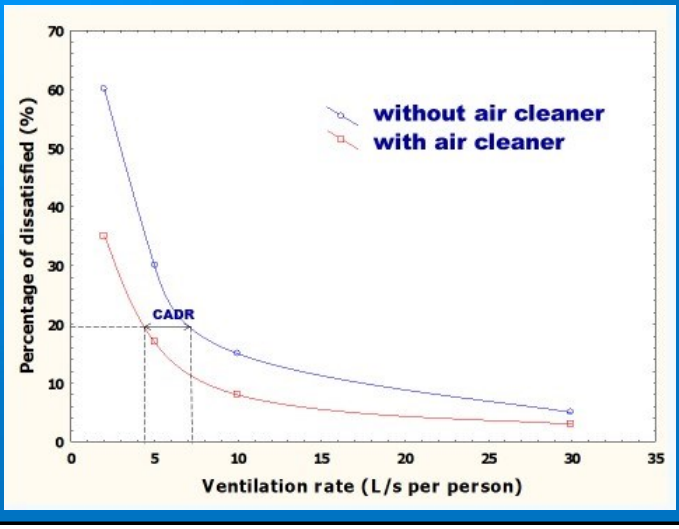
Source: Berg-Munch et al. (1986)

Methodological aspects

Face vs. whole body exposure



Applications
Clean air delivery rate



Designed ventilation rate can be reduced by CADR

People Component

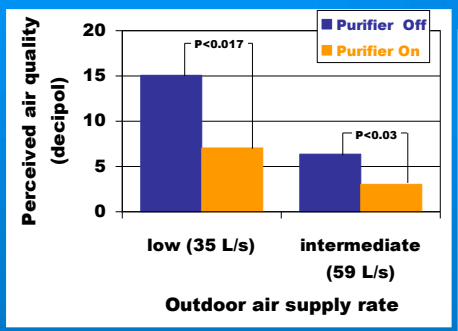
Building Component

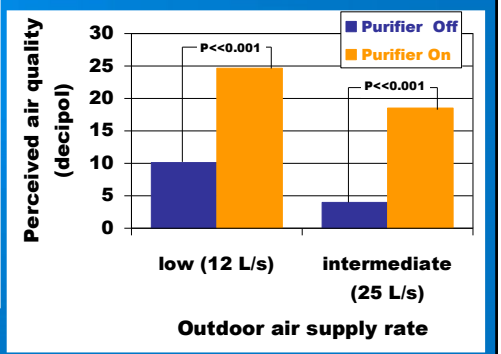
Breathing Zone Outdoor Airflow

$$V_{bz} = R_p P_z + R_a A_z$$

- R_p: Minimum l/s/Person
- P_z: Number of People
- R_a: Minimum l/s/m²
- A_z: Building Area

Applications detection of by-products





Thank you (pawar@dtu.dk)