HEALTH RISK ASSESSMENT ASSOCIATED WITH EMISSIONS FROM HOUSEHOLD USE OF SELECTED CONSUMER PRODUCTS

'The case of single product use'

M. Trantallidis¹, P. Carrer¹, C. Dimitroulopoulou², G. Efthimiou², J. Bartziš³, P. Wolkof³

¹Occupational and Environmental Health, Dept. of Biomedical and Clinical Sciences, University of Milan, Italy
²Mechanical Engineering Dept., University of West Macedonia, Greece
³Indoor Environment Group, National Research Centre for the Working Environment, Denmark

Objective

The scope of Health Risk Assessment (HRA) in the framework of EPHECT was to evaluate possible adverse effects of respiratory relevance, which are associated with acute (30 min) and long-term (24 h) inhalation exposure to key and emerging indoor air pollutants emitted during household use of selected consumer products.

The current work aimed at proposing a methodology to be followed for HRA in the case of single consumer product use in the indoor environment.

Focus

- HRA was conducted accounting only irritative and respiratory end-points, since EPHECT focuses on air pollutants considered to be risk factors of respiratory diseases.
- Housewives and retired people (> 65 years old) were considered as target population, as these groups spend the majority of their time indoors.
- For acute exposure, a 30-min time period was chosen, reflecting exposure during use of the product.
- For long-term exposure, a 24-h time period was selected, reflecting exposure during daily activity of the target population (considered as representative of all days of a year).
- A ‘worst-case scenario’ strategy was followed for HRA.

Methodology

(1) Hazard identification and dose – response relationship:

Human and animal toxicological data regarding effects of short- and long-term inhalation exposure to the target compounds were evaluated in order to:

- identify the critical effect,
- identify the corresponding No-Observed-Adverse-Effect-Level (NOAEL) or Lowest-Observed-Adverse-Effect-Level (LOAEL),
- calculate a health-based limit of exposure for risk characterization according to the (NOAEL or LOAEL) / (Assessment Factor) approach.

(2) Exposure assessment:

Construction of scenarios for the use of 15 consumer products by two population groups (Housewives, Retired) in 4 geographical areas of Europe (North, West, South, East), based on further analysis of IPSOS data.

“Most representative worst-case scenario” strategy: scenarios reflecting the worst-cases for the use of each product, under realistic conditions, used for HRA.

Microenvironmental modeling to simulate indoor air pollutant concentrations in dwellings, resulting from the use of the 15 consumer products, with inputs:

- Quantified emission rates derived from chamber testing, according to the above constructed scenarios.
- Ventilation rates from literature (R: 0.3, S: 0.5, E: 0.75, W: 0.35 ach – Dimitroulopoulou, 2012) plus ventilation ‘zero’ (0.1 ach) to be proactive in case of ‘tightest’ future building regulations.
- Room volumes derived from data across EU countries (Dol and Haffner, 2010).

‘CONC_CPM’ model used:

\[
\text{CONC}_i = \frac{1}{V} \sum_{j=1}^{n} \left( \frac{E_j + C_{j-1} - C_i}{1 - e^{-\lambda_{j-1}t_{j-1}}} \right) - C_i
\]

Outcome: indoor air concentrations (µg/m³) in home microenvironments
- acute exposure (max 30 min rolling average)
- long-term exposure (24 h mean)

(3) Risk Characterization:

Comparison of microenvironmental modelling outcome with health-based limits of exposure – derived for the purposes of EPHECT for each target compound.

Selection of target compounds

On the basis of a literature review, evaluation of toxicological information from inhalation exposure studies and assessment of chamber testing results, the following pollutants were selected for HRA:

- naphthalene
- d-limonene
- α-pinene
- acrolein
- formaldehyde

Results

I. per target compound:

Max results per compound (30 min):

<table>
<thead>
<tr>
<th>Compound</th>
<th>Max result per compound (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrolein</td>
<td>0.88</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.07</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.07</td>
</tr>
<tr>
<td>D-limonene</td>
<td>0.07</td>
</tr>
<tr>
<td>α-pinene</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Max results per compound (24 h):

<table>
<thead>
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<th>Compound</th>
<th>Max result per compound (µg/m³)</th>
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</tr>
</tbody>
</table>

II. per consumer product class:

Results > 1 % of health-based limit of exposure:

<table>
<thead>
<tr>
<th>Product</th>
<th>Health-based limit of exposure (µg/m³)</th>
<th>Concentration exceedance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2 kitchen cleaning agent</td>
<td>0.05</td>
<td>17</td>
</tr>
<tr>
<td>A3 floor cleaning agent</td>
<td>0.05</td>
<td>17</td>
</tr>
<tr>
<td>A5 furniture polish</td>
<td>0.05</td>
<td>17</td>
</tr>
<tr>
<td>A6 candle</td>
<td>0.05</td>
<td>17</td>
</tr>
<tr>
<td>A11 electric air freshener</td>
<td>0.05</td>
<td>17</td>
</tr>
</tbody>
</table>

For each of the five target pollutants emitted from the selected consumer products tested, the estimated worst-case indoor air concentration in each microenvironment, resulting from the most representative conditions of single product use, was lower than the corresponding limit of exposure, both in the case of acute (30 min) and long-term (24 h) exposure.