A Field Practitioner’s Collaborations to Produce the Best Sampling Results

Cynthia A. Ostrowski, MS, CIH, FAIHA
CAO Consulting, LLC
What are my options?

TRADITIONAL SAMPLING

VS

DIRECT READING TECHNOLOGIES
PURPOSE OF SURVEY

- Prevention
- Compliance
- Injury/illness investigation
- Complaints
- Engineering controls
- Use PPE
Develop Sampling Strategy

Based on Exposure Assessment
- Understand processes, tasks
- Observations
- Interviews
  - workers
  - maintenance
  - management
Develop Sampling Strategy

- Safety Data Sheets (SDSs)
- Previous exposure monitoring results
- Occupational exposure limits (OEL)
- Engineering controls
- Personal protective equipment (PPE)
- Personal vs. area sample
Choose Traditional Sampling

* Pumps and media
* Passive dosimeter badges
* Diffusion tubes
* Gas detector tubes
PASSIVE DOSIMETER BADGES
DIFFUSION TUBES
GAS DETECTOR TUBES
SELECT AN ACCREDITED LABORATORY
What is Accreditation?

- Recognition of an entity’s competence against a specific standard
- A means for regulators and consumers to identify and select goods/services for which they can have confidence
Standard for Accrediting Laboratories

* International industry standard for accreditation of laboratory testing
ISO/IEC 17025 Accreditation Means...

* The testing laboratory has been assessed and determined to be in compliance with the Standard

* Meets both technical competence and management system requirements necessary to consistently deliver technically valid test results
AIHA began accrediting IH laboratories in 1974

AIHA Laboratory Accreditation Programs, LLC which was formed in 2009 by AIHA

AIHA-LAP accredits all testing labs to the ISO/IEC 17025 Standard

Go to website at www.aihaaccreditedlabs.org
AIHA-LAP

- Industrial Hygiene (IHLAP)
- Environmental Lead (ELLAP)
- Environmental Microbiology (EMLAP)
Accreditation Requirements

* Annual application
* Site assessment *(ISO:IEC 17025:2017)* every 2 years
  - Field of Testing (FoT)
  - Proficiency Analytical Testing (PAT) scores
* Technical support
Field of Testing (FoT)

VERIFY LABORATORY SCOPES

* Gas Chromatography (GC) for Solvents
* Phase Contrast Microscopy (PCM) for Asbestos in air
* Inductively Coupled Plasma (CP) for Metals
* Many more
Review pros and cons of sampling options

- Passive vs. active
- Different media choices
- Different analytical techniques
- Different levels of sensitivity (LOQ or RL)
<table>
<thead>
<tr>
<th>Analyte Name</th>
<th>Method</th>
<th>Technique</th>
<th>Media</th>
<th>Flow Rate (Lpm)</th>
<th>Air Volume (L)</th>
<th>RL (μg)</th>
<th>Compatibility Code</th>
<th>Special Handling Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic Acid Scan</td>
<td>NIOSH 7903</td>
<td>IC</td>
<td>SG-T12 (SKC 226-10-03 OR ORBO 53)</td>
<td>0.2-0.5</td>
<td>3-100</td>
<td>Varies 3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Iodine</td>
<td>OSHA ID-212</td>
<td>Wet Chem</td>
<td>Carbon bead-T (SKC 226-80)</td>
<td>0.5</td>
<td>≥5</td>
<td>5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>NIOSH 7300/7303</td>
<td>ICP</td>
<td>MCE (or PVC-PW w/ total dust)</td>
<td>1-4</td>
<td>5-100</td>
<td>1</td>
<td>7</td>
<td>Do not exceed 2 mg of total dust on filter.</td>
</tr>
<tr>
<td></td>
<td>OSHA ID-125G</td>
<td>ICP</td>
<td>MCE (or PVC-PW w/ total dust)</td>
<td>2</td>
<td>30-480</td>
<td>1</td>
<td>8</td>
<td>Welding fumes method.</td>
</tr>
<tr>
<td>Isoamyl alcohol</td>
<td>NIOSH 1405 (OSHA 7)</td>
<td>GC/FID</td>
<td>CT (SKC 226-01)</td>
<td>0.01-0.2</td>
<td>1-10</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Isobutyl acetate</td>
<td>NIOSH 1450 (OSHA 7)</td>
<td>GC/FID</td>
<td>CT (SKC 226-01)</td>
<td>0.01-0.2</td>
<td>1-10</td>
<td>3</td>
<td>1</td>
<td>OSHA 1009 is written for passive badges (SKC 575-002 and SKC 3520). Lab will cite equivalent analytical method (OSHA 7).</td>
</tr>
<tr>
<td>Isobutyl alcohol</td>
<td>NIOSH 1405 (OSHA 7)</td>
<td>GC/FID</td>
<td>CT (SKC 226-01)</td>
<td>0.01-0.2</td>
<td>2-10</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Isophorone</td>
<td>NIOSH 2508 (OSHA 7)</td>
<td>GC/FID</td>
<td>Anasorb 747 (SKC 226-81A)</td>
<td>0.01-1.0</td>
<td>2-25</td>
<td>3</td>
<td>-</td>
<td>Store cold.</td>
</tr>
<tr>
<td>Isophorone diisocyanate (IPDI)</td>
<td>OSHA 42</td>
<td>HPLC</td>
<td>GFF-T11 (SKC 225-9002)</td>
<td>1</td>
<td>15</td>
<td>0.4</td>
<td>4</td>
<td>Store cold; sample opened-faced; protect from light.</td>
</tr>
<tr>
<td>Isooctyl acetate</td>
<td>NIOSH 1450</td>
<td>GC/FID</td>
<td>CT (SKC 226-01)</td>
<td>0.01-0.2</td>
<td>1-10</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
OEL: Occupational Exposure Limits

