Practical use of the Annex 68 Indoor Air Quality Dashboard

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Target pollutants

Metrics

Health

Presence frequency

Comfort

PM
VOC
Bio-contaminants

Radon
IAQ

Energy use

Indoor Air Pollution

Target pollutants

Metrics

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40 years of AIVC, 15-16 October 2019, Ghent, Belgium

Contents

- Subtask 1 – Defining the metrics
- Case Study
- Results
- Conclusion
Subtask 1 – Defining the metrics

Previous attempts on the prioritization of Pollutants
Concentration Levels in Residences
Exposure Limit Values (ELV)

IAQ indices from literature

“SHORT” LIST OF POLLUTANTS for ANNEX68

METRICS for ANNEX68
accounting for energy consumption

List of pollutants of concern for Annex68

<table>
<thead>
<tr>
<th>Pollutants</th>
<th>Long-term Exposure</th>
<th>Short-term Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ELV</td>
<td>Source</td>
</tr>
<tr>
<td></td>
<td>Averaging period</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>ELV</td>
<td>Source</td>
</tr>
<tr>
<td>Acrolein</td>
<td>0.35</td>
<td>USA-California</td>
</tr>
<tr>
<td>α-pinene</td>
<td>200</td>
<td>Germany</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.2</td>
<td>France</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>9</td>
<td>USA-California</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>2</td>
<td>Germany</td>
</tr>
<tr>
<td>Nitrogen dioxide</td>
<td>20</td>
<td>France, Canada</td>
</tr>
<tr>
<td>PM10</td>
<td>20</td>
<td>WHO</td>
</tr>
<tr>
<td>PM2.5</td>
<td>10</td>
<td>WHO</td>
</tr>
<tr>
<td>Radon</td>
<td>200</td>
<td>Austria, Canada,</td>
</tr>
<tr>
<td>Styrene</td>
<td>30</td>
<td>Germany</td>
</tr>
<tr>
<td>Toluene</td>
<td>250</td>
<td>Portugal</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>2</td>
<td>France</td>
</tr>
<tr>
<td>TVOC</td>
<td>-</td>
<td>600</td>
</tr>
<tr>
<td>Mold</td>
<td>200</td>
<td>EU</td>
</tr>
</tbody>
</table>

Averaging period: 1 year, 1 h, whole life (carcinogenic risk level: 10^-6)
Source: Japan, USA, Germany, France, Portugal, Austria, China, Canada, Portugal, EU
Metrics for Annex68 – Dashboard

\[ I_P = \frac{C_P}{ELV_P} \]

Data represented here are just for display and do not represent actual situation

Case Study

- Numerical evaluation of exposure concentration with TRNSYS – CONTAM coupling
- Prototypical house + scenarios regarding ventilation systems, pollutant source strengths, outdoor pollution, occupants' activities...
- Validation against French survey from 567 houses and apartments (Kirchner et al., 2006)

- Louis Cony-Renaud-Salis: PhD Thesis to be defended in beginning of 2020

Case Study

- Two-storey house: 1 living room and 3 bedrooms
- Location: La Rochelle (small city, low pollution), France
- Ventilation rates (French standards):
  - 180 m$^3$/h during 30 min. at noon and 19:30
  - 105 m$^3$/h otherwise
- Ventilation systems:
  - Natural ventilation using vertical ducts for extraction (NAT)
  - Pressure-controlled exhaust ventilation (EXH)
  - Balanced mechanical ventilation (BAL)
- Occupants: Sedentary people (always at home)
- Considered pollutants (9/16 ST1 target pollutants):
  - acetaldehyde, acrolein, benzene, formaldehyde, nitrogen dioxide, particulate matter (PM2.5, PM10), styrene and toluene.
- Simulation: 1 week, timestep = 5 min.

Results – example for Natural Ventilation

- IAQ – LTEL
- IAQ – DALY
- IAQ – STEL
- Minimal value: 0.01 (Benzene & Formald.)
- Total: 930 DALYs lost/(year. 100,000 persons)
- Minimal value: 0% (all)
- Energy consumption: xxx kWh PE/(m$^2$.year)
Results – comparison

<table>
<thead>
<tr>
<th></th>
<th>NAT</th>
<th>EXH</th>
<th>BAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTEL</td>
<td>3.2</td>
<td>2.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Target Pollutant</td>
<td>Benzene and Formaldehyde</td>
<td>Benzene, Formaldehyde</td>
<td>Benzene, Formaldehyde and NO2</td>
</tr>
<tr>
<td>DALY</td>
<td>930</td>
<td>900</td>
<td>494</td>
</tr>
<tr>
<td>Target Pollutant</td>
<td>98.1% (PM2.5)</td>
<td>98.7% (PM2.5)</td>
<td>98.3% (PM2.5)</td>
</tr>
</tbody>
</table>

Conclusion

- AIVC Contributed Report

Energy and Buildings Special Issue for EBC Annexes:

Towards the definition of indicators for assessment of indoor air quality and energy performance in low-energy residential buildings

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