Alternatives to Methylisothiazolinone and Chloromethylisothiazolinone in Leather Tanning

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2nd International Symposium on Alternatives Assessment
November 1, 2018
Leather Tanning Process

- LOTS of chemicals are used in leather production
- Chromates (80-95% of production), vegetable tannins or glutaraldehyde
- Fatliquoring agents
- Dyes, pigments and related chemicals
- Adhesives
- Finishes
- Antimicrobials
Leather Preservatives and Skin Sensitization

• Isothiazolones
  • Widely used in leather and other consumer products
  • Some are highly potent skin sensitizers/allergens
    • Methyisothiazolone (MI)/chloromethyl isothiazolone (MCI) used in combination as Kathon CG
    • Increasingly being restricted in cosmetics and other products
  • Sensitization exposure limit for MCI is 1.9 mcg/cm² skin surface area
Case Study

• Company produces consumer products of which leather wrist straps are one product option
  • New product models are rigorously tested for chemical leaching prior to release
• Testing reveals MI/MCI present in extracts of leather products
  • Most have acceptably low concentrations but a few fail and must be redesigned (at substantial time & cost)
Case Study

• **Question:** Are there alternatives to MI/MCI in leather that we can propose to our suppliers?

• **Solution:** Conduct an IC2 Stage 1 AA to see what options are possible

• **Goal:** Be able to have an informed conversation with suppliers about possible options
Initial AA Questions

• Can the chemical just be eliminated?
  • No. Due to the biological nature of leather, some antimicrobial is needed

• Can the company just avoid using leather?
  • No. Customers are asking for leather products.
Stage 1 IC2 AA Process

• High level review to see if data are available to support a more in-depth AA
• Limited to data that are readily available (no new research, no proprietary data)
• Modules: Hazard, Availability, Exposure, Performance, Cost
• Scope: Limited to alternatives actually in the market place
Process

• Identify Possible Biocides
• Being used/have been suggested for use in leather production or related processes
  • Manufacturer websites
  • Government reports
  • Journal articles
• Qualitative screen for Hazard, Exposure Potential, Performance, Availability and Cost
  • Pharos for hazard, EpiSuite for Phys/Chem data, on-line searches for performance, availability and cost
Biocides With Documented Use in Leather Tanning or Related Materials or Processes

• Sodium- dimethyldithiocarbamate
• Potassium-dimethyldithiocarbamate
• Phenoxyethanol
• 2 (Thiocyano methylthio) benzothiazole (TCMBT); also referred to as TCMTB
## Hazards of Alternatives (*via* Pharos)

<table>
<thead>
<tr>
<th>Common Chemical Name</th>
<th>Skin Sensitization</th>
<th>Carcinogenic</th>
<th>Mutagenic</th>
<th>Repro/Developmental</th>
<th>Ecological</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl isothiazolinone (CAS 2682-20-4)</td>
<td>Skin sensitizer. POD = 16.5 μg/cm²</td>
<td>Not flagged</td>
<td>Not flagged</td>
<td>Not flagged</td>
<td>Yes (GHS Very Toxic)</td>
<td>Eye Irritation (NZ, A) Skin Irritation (A) Endocrine (TEDEX) Acute Inhalation (A) Respiratory Irritation (EU)</td>
</tr>
<tr>
<td>Methylchloro isothiazolinone (26172-55-4)</td>
<td>Skin sensitizer. POD = 1.9 μg/cm²</td>
<td>Not flagged</td>
<td>Not flagged</td>
<td>Not flagged</td>
<td>Yes (GHS Very Toxic)</td>
<td>Acute Inhalation (A) Eye Irritation (NZ, A) Skin Irritation (A)</td>
</tr>
<tr>
<td>Sodium- dimethyl dithiocarbamate (128-04-1)</td>
<td>Possible sensitizer (structural alert). estimated POD = 250 μg/cm²</td>
<td>Not flagged</td>
<td>Yes (GHS Cat 2)</td>
<td>Yes (GHS Cat 2, Prop65)</td>
<td>Yes (GHS Cat 1)</td>
<td>STOT Single (J) Acute Oral (NZ) Skin Irritation (J)21564-17-0</td>
</tr>
<tr>
<td>Potassium-dimethyl dithiocarbamate (128-03-0)</td>
<td>Possible sensitizer (structural alert). estimated POD = 250 μg/cm²</td>
<td>Not flagged</td>
<td>Yes (GHS Cat 2)</td>
<td>Yes (GHS Cat 2, Prop65)</td>
<td>Yes (GHS Very Toxic)</td>
<td>No other hazards flagged</td>
</tr>
<tr>
<td>Phenoxyethanol (122-99-6)</td>
<td>Non-sensitizer</td>
<td>Not flagged</td>
<td>Not flagged</td>
<td>Yes (GHS Cat 2 but &gt;375 mg/kg)</td>
<td>Yes (GHS Harmful)</td>
<td>Acute Oral (EU) Eye Irritation (EU) STOT Single (J)</td>
</tr>
<tr>
<td>TCMBT (21564-17-0)</td>
<td>Skin sensitizer. POD = 25,000 μg/cm²</td>
<td>Not flagged</td>
<td>Not flagged</td>
<td>Yes (GHS Cat 2 but &gt;125 mg/kg)</td>
<td>Yes (GHS Very Toxic)</td>
<td>Endocrine (TEDEX) Acute Inhalation (EU) Eye Irritation (EU) Skin Irritation (EU) STOT Single (NZ)</td>
</tr>
</tbody>
</table>
# Results of Stage 1 AA

