A pragmatic risk assessment tool for assessing risks related to carcinogens

Josje Arts – Nouryon (former AkzoNobel Chemicals)
Introduction

- **Nouryon** (former AkzoNobel Chemicals) produces a whole array of specialty chemicals
- This global company has ~10,000 employees and 90 production units worldwide
- Carcinogens are occasionally used in production processes (e.g. formaldehyde is used to produce certain chelating agents (non-classified))
- As a sustainable company we try to protect our workforce, consumers and the environment ([Priority Substances Program](#) – phase out or restricted use of chemicals; since 2011)
- As an (inhalation) toxicologist I am dedicated to assess risks of chemical exposure
Hazard x Exposure = Risk

Hazard assessment:
1. Classification
2. OEL

EU-CLP Regulation:
- Acute toxicity: cat. 1, 2, 3, 4
- Irritation: cat. 1, 2A, 2B
- Sensitization: cat. 1A, 1B
- STOT SE/RE: cat. 1, 2

All based on: POTENCY

EU-CLP Regulation:
- CMR: cat 1A, 1B, 2

Based on: EVIDENCE

Cat. 1A: evidence in humans
Cat. 1B: strong evidence in animals
Cat. 2: limited evidence in animals

Mixtures
Cat. 1A: 0.1%
Cat. 1B: 0.1%
Cat. 2: 1%

Thus: not based on POTENCY
Carcinogenic substances in NL

- Official list of carcinogenic substances and processes
- Based on:
  - Annex VI (cat. 1A and 1B)
  - and as concluded by the Dutch Health Council (e.g. ethanol)

Examples:
- Ethanol  OEL: 260 mg/m3 (130 ppm)
- Formaldehyde OEL: 0.15 mg/m3 (0.12 ppm)

Other countries (mainly):
- 500-1000 ppm
- 0.3-0.5 ppm

Factor ~1000 difference in potency
Occupational Hygiene Risk Management (OHRM) Tool

- Started in 2011 – at that time, many substances were not REACH registered yet
- However, Dutch Labor Inspectorate wanted to have information on:
  1. An inventory of all chemicals in the workplace, including their hazards
  2. Evaluation of the risks
  3. Appropriate measures to control the risks
  4. How to safeguard the entire system

- OHRM tool accepted as good practice by the Dutch Labor Inspectorate
OHRM: Hazard class (HC); assigned by toxicologist
OHRM: Potential Degree of Exposure (PDE); assessed by technicians

Six determinants for inhalation exposure:

- Material Characteristics [MC]
- Manual Interaction [MI]
- Quantity Handled [QH]
- Aerosol Dispersion [AD]
- Duration of Task [DT]
- Degree of Dilution [DD]

\[
PDE = [MC] + [MI] + [QH] + [AD] + [DT] + [DD] \\
(0-18) = (0-3) + (0-3) + (0-3) + (0-3) + (0-3) + (0-3)
\]
OHRM: Risk Ranking Table

<table>
<thead>
<tr>
<th>Potential Degree of Exposure (PDE)</th>
<th>Hazard Class (HC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0-4</td>
<td>Green</td>
</tr>
<tr>
<td>5-8</td>
<td>Yellow</td>
</tr>
<tr>
<td>7-12</td>
<td>Yellow</td>
</tr>
<tr>
<td>13-15</td>
<td>Red</td>
</tr>
<tr>
<td>16-18</td>
<td>Red</td>
</tr>
</tbody>
</table>

Legend:
- Green: Low
- Yellow: Moderate
- Red: High
- Pink: Special attention
**Hazard class (HC) – based on COSHH essentials (UK-HSE)**

<table>
<thead>
<tr>
<th>HC</th>
<th>Hazard Statements</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All others not otherwise listed</td>
<td></td>
</tr>
</tbody>
</table>
| 2  | 302, 304, 312, 315, 319, 332, 335, 336, 361, 373 | H335 – moderately irritating  
H373 – sign. effects at 10-100 mg/kg bw  
H361 – sign. effects > 30 mg/kg bw |
| 3  | 301, 311, 314, 317, 318, 331, 335, 360, 371, 372 | H317 – moderate skin sensitizer  
H335 – strongly irritating  
H372 – sign. effects at 1-10 mg/kg bw  
H360 – sign. effects at 3-30 mg/kg bw |
| 4  | 300, 310, 317, 330, 341, 351, 360, 362, 370, 372 | H317 – strong skin sensitizer  
H372 – sign. effects at 0.1-1 mg/kg bw  
H360 – sign. effects at 0.3-3 mg/kg bw |
| 5  | 334, 340, 350 | In case of CM ask for expert advice to set exposure level |
## Hazard class (HC) – OHRM

<table>
<thead>
<tr>
<th>HC</th>
<th>Hazard Statements</th>
<th>Remarks</th>
<th>OEB (dust, no or slightly volatile) [mg/m³]</th>
<th>OEB (medium / high volatile) [ppm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All others not otherwise listed</td>
<td></td>
<td>&gt;1</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>
| 2  | 302, 304, 312, 315, 319, 332, 335, 336, 361, 373 | H335 – moderately irritating  
H373 – sign. effects at 10-100 mg/kg bw  
H361 – sign. effects > 30 mg/kg bw | >0.1-1 | >5-50 |
| 3  | 301, 311, 314, 317, 318, 331, 335, 360, 371, 372 | H317 – moderate skin sensitiser  
H335 – strongly irritating  
H372 – sign. effects at 1-10 mg/kg bw  
H360 – sign. effects at 3-30 30 mg/kg bw | >0.01-0.1 | >0.5-5 |
| 4  | 300, 310, 317, 330, 341, 350, 360, 362, 375, 372 | H317 – strong skin sensitizer  
H372 – sign. effects at 0.1-1 mg/kg bw  
H360 – sign. effects at 0.3-3 mg/kg bw | >0.001-0.01 | >0.05-0.5 |
| 5  | 334, 340, 350 | In case of CM ask for expert advice to set exposure level | ≤0.001 | ≤0.05 |

Volatile: ≥ 0.13 kPa (≥ 1 mm Hg)
<table>
<thead>
<tr>
<th>HC</th>
<th>OEB (dust, no or slightly volatile) [mg/m³]</th>
<th>OEB (medium / high volatile) [ppm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&gt;1</td>
<td>&gt;50</td>
</tr>
<tr>
<td>2</td>
<td>&gt;0.1-1</td>
<td>&gt;5-50</td>
</tr>
<tr>
<td>3</td>
<td>&gt;0.01-0.1</td>
<td>&gt;0.5-5</td>
</tr>
<tr>
<td>4</td>
<td>&gt;0.001-0.01</td>
<td>&gt;0.05-0.5</td>
</tr>
<tr>
<td>5</td>
<td>≤0.001</td>
<td>≤0.05</td>
</tr>
</tbody>
</table>

Ethanol (130 ppm)
Formaldehyde (0.12 ppm)
Conclusions / remarks

- Carcinogenic substances differ in potency; this also holds for genotoxic substances
- In case of genotoxic carcinogens, a DMEL approach is used to assess hazard class
- Exposure concentrations should be as low as possible
- To assess the real risk, a risk-based approach should be used – not only looking at hazard
- We use the OHRM tool within Nouryon globally
Thanks for your attention