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Maine Worksite Wellness Initiative
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Status of Legal and Recommended Occupational Airborne Exposure Limits: OSHA PELs and ACGIH TLVs, A Quantitative Examination
Topics

- Background
  - Origins & connections between most commonly used air contaminant limits
    - Definitions/terms
  - Difference between air limits and comprehensive health standards
- Examination of substances with carcinogen designations
- Case study
Background

- Dec. 1970 – Congress Passes the OSH-Act
  - gave 2-year window for the new agency to adopt existing standards
- May 1971 – Air Limits Adopted:
  - ACGIH 1968 TLVs ~ 450 (“Z-1 Table”)
  - ANSI Z-standards ~ 21 (“Z-2 Table”)
  - ANSI mineral dusts ~ 9 (“Z-3 Table”)
  - Found in CFR 1910.1000
Definitions/Background

- Newly adopted air contaminant limits termed: Permissible Exposure Limits (PELs)
- Since adoption:
  - Few PEL values have changed (e.g. lowered)
  - Few PELs for other substances created
  - Exception: Comprehensive Health Stds.
- Shortcomings:
  - Adopted limits did not receive adequate (or any?) vetting
  - OSH-act did not provide for change/updating process over time
Background

- American Conference of Governmental Hygienists
  - ACGIH - professional, non-profit scientific association
  - Membership from academic, governmental, military and private sectors
  - Process for TLV updates & changes:
    - Annual report (published early February):
      - NIC list: proposed changes (values, designations, new substances, etc.)
      - Lists substances/changes adopted
Background

- ACGIH
  - “Documentations” provide rational for TLVs & Designations:
    - “A1, A2, A3, A4, or A5” (carcinogens)
    - “Skin” (absorption viable exp. route)
    - Sen” (skin or respiratory sensitizer)
  - BEIs – Biological Exposure Indices
  - TLVs generally regarded as “state of science”
Background

- ACGIH position:
  - Non-profit scientific association
  - Not a standards-setting body
  - TLVs & BEIs expression of scientific opinion
  - TLVs & BEIs based solely on health factors, not technical or economic feasibility
  - Since 2002 lawsuits, state and federal entities advised not to use TLVs as basis for citations
Background

- Occupational Exposure Limit (OEL)
  - Generic term, can apply to:
    - OSHA PELs
    - ACGIH TLVs
    - NIOSH RELs
    - AIHA WEELs
    - Manufacturer limits (DuPont)
    - Other countries (German MAKs)
Air Limit Limitations

- Other routes of entry for substances
- Variability (what’s the distribution?)
- Tendency to regard levels as distinguishing between “safe” and “unsafe”
- Focuses on individual substances, mixtures seldom addressed
Background

- What is an Occ. Exposure Limit (OEL)?

The average airborne conc. of a substance required or recommended not to be exceeded.

- Usually over an 8-hr shift;
- Exceptions: STELs & Ceiling values

2003: Monitoring Al dust exposure during changing of dust collector cylinder filters.

OSHA PEL: 15mg/m³(T), 5mg/m³(R)
ACGIH TLV: 1mg/m³(R) - 2008
Background: Number of OELs

- TLVs (734)
- RELs (677)
- PELs (480)
PEL Background

- 1988 - OSHA Air Contaminant Initiative:
  - Lowered PELs for 212 substances, new limits for 164 - all mostly to ’89 TLVs
  - July, 1992 – 11th circuit court vacated entire rulemaking
  - March, 1993 – OSHA reverts back to enforcing 1971 levels (’68 TLVs)
  - Exception: some states with OSHA plans maintained 1989 changes.
PEL Background

- Lowering of a PEL has been accomplished through promulgating Comprehensive Health Standards
  - 1971-2007 - 29 CHS:
    - 15 substance-specific with air limits
    - 1 non-specific with an air limit
    - "13 carcinogens" – no air limits
PEL Background

- Each CHS has similar template:
  - Action Level – usually 50% of (new) PEL
  - Initial & periodic air monitoring (e.g. process changes)
  - Medical surveillance & Training (>AL)
  - Signs and Labels
  - Record Keeping
  - Abatement of exposure (>PEL) via engineering, admin., PPE controls

- Some CHS PELs/ALs lower than TLVs
## 15 CHS With Air Limit Triggers

<table>
<thead>
<tr>
<th>Substance</th>
<th>Year Promulgated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>1971</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>1975</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>1978</td>
</tr>
<tr>
<td>1,2-dibromo-3-chloropropene</td>
<td>1978</td>
</tr>
<tr>
<td>Inorganic Arsenic</td>
<td>1978</td>
</tr>
<tr>
<td>Lead</td>
<td>1979</td>
</tr>
<tr>
<td>Cotton Dust</td>
<td>1980</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>1984</td>
</tr>
<tr>
<td>Benzene</td>
<td>1987</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>1988</td>
</tr>
<tr>
<td>Cadmium</td>
<td>1992</td>
</tr>
<tr>
<td>Methylenedianiline</td>
<td>1992</td>
</tr>
<tr>
<td>1,3-Butadiene</td>
<td>1996</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>1997</td>
</tr>
<tr>
<td>Hexavalent chromium</td>
<td>2007</td>
</tr>
</tbody>
</table>
Other CHS

- **Coke Oven Emissions – 1977**
  - Non-specific, total particulate matter during the destructive distillation of coal for production of coke.

