Areas of interest/contributions to ANNEX 68

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Kick off meeting

IEA EBC Annex 68 Design and Operational Strategies for High IAQ in Low Energy Buildings

March 19 – 20, 2015

Contents

- **Short presentation of LaSIE including actual research / results / key-findings**
- **Views on gaps of knowledge to fill. Plans for contributions to the Annex.**
- **Indication of subtask interest**

What is LaSIE?

- **LEPTAB → LEPTIAB →LaSIE: Laboratory of Engineering Sciences for the Environment**

- **Location: La Rochelle (France)**

- **Staff:**
  - **Professors: 18**
  - **Associate Professors: 30**
  - **PhD Students: 63**
  - **Post-Doctoral fellows: 18**
  - **Administration/technical…**

Total ~150

What is LaSIE?

A. Flows, Energy and Environment

A1: Building energy and Indoor Environment Quality

A2: Transfer Intensification for Eco-processes

B. Materials and Transfers in Aggressive Environment

B1: Transfers and material degradation and corrosion mechanisms

B2: Material protection and coatings

AB: Mathematical and numerical methods for transfer phenomena

What is LaSIE?

Permanent researchers: 10
ABADIE M., ALLARD F., BELARBI R., BLONDEAU P., BOZONNET E., INARD C., JOUBERT P., LIMAM K., MICHAUX G., SALAGNAC P.
PhD + Post-Doctoral Students: 36

A1: Building energy and Indoor Environment Quality

1: AIR

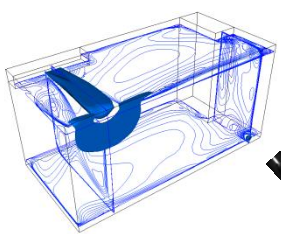
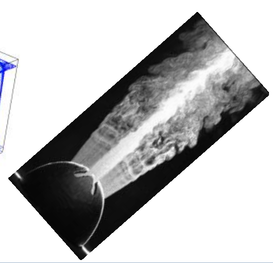
- IAQ
- Indoor Airflow
- Heat and Mass Transfer in buildings
- Acoustics

2: Rational use of Energy in Buildings/Systems, Renewable Energy

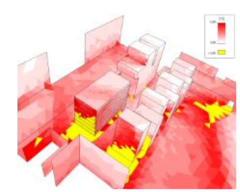
- Rational use of Energy in Buildings/Systems
- Heating/Cooling systems with low environmental impact

3: Urban micro-climate and Building interactions

- Heat and mass transfer in building envelope
- Urban micro-climate and Building interactions






A1: Research Activities - Modelling

Ventilation	• Airflow and Pollutant distribution in rooms (Zonal approach) K.F. • Particle deposition in duct elements • Optimal ventilation strategies for low-energy buildings (IAQ/Energy)
Sources	• Modelling of pollutant transfer from the ground • Characterization of material and material assemblies emissions • Compilation of emission data from indoor sources
Reactivity	• Dynamic modelling of homogeneous and heterogeneous chemistry in indoor air • Implementation of reactivity models in sorption/diffusion equations: secondary emission of formaldehyde by hydrolysis, chemical adsorbents in materials K.F.
Air cleaning	• Characterization of the efficiency and energy consumption of air cleaning systems (portable, in-duct) • Impact of air cleaning materials (gypsum board, paint, glass fabric) on IAQ • Dynamic modelling of adsorbent filter (influence of T and RH)
IAQ / Exposure	• Prioritization of indoor air pollutant: office, hospital, residential buildings K.F. • Definition of IAQ indices for the assessment of optimal control strategies and systems