* OSHA PELs and NIOSH RELs
  Each agency publishes methods to assess against their own exposure limits.

* ACGIH TLVs (Threshold Limit Values)
  - TLVs based on toxicology, not technical feasibility
  - They do not publish / validate methods
  - Creates conflict, “How do I sample?”
Reporting Limit (RL)

The smallest concentration of analyte that can be reported with reproducible certainty
- Same concept as Limit of Quantitation (LOQ)
- Affects sensitivity, especially for STEL samples
- RLs vary by laboratory – cannot assume your laboratory will match the RL in published method
- Everyone wants the lowest RL, but balance against commercial turnaround time pressures
Recommended
Flow Rates & Volumes

* How much latitude is contained in “recommended” air volume / flow rate?
* An agency cannot anticipate all sampling environments
* Air volume (total liters):
  - Enough air to achieve required sensitivity
  - Limit air to avoid an overloaded sample
* Extremely clean or dirty environments may not yield useful results in the recommended ranges
Recommended Flow Rates and Volumes

- Much more critical to stay within recommended flow rates
- Methods validated by OSHA, NIOSH, others at the given flow rates ensure:
  - Sufficient flow to capture the analyte
  - Flow slow enough to stop analyte from completely blowing through the media
  - Chemical reactions can occur properly on treated media
Interferences can be either:

- Positive – artificially inflating result
- Negative – artificially suppressing result
Chromatography

Separation of mixture into components, using a chromatographic column and mobile phase (gas, liquid)
Chromatography

Chromatogram from a gas chromatograph (GC) Toluene retention time (RT) shown:

Provided by Laura Parker Consulting Scientist
LIMITATIONS

However, with different instrument conditions, toluene could have an RT of 9.71 minutes.
Chromatogram – Good Separation

Distinct peaks:

Benzene 7.32 minutes

Provided by Laura Parker Consulting Scientist
More Components:

Benzene 7.14
Cyclohexane 7.38
Retention time is not absolute proof of chemical identity

For GC analysis, additional options are:
- Second column confirmation
- GC/MS confirmation

Similar concepts of interference can apply to other techniques
- Chromatography (HPLC, IC)
- XRD
Excessive particulate loading an analytical challenge

Most methods (OSHA/NIOSH) recommend a particulate loading ≤ 2 mg (2,000 µg)
- This is too much particulate!

Excessive particulate may require dilution – can raise RL
Use validated methods, BUT;

* Laboratory can provide guidance based on "typical" personal sampling

* Every sampling situation is different
Sample Handling and Shipping

- Cross contamination
- Overnight vs. ground
  - Cold vs. ambient
  - Time of year
  - Distance
- Tracking number/Reputable courier
- Delivery date (holiday, weekend)
Provide good information to prevent miscues:

* Be specific on turn-around time request
* Notify laboratory about rush requests
* Request specific analytical methods
* Note information as relates to samples
What Do the Numbers Mean?

Practitioner’s responsibility to interpret results!

Unexpected results
- Significant difference in results
- One positive, remainder none detect

Understand test limitations
DIRECT READING INSTRUMENTS

* Improved, well established technologies
* More user friendly
* Better applications
  - Photo Ionization Detectors (PID)
  - Fourier Transform Infrared Spectroscopy (FTIR)
  - Chip Measurement Systems (CMS)
SELECT REPUTABLE SERVICE PROVIDER

* Rental vs Purchase
* Technical support
* Quality
* Cost
Best instrumentation to achieve goal

- Sensitivity
- Interferences
- Ease of Use
- Calibration
As sampling options increase:

- need to communicate and collaborate with your laboratory and service providers
Questions?