Objectives

- Basic concepts and terminology of air sampling
- Units of concentration
- Exposure limits for air contaminants
- Methods of sampling strategy
- Appropriate use of and types of IH sampling equipment
- Hands on demonstrations
Basic Air Sampling

What is industrial hygiene?

Chemical
- Gases
- Vapors
- Fumes
- Dusts
- Fibers
- Mists

Physical
- Temperature
- Noise
- Repetitive Motion & Awkward Postures
- Ionizing & Non-Ionizing Radiation

Biological
- Fungi (Mold)
- Bloodborne Pathogens
- Bacteria
- Poisonous Plants
- Poisonous & Infectious Animals
Chemical Hazards

- gases (Carbon Monoxide, Carbon Dioxide, Acetylene, Oxygen)
- vapors (Acetone, Toluene, MEK)
- fumes (Asphalt, diesel, welding)
- dusts (Wood, limestone)
- fibers (Asbestos)
- mists (Oil Mist)

Routes of Entry

- Inhalation
- Ingestion
- Absorption
- Injection
- Alveoli
Chemical Health Effects

- Acute
- Chronic
- Local
- Systemic

Units of Concentration

- PPM – Parts Per Million
- MG/M$^3$ – Milligrams per cubic meter
- UG/M$^3$ – Micrograms per cubic meter
- F/CC – Fibers per cubic centimeter
Part Per Million (ppm)

Four (4) eye drops in a 55 gallon drum is equivalent to 1 part per million (1 ppm).

Milligrams per Cubic Meter of Air (mg/m³)

Example:
[One (1) packet of artificial sweeter is 1 gram]

One (1) packet of artificial sweeter in the volume of the Empire State Building is equivalent to 1 microgram per cubic meter of air (1 μg/m³).

Approximate Volume = 1,000,000 m³
Micrograms per Cubic Meter of Air (µg/m³)

X 1 = (1 µg/m³)

X 50 (artificial sweetener packets) = 50 µg/m³ (OSHA PEL for Lead).

Empire State Building

Fibers per Cubic Centimeter (f/cc)

Fiber – Means a particulate form of asbestos, 5 micrometer (µm) or longer, with a length-to-width ratio of at least 3 to 1.
OSHA PEL for Asbestos

0.1 f/cc is equivalent to the number of fibers on the tip of a pencil mixed in with the volume of ten refrigerators.

Average amount of air a worker breathes during an 8-hour shift (ten refrigerators).

Respirable Particles

Respirable Dust, e.g., Lead, Silica & Asbestos (<10 µm)

Human Hair (80 – 120 µm)

A lower case 'o' when printed in Times New Roman size 10 (1mm).

Large Dog

0.000001 Micron (µm) 0.001 Millimeter (mm) 0.01 Centimeter (cm) 0 1 Meter (m)
Exposure Limits – Air Contaminants

• OSHA – Occupational Safety and Health Administration - Permissible Exposure Limits (PELS)

• NIOSH – National Institute for Occupational Safety and Health – Recommended Exposure Limits (RELS)

• ACGIH – American Conference of Governmental Industrial Hygienist – Threshold Limit Values (TLVs)
OSHA Permissible Exposure Limits

- **Time Weighted Average (TWA)**
  - Average employee exposure over an 8-hour period
- **Action Level (AL)**
  - Exposure level at which some OSHA regulations set to protect employees takes effect
- **Ceiling Limit (C)**
  - Maximum allowable level.
- **Short Term Exposure Limit (STEL)**
  - Level that must not be exceeded when averaged over a specified short period of time - usually 15 minutes

1910.1000

Derived from 1968 ACGIH* TLV® booklet

*American Conference of Governmental Industrial Hygienists
### 1910.1000 Examples

<table>
<thead>
<tr>
<th>Substance</th>
<th>8-hr TWA</th>
<th>Ceiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>1000 ppm</td>
<td></td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>50 ppm</td>
<td></td>
</tr>
<tr>
<td>Hydrogen Chloride</td>
<td></td>
<td>5 ppm</td>
</tr>
<tr>
<td>Particulates not otherwise regulated (PNOR)</td>
<td></td>
<td>15 mg/M³, Total dust 5 mg/M³, Respirable fraction</td>
</tr>
</tbody>
</table>

NOTE: The employer must ensure no employee exceeds any PEL.

