Chlorinated and Brominated Solvents Exposure Study

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Background

- Chlorinated and Brominated solvents are found in many products used at AEP
- Many of these products are associated with potential health effects
- Recent evidence of health effects for 1-BP suggests that it may be the most hazardous product in this solvent class
Background: Chemicals In Question

- Chlorinated solvents are part of a larger group of chemicals known as chlorinated hydrocarbons. Over time some have become used as industrial solvents because of their non-polar structure and low molecular weight.
- Some chlorinated solvents have been banned due to environmental and health reasons: 1,1,1, Trichloroethane, Chloroform, Carbon Tetrachloride,
- Others remain popular as solvents: Methylene Chloride (MC), Trichloroethylene (TCE) and Perchloroethylene (PERC).
- Since MC is already heavily regulated by OSHA, the focus of this study was TCE and PERC.
Background: Chemicals In Question

• Brominated solvents are similar to chlorinated solvents, but with bromine attached to organic compounds in place of chlorine

• While there are a number of these solvents 1-Bromopropane (1-BP) was the only one that was a part of this study

• 1-BP is used as an adhesive solvent and increasingly a replacement for MC in cleaners and degreasers

• 1-BP is relatively new to industry and has increased in use since some chlorinated products were banned in the 1990s
# Exposure Limits

<table>
<thead>
<tr>
<th>Chemical</th>
<th>PEL (ppm)</th>
<th>TLV (ppm)</th>
<th>REL¹ (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform</td>
<td>50 (ceiling limit)</td>
<td>10</td>
<td>2 (60 min. EL²)</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>10</td>
<td>5</td>
<td>2 (60 min. EL)</td>
</tr>
<tr>
<td>MC</td>
<td>25</td>
<td>50</td>
<td>LFC³</td>
</tr>
<tr>
<td>TCE</td>
<td>100</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>PERC</td>
<td>100</td>
<td>25</td>
<td>LFC</td>
</tr>
<tr>
<td>1-BP</td>
<td>None</td>
<td>0.1</td>
<td>None</td>
</tr>
</tbody>
</table>

1 – Recommended Exposure Limit by the National Institute for Occupational Safety and Health.  
2 – Excursion Limit  
3 – Lowest Feasible Concentration
Background: Health Concerns

• TCE was originally introduced as a replacement anesthetic for chloroform, but was found to have the same cardiac affects as chloroform as well as liver and kidney toxicity

• PERC was thought to be a safe alternate for carbon tetrachloride. While less potent than carbon tetrachloride, it is still toxic to liver and kidney tissue and has neurological, cardiac and immune effects

• Both TCE and PCE are listed as suspected carcinogens
Background: Health Concerns

• 1-BP was initially considered a safe alternate to MC
• Mounting evidence, including high profile industry exposure events, demonstrate that 1-BP has neurological effects, may be toxic to liver tissue and a suspected reproductive toxin.
• 1-BP is as suspected carcinogen
• OSHA issued a Hazard Alert on 1-BP and the ACGIH lowered the TLV from 10 ppm to .1 ppm in 2014
Methods and Materials

• First Developed a Spreadsheet of Chemical Products and Locations using AEP Hazcom Database and CAS numbers
• Using the Spreadsheet, Surveys were sent to sites regarding the product usage. (application method, amounts used, frequency, etc.)
• Air Sampling was conducted using 3M 3500 Organic Vapor Badges and Analysis Conducted by an AIHA Approved Lab
Sampling Results

• During the survey it was determined that the Regional Service Organization (RSO) were using large amounts of a product called Z-99 which contained 94% TCE in a way which was predictable enough to permit air sampling.

• Eight full shift air samples were collected using 3M 3500 organic vapor badges during the work which consisted of cleaning turbine parts during an outage.
Sampling Results (cont.)