Small-scale Experiment → **Modelling** → **Real-scale Exp. (Lab/in situ)**

A1: Research Resources

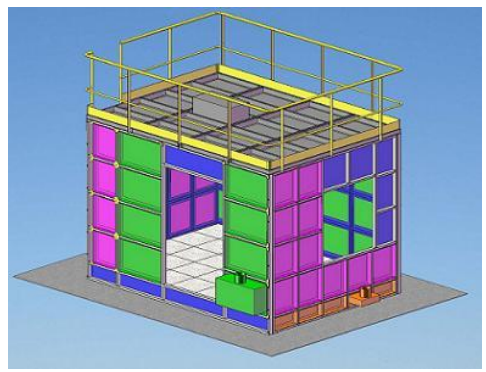
Experimental Platforms / Test beds

Material properties / emission of COV

46 liter, controlled T, RH, ACH

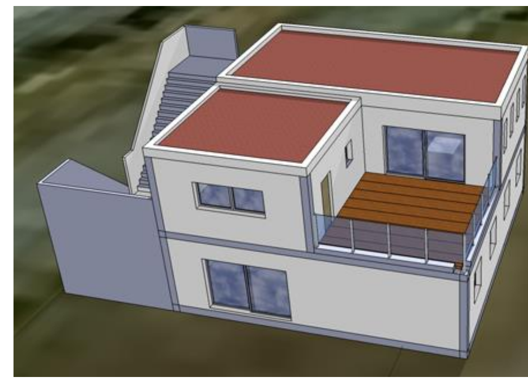
1 m^3, T=23°C, RH=50%, ACH=0.5 /h
(ISO 16000 series)

Environmental Chamber



30 m^3, modular (wall materials/ventilation/T, RH)

IEQ House



110 m^2, modular (envelop permeability, wall materials, ventilation system, indoor sources)

Equipment:

- Proton-transfer-reaction mass spectrometry (PT-RMS)
- Optical particle counters: Met-one, GRIMM, Mini-WRAS

A1: Research Resources

Numerical tools

Building Energy Simulation programs:

- TRNSYS, Codyba, Comfie-Pléïade, EnergyPlus, Simbad

Multiphysics softwares:

- TRNSYS, Dymola (Modelica), HAM tools, INCA-INDOOR

CFD software:

- StarCCM+

Database

PANDORA: A comPilAtion of iNDoOR Air pollutant emissions

- Number of pollutant sources: 542
- Number of pollutant emission rates included in the database: 8171
  - Gaseous pollutants: 7980
  - Particulate Matter: 191

http://lasie.univ-larochelle.fr/PANDORA-A-comPilAtion-of-iNDoOR

Results / key-findings related to Annex 68

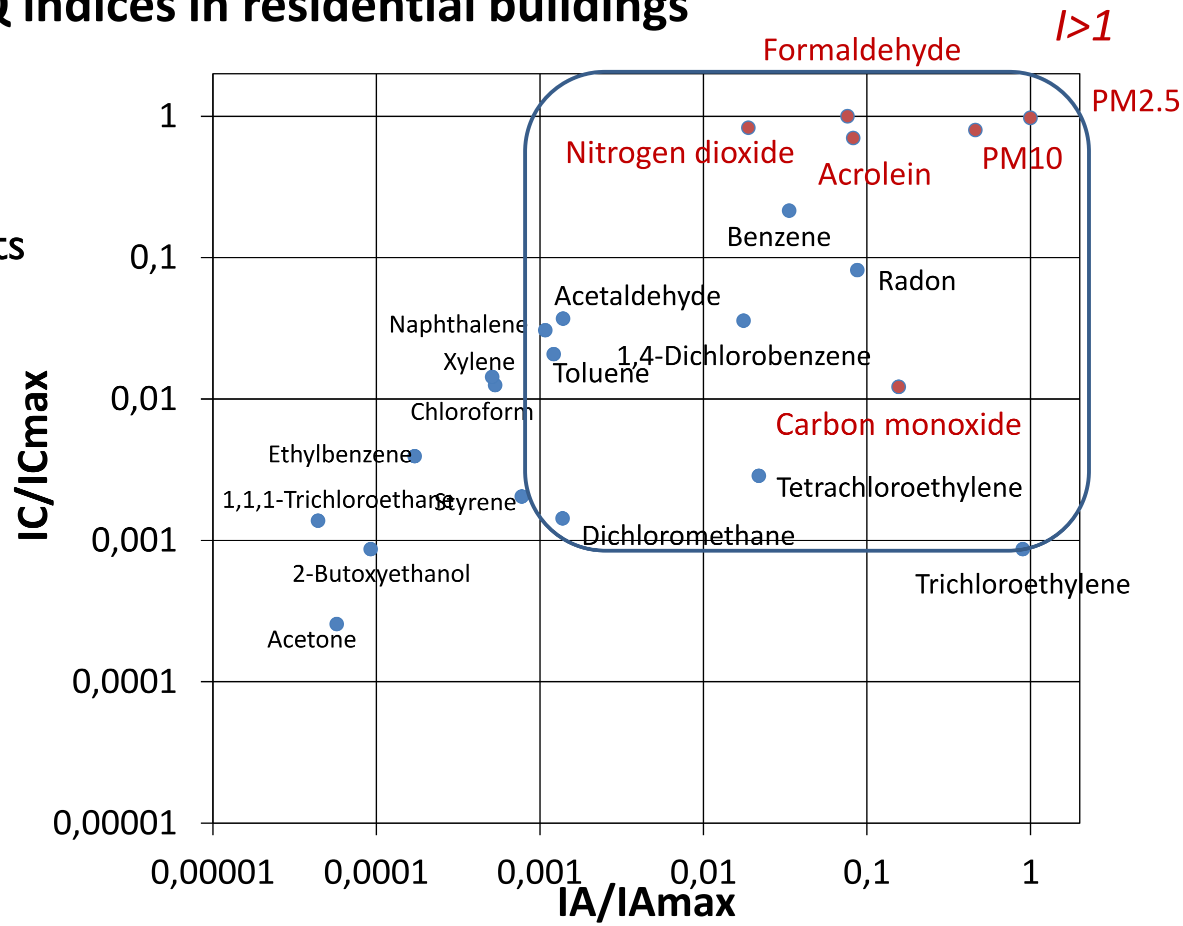
1. Target pollutants and IAQ indices in residential buildings