### 1910.1000(b) - Table Z-2

<table>
<thead>
<tr>
<th>Substance</th>
<th>8-hr TWA</th>
<th>Ceiling</th>
<th>Peak</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Disulfide</td>
<td>20 ppm</td>
<td>30 ppm</td>
<td>100 ppm</td>
<td>30 min</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>20 ppm</td>
<td>50 ppm</td>
<td></td>
<td>10 min</td>
</tr>
<tr>
<td>Styrene</td>
<td>100 ppm</td>
<td>200 ppm</td>
<td>600 ppm</td>
<td>5 min in any 3 hrs</td>
</tr>
<tr>
<td>Toluene</td>
<td>200 ppm</td>
<td>300 ppm</td>
<td>500 ppm</td>
<td>10 min</td>
</tr>
</tbody>
</table>
OSHA adopted this table from the American Conference of Governmental Industrial Hygienist’s (ACGIH) mineral limits.

<table>
<thead>
<tr>
<th>Substance</th>
<th>PEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline Silica (Respirable fraction)</td>
<td>10mg/M³</td>
</tr>
<tr>
<td></td>
<td>% Sio2 + 2</td>
</tr>
<tr>
<td>Coal dust (&lt; 5% SiO2)</td>
<td>2.4 mg/M³</td>
</tr>
<tr>
<td>Nuisance dust</td>
<td>15 mg/M³</td>
</tr>
<tr>
<td>Respirable dust</td>
<td>5 mg/M³</td>
</tr>
</tbody>
</table>
How to Find Health Hazards

- Review MSDS or SDS
- Review Processes in all Departments/Areas looking for health & physical hazards
- Review Past Air Sampling Records
- Create Spreadsheets to make it visual (Documentation)
- Prioritizing health hazards to evaluate

Facility Health Audit

- Looking for Part A/Part B products
- Brake Cleaners/Carburetor Cleaners
- Spray Booths….Isocyanates/Formaldehyde
- Stainless Steel Welding…..Hex Chrome
- Dust Exposures…Sanding, Cutting, Welding
- Forktrucks….Carbon Monoxide
During Walkaround

- Corrosive Materials…changing out totes… PPE - Chemical goggles / faceshield, gloves, safety shower / eyewash – tested weekly

- Lead Solder & other lead products

- Health Rating of 2 or 3 on labels (older)
- New - Hazard communication 2012 (GHS) 0 or 1 on labels will become the more hazardous chemicals

Screen and or Sample

- Screening (shorter period of time) sec/mins
  - Hazardous chemicals - detector tube and air sampling pump, direct reading monitor
  - Noise (Sound level meter)
- Sampling (longer period of time) hours
  - Hazardous chemicals - media and air sampling pump, air sampling badges
Types of Instruments

- Pumps - send samples to lab
- Direct reading - electronic
  - Instantaneous
- Detector tube - read stain from chemical reaction
  - Cylinder or bellows pump
  - Passive tube - usually dosimeter

Pump Sampling

- Wide variety of media for many contaminants
- Very accurate - + or - 5 % typical
- Must wait for results
Direct Reading Instruments

- Instant results - printout or display
- Can be expensive
- Must replace sensors
- Can be delicate
- Hybrids - chip readers. Chemical / electronic
Detector Tubes / Badges

- Instant results
- Inexpensive pumps
- Badges – usually TWA sampling
  - Wait for results from lab
  - Usually not the best accuracy - 25 to 35% typical
- Tube usually specific for contaminant
- Tubes degenerate by time
Miscellaneous to Observe

- Calibrate before and after
- Intrinsic safety
- Suitability for method, accuracy, conditions, etc.
- Often less expensive to rent
Sampling Guidelines

• Manufacturer

• OSHA health standard may specify

• www.osha.gov

• www.cdc.gov

• acgih_pubs@pol.com

Summary

• Looking for health hazards
• Chemical health effects
• Routes of entry
• Units of concentration
• Exposure limits
• Screening versus sampling
• Types of sampling instruments
• Sampling guidelines
Questions?

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