- **“13 Carcinogens”- No Airborne Limits**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Year Promulgated</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Nitrophenyl</td>
<td>1974</td>
</tr>
<tr>
<td>Alpha-Naphthylamine</td>
<td>1974</td>
</tr>
<tr>
<td>Chloromethyl ether</td>
<td>1974</td>
</tr>
<tr>
<td>3,4-Dichlorobenzidine (and salts)</td>
<td>1974</td>
</tr>
<tr>
<td>Bis-Chloromethyl ether</td>
<td>1974</td>
</tr>
<tr>
<td>Beta-Naphthylamine</td>
<td>1974</td>
</tr>
<tr>
<td>Benzidine</td>
<td>1974</td>
</tr>
<tr>
<td>4-Aminodiphenyl</td>
<td>1974</td>
</tr>
<tr>
<td>Ethyleneimine</td>
<td>1974</td>
</tr>
<tr>
<td>Beta-propiolactone</td>
<td>1974</td>
</tr>
<tr>
<td>2-Acetylaminoethylfluorene</td>
<td>1974</td>
</tr>
<tr>
<td>4-Dimethylaminoazo-benzene</td>
<td>1974</td>
</tr>
<tr>
<td>N-Nitrosodimethylamine</td>
<td>1974</td>
</tr>
</tbody>
</table>
ACGIH Carcinogens

- ACGIH may propose/adopt carcinogen designation to a substance w/ or w/out numerical TLV change:
  - A1 = Confirmed Human Carcinogen
  - A2 = Suspected Human Carcinogen
  - A3 = Confirmed Animal Carcinogen with Unknown Relevance to Humans
  - A4 = Not Classifiable as a Human Carcinogen
  - A5 = Not Suspected as a Human Carcinogen
ACGIH Carcinogens

- Current count: 343/734 (~47%) TLVs have a carcinogen designation
- Almost all designations post-1970
  - Cancer latency periods (e.g. post WWII)
  - Health studies/review processes
  - Advances in science/epidemiology
- Substances now known or suspected to be cancer-causing weakly reflected in OSHA numerical PELs
  - Exception - CHS
ACGIH Carcinogens

Distribution of Carcinogen Designations (of 734 TLVs)
ACGIH Carcinogens: A1, A2, A3

![Chart showing 2011 TLVs & PELs for ACGIH (A1, A2, A3), OSHA, and ACGIH (post-1968).]
ACGIH Carcinogens: A1, A2, A3

ACGIH/OSHA Overlap

- TLVs & PELs: 113
- CHS with PELs & Al's: 13
- CHS without PELs: 10
- CHS w/out PELs, but w/ TLVs: 3
Decade PEL Value Adopted

- Represents 78/159
- 12 Substances have same PEL/TLV values
ACGIH 46 Post-1968 Carcinogens

![Bar chart showing designations and redesignations for A1, A2, A3, and A1/A2 to A3 categories.]
ACGIH 1996 Carcinogen Changes

The graph illustrates changes in carcinogen designations from 1996. It compares the number of substances categorized as All Designations (65) and those categorized as A1/A2 to A3 (24).
"Skin" Designations

Note: 19/36 are post-1968 TLVs
TLV/PEL Values: Magnitudes of Differences

(Note: 60/159 comparable)
Field Considerations: Molybdenum (Mo) Exposure Assessment

- Mo OELs:
  - OSHA
    - 15mg/m³ metal
    - 5mg/m³ soluble compounds
  - ACGIH
    - 0.5mg/m³ (R) soluble compounds – A3
    - 10mg/m³ (I) metal & insoluble compounds
    - 3mg/m³ (R) metal & insoluble compounds

Employee passing hot ingots through a rolling mill.
Field Considerations: Molybdenum (Mo) Exposure Assessment

- **Considerations:**
  - 15mg/m³ PEL for metal/insoluble compounds est. in 1961
    - TLV lowered to 10mg/m³ in 1971
    - 1989 Vacated PEL, proposed: 10mg/m³
  - 5mg/m³ for soluble compounds est. in 1956
  - 0.5mg/m³ (R) TLV & A3 designation first proposed in 1999, adopted 2001
    - A2 proposed in 2001, w/drawn in 2003 due to insufficient human data
  - 3mg/m³ (R) for metallic & insoluble compounds also adopted in 2001
Field Considerations: Molybdenum (Mo) Exposure Assessment

- Is the Mo in soluble or insoluble form?
  - Depends upon oxidation
    - MoO$_2$ – insoluble
    - MoO$_3$ – soluble

- Is respirable dust present?
  - Hot processes
  - Grinding performed

- Is this assessment a regulatory evaluation or health evaluation?
Field Considerations: Molybdenum (Mo) Exposure Assessment

- Another wrinkle
  - Differences in sampling techniques & cassettes:
    - Total – 37mm cc cassette
    - Inhalable – IOM sampler
    - Respirable
      - Nylon cyclone per OSHA
      - Aluminum cyclone per ACGIH
Final Thoughts

- New paradigm for addressing exposure to substances
  - OSHA failure to update/add PELs over 40 years long standing issue in OH&S profession
  - Complexities, challenges & ethical dilemmas faced by occ. hygienists
  - TLVs & other OELs help, but not the whole solution