- ✓ **IAQ French campaign in dwellings (OQAI, 2006)**
  - ✓ 570 houses and apartments
  - ✓ + than 30 parameters (chemical, biological and physical)

- ✓ **Definition of the Index**

$$I = \frac{C_{meas.}}{C_{MRL}}$$

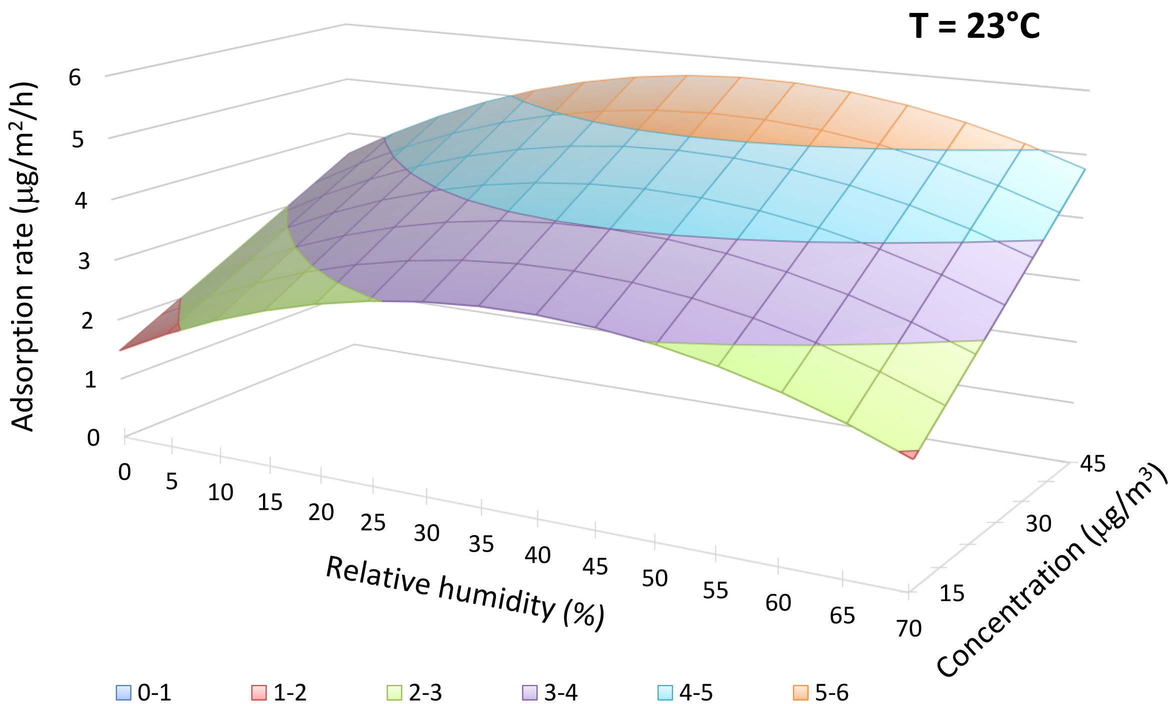
meas.: maximal or averaged measured
MRL: acute or chronic Minimal Risk Level