- The results ranged from .73 ppm to 110 ppm.
- The low result was a worker not actually handling the material, but in the area.
- The high result may have been biased when material reportedly splashed on the badge.
- Other samples ranged from 4.3 ppm to 29 ppm.
<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Work Description</th>
<th>Time (min.)</th>
<th>TCE Result (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTF14-01</td>
<td>Cleaning coupling bolts, spray bolts and/or nuts with Z-99, wipe with rag, use wire brush attached to electric drill, polish with Scotch Brite pad attached to pneumatic grinder, open area, another employee performing similar task 5’ away, used 3 cans (18 oz.) of Z-99 during sampling period.</td>
<td>480</td>
<td>4.0</td>
</tr>
<tr>
<td>WTF14-02</td>
<td>Cleaning coupling bolts, spray bolts and/or nuts with Z-99, wipe with rag, use wire brush attached to electric drill, polish with Scotch Brite pad attached to pneumatic grinder, open area, another employee performing similar task 5’ away, used 4 cans (18 oz.) of Z-99 during sampling period.</td>
<td>480</td>
<td>12</td>
</tr>
<tr>
<td>AMU3040814-1</td>
<td>Cleaning the HP#3 bearing using Z-99, used rag to wipe the area that had been sprayed, cleaned for 1-hour during sampling period and used half of an 18 oz. can, open area on tables.</td>
<td>480</td>
<td>16</td>
</tr>
<tr>
<td>AMU3040814-2</td>
<td>Cleaning the HP#3 bearing using Z-99, used rag to wipe the area that had been sprayed, cleaned for 1-hour during sampling period and used half of an 18 oz. can, open area on tables.</td>
<td>480</td>
<td>6.3</td>
</tr>
<tr>
<td>AMU3040914-1</td>
<td>Cleaning the rotor and IP shell with Z-99, used a rag to wipe the area that had been sprayed, cleaned for approximately 2-hours during sampling period, used approximately 2.5 cans (18 oz.), open area on tables, employee stated that some of the Z-99 may have splashed back toward the sampling media.</td>
<td>480</td>
<td>110</td>
</tr>
<tr>
<td>AMU3040914-2</td>
<td>Cleaning the turning gear with Z-99, used a rag to wipe the area that had been sprayed, cleaned for 3-4 hours during sampling period, used approximately 5 cans (18 oz.), open area on tables.</td>
<td>480</td>
<td>29</td>
</tr>
<tr>
<td>AMU3040914-3</td>
<td>Cleaning parts with Z-99, used a rag to wipe areas that were sprayed, cleaned for approximately 1-2 hours, used approximately 1 can (18 oz.), open area on tables.</td>
<td>480</td>
<td>13</td>
</tr>
<tr>
<td>AMU3040914-4</td>
<td>Cleaning the HP #3 bearing with Z-99. This employee did not use Z-99 during the shift but was working beside an employee who did, open area on tables.</td>
<td>480</td>
<td>0.73</td>
</tr>
</tbody>
</table>
Conclusions

• Use of chlorinated and brominated solvents is widespread and there are opportunities to control purchase and use of these chemicals
• Typical use and exposure to these chemicals is limited in duration and quantity such that they would not be expected to exceed occupational exposure limits
• Use of these products in a confined area would carry a greater potential for exposure
• Heavy use of PERC and TCE can exceed occupational exposure limits
• Even light use of 1-BP has the potential to exceed occupational exposure limits since it has such a low TLV
Recommendations

- Corporate IH added TCE, PERC and 1-BP to mandatory IH review list
- Corporate IH distributed “Chlorinated and Brominated Solvent Study Product List” (spreadsheet) to field
- Corporate IH is working with Procurement to identify alternate products/opportunities
- Field locations to evaluate the use of products containing the target chemicals
Recommendations (Cont.)

• Field Locations will use replacement products and techniques when possible
• Field Locations will use appropriate PPE
• Field Locations will avoid 1-BP unless it is absolutely necessary
Questions?