Approaches for Deriving an OEL for Peracetic Acid and Occupational Risk Management

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Abstract

To provide perspectives on current and proposed occupational exposure limits (OELs) for peracetic acid (PAA, CAS 79-06-1) as an evolving PAA worker safety and health issue is important to pose its regulatory status and ongoing concerns. OELs are often established for rapidly acting sensory irritants that lack significant secondary or chronic tissue toxicity. Defined as rapid onset, transient, and dose-related responses, OELs provide crucial information to safety managers and limit the risk to worker health. Moreover, these OELs are not necessarily fixed and may change as the data and understanding evolve. For PAA, the data are limited and the OELs are subject to change as new data become available.

Table 1. Key Peracetic Acid Worker Exposure Studies and Effect Levels

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Duration</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>ppm</td>
<td>mg/m³</td>
</tr>
<tr>
<td>McDonagh (1997) (aerose)</td>
<td>3.5–5.0 ppm</td>
<td>11.5–16.7 mg/m³</td>
</tr>
<tr>
<td>Ferrier and Thorbison (1986) (aerose)</td>
<td>5.6 ppm</td>
<td>16.8 mg/m³</td>
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</tbody>
</table>

Table 2. Key Peracetic Acid Data from Animal Exposures

<table>
<thead>
<tr>
<th>Study</th>
<th>Species</th>
<th>Formulation</th>
<th>Duration</th>
<th>RD₅₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gagnaire et al. (2002), as cited by ACGIH, 2011; OCIID, 2008</td>
<td>Mouse</td>
<td>Pure peracetic acid vapor evaporated from a buffered (1% sodium bicarbonate) 75% peracetic acid, 45% acetic acid, and 0% hydrogen peroxide</td>
<td>3 hours</td>
<td>0.9 ppm (17 mg/m³)</td>
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Table 3. Summary of Potential and Existing Exposure Limits

<table>
<thead>
<tr>
<th>Value</th>
<th>Basis</th>
<th>Point of Deputation</th>
<th>Uncertainty Factor</th>
<th>Final Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>McDonagh (1997)</td>
<td>3.5–5.0 ppm</td>
<td>11.5–16.7 mg/m³</td>
<td>2.5 (multiplicator)</td>
<td>26–26.15 mg/m³ (95%–99.5% confidence)</td>
</tr>
<tr>
<td>Ferrier and Thorbison (1986)</td>
<td>5.6 ppm</td>
<td>16.8 mg/m³</td>
<td>2.5 (multiplicator)</td>
<td>36–1.56 mg/m³</td>
</tr>
</tbody>
</table>

Background

- Produced from the acid-catalyzed reaction between acetic acid and hydrogen peroxide (Levon and Meron, 2000).
- Technical grade of peracetic acid contains approximately 40% PAA in aqueous and wetted hydrochloric-acid solution (MGGH, 2013).
- Used commercially as a bacteria intermediate, bleaching agent, and surfactant, as well as in the formation of epoxides, epoxy resin, and the bleaching of textiles.
- Neutralizing chemistry that is highly temperature sensitive. Lower concentrations can irritate to eye and mucous membranes.
- Vapor pressure of 4.34 mbar at 25°C. Saturated vapor concentration of 70.9 ppm (ACGIH, 2013).
- Benger color with a clearly established threshold. Color can serve as a warning property for the presence of atmospheric PAA.
- Atmospheric monitoring of PAA can be problematic, particularly in atmospheres with appreciable levels of H₂O and/or hydrocarbon products.

Time-Averaging Approach - TWA, Ceiling or STEL

- Ceiling limits established for rapidly acting sensory irritants that lack significant secondary or chronic tissue toxicity. Ceiling limits should protect against both acute irritation and secondary reactions that could accumulate over time. Acute irritant effects of PAA can be transient, and eye irritation can be significant. Inappropriate dose information (if available) can ensure that the limits are lower than the onset of sensory irritation, thereby reducing subclinical observations.
- Then, a ceiling limit approach is recommended.

- A short-term exposure limit (STEL), can provide perspectives from non-acute and maintenance effects such as irritative irritation.
- The TWA is typically synonymous with a STEL derived exposure to nuisance exposures from longer term exposures.
- Overall Conclusions

- We calculated potential TWA OELs ranging from 0.26 to 1.56 mg/m³. This is similar to the range of 0.62 to 2 mg/m³ found among the published OELs.
- Any value within the range could be justified as pertinent to worker health in light of the uncertainty in the data and the precision of the OEL methodology.
- More definitive sensory irritation studies would further clarify selection of a value in the range.
- The ultimate OEL choice is a policy-based risk management decision, not a scientific one.
- The optimal time-averaging approach is not clearly established by the data; however, a combination of a TWA with a STEL is recommended as a preferred risk management option.

References

ECHA Worker Datasheets, local of facts – acute / long-term exposure. Endurox OSHA data sheets.

Recommendations/Conclusions Regarding Time-Averaging

- Based on MAA considerations, PAA may have longer-term effects. For which a TWA or STEL approach alone does not provide adequate protection.
- The selection of a TWA without a STEL should be driven by the absence of robust longer-term effects data.
- The use of a TWA with a STEL at a high concentration reflects the different biological responses (sensory irritation and cytotoxicity) in ways that give the STEL added significance.
- The use of a TWA with a STEL may also be a better reflection of the temporal pattern in biology, since some elements of the irritation response are not completely independent of exposure duration.
- The use of a TWA and STEL together provides meaningful guidance for exposure limits and is consistent with current practices.