<table>
<thead>
<tr>
<th>Common Chemical Name</th>
<th>Performance</th>
<th>Hazard</th>
<th>Availability</th>
<th>Comparative Exposure</th>
<th>Comparative Cost per ton</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compounds of Concern</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methylisothiazolinone (CAS 2682-20-4)</td>
<td>Demonstrated use</td>
<td>Skin sensitizer, not reprotoxic, aquatic toxicity</td>
<td>Readily available</td>
<td>Existing chemicals</td>
<td></td>
</tr>
<tr>
<td>Methylchloroisothiazolinone (26172-55-4)</td>
<td>Demonstrated use</td>
<td>Skin sensitizer, not reprotoxic, aquatic toxicity</td>
<td>Readily available</td>
<td>Existing chemicals</td>
<td></td>
</tr>
<tr>
<td><strong>Possible Alternatives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium dimethyl dithiocarbamate (128-04-1)</td>
<td>Used in leather process, ability to replace</td>
<td>Possible skin sensitizer, mutagenic, Prop65 Repro hazard, aquatic</td>
<td>Readily available</td>
<td>Less volatile, more hydrophilic</td>
<td>Less</td>
</tr>
<tr>
<td></td>
<td>isothiazolones uncertain</td>
<td>toxicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium dimethyl dithiocarbamate (128-03-0)</td>
<td>Used in leather process, ability to replace</td>
<td>Possible skin sensitizer, mutagenic, Prop65 Repro hazard, aquatic</td>
<td>Readily available</td>
<td>Less volatile, more hydrophilic</td>
<td>similar</td>
</tr>
<tr>
<td></td>
<td>isothiazolones uncertain</td>
<td>toxicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phenoxyethanol (122-99-6)</td>
<td>Used in textile processing, replacing isothiazolones in some consumer products</td>
<td>Not sensitizing, repro at high concentrations (&gt;300 mg/kg), lowest aquatic toxicity</td>
<td>Readily available</td>
<td>Similar volatility, more hydrophobic</td>
<td>similar</td>
</tr>
<tr>
<td>TCMBT (21564-17-0)</td>
<td>Marketed for use in leather process, ability to replace MI/MCI unknown</td>
<td>Not sensitizing, repro at high concentrations, endocrine active, aquatic toxicity</td>
<td>Readily available</td>
<td>Less volatile, more hydrophobic</td>
<td>Substantially higher</td>
</tr>
</tbody>
</table>

Note: Cost data are highly uncertain and represent cost of bulk material, not cost accounting for different antimicrobial potency (no data available)
Key Findings

• MI/CMI actually have some benefits over most alternatives
• Phenoxyethanol offers the best trade off between sensitization and other health hazards
  • Not clear it could be used in leather tanning
• TCMBT is non sensitizing and is being marketed for use in leather production
  • Cost could be substantially higher, depending on relative potency
  • Reported endocrine activity needs to be evaluated more closely
• Company should contact suppliers, get input and explore possibilities
• Depending on supplier input, conduct a 2nd Stage AA
**Limitations**

- There are other chemicals of concern in leather (chromium VI, acrylate or formaldehyde based adhesives) – are we targeting the key concern?

- Available cost data are of extremely poor quality, specific prices depend on volume and contracting
  - What really matters is cost for equivalent antimicrobial effect for which data could not be located

- Difficult for a small purchaser to put pressure on suppliers to research new options
Questions?

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