Results / key-findings related to Annex 68

2. Implementation of reactivity models in sorption/diffusion mass transfer models (hydrolysis/thermolysis, adsorptive coating materials)

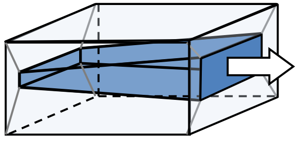
- ✓ 0.2 mm thick glass fabric
- ✓ Commercially available
- ✓ 75% glass fibers and 25% organic binder containing scavengers
- ✓ Chemical adsorption of formaldehyde



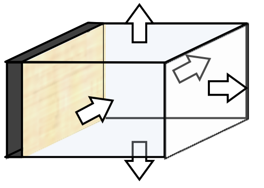
Results / key-findings related to Annex 68

3. Elemental models for airflow and gas/particle distribution in rooms and ventilation systems

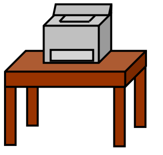
AIRFLOW



Air jet cell



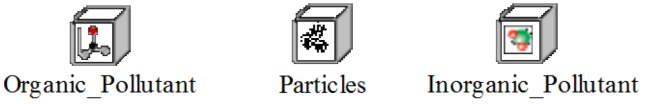
Standard cell



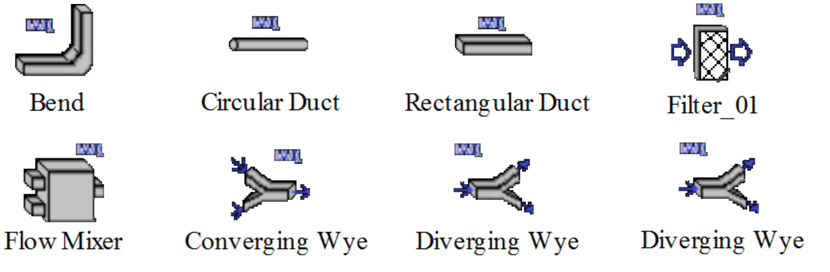
Obstacles

POLLUTANT

Room



Ventilation System (PM)



Results / key-findings related to Annex 68

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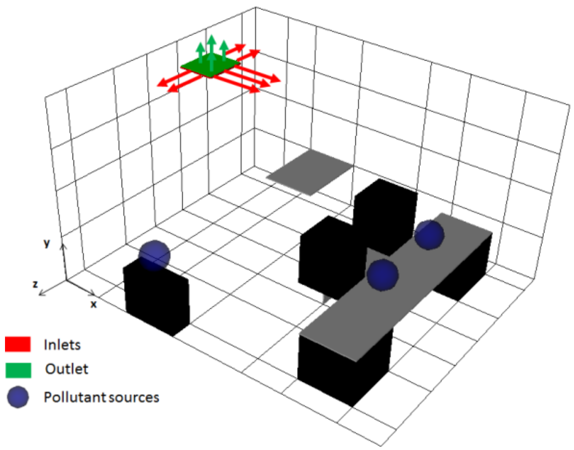
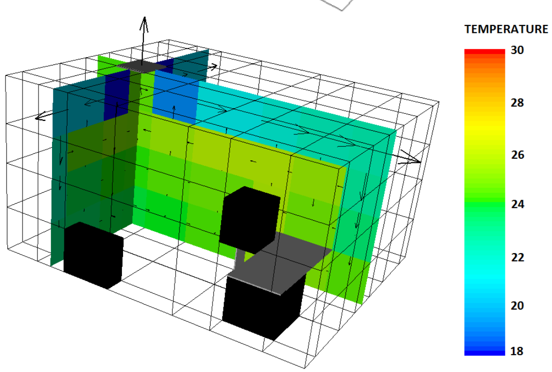
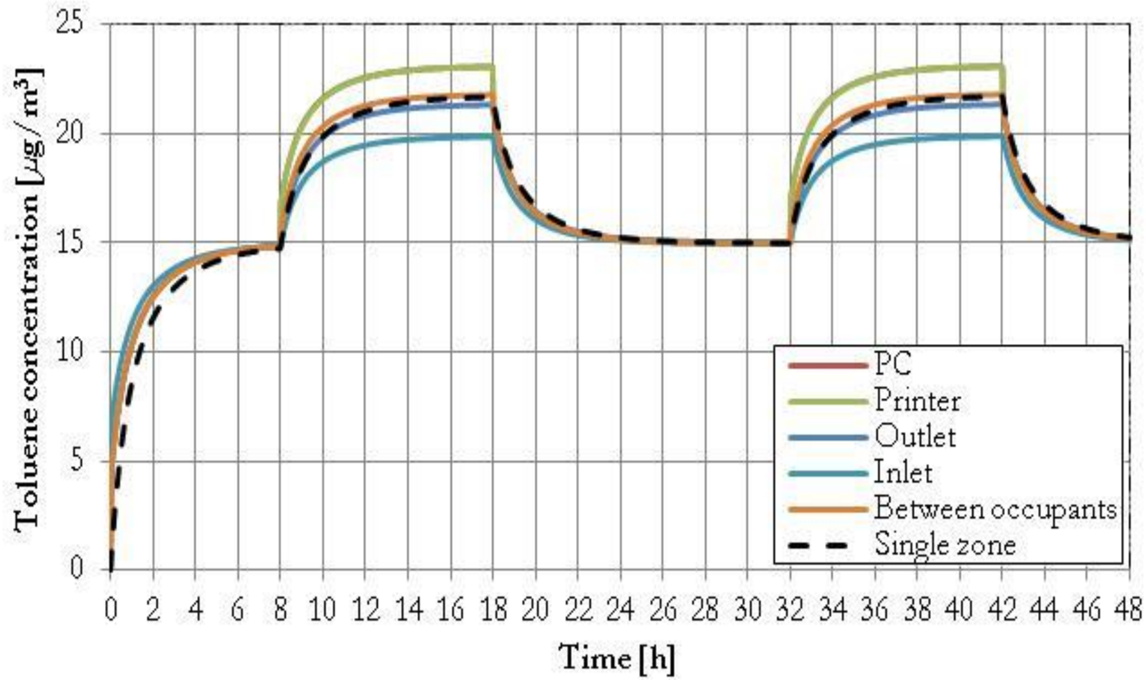




Toluene



Views on gaps of knowledge to fill

- **Metrics:**
  - What are the Target pollutants?
  - How to aggregate multiple indices?

- **Pollutant loads in buildings**
  - Outdoor air pollution data for IAQ dynamic realistic simulations?
  - Influence of T, RH, solar radiation… on the pollution loads (material emission)?
  - Prioritization of indoor sources?
  - Definition of representative schedules for occupant activities and pollutant emissions?

- **Modelling:**
  - Database of material properties for IAQ simulation (relevancy of data for implemented models)?
  - Couplings between gas and particle transports in indoor settings (nucleation/condensation of SVOCs, sorption of gases in particles…)?

Indication of subtask interest

- **Subtask 1: Defining the metrics**
- **Subtask 2: Pollutant loads in buildings**
- **Subtask 3: Modelling**
- **Subtask 4: Strategies for design and operation of buildings**
- **(Subtask 5: Field measurements and case